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# Blinking Eyes Behaviors and Face Temperatures of Students in YouTube Lessons – For the Future E-learning Class

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**Abstract**

Nowadays, e-learning and the application of ICT to learning in various ways are going to move to the forefront of education due to various reasons. However, the learning style often lacks the characteristics of students' synchronized feedback in the class simultaneously, even though the information is always needed to achieve the tutorial effectiveness and educational outcomes in the virtual class. Some of the current authors have investigated the application of biological data, the number of eye blinks, to e-learning or distance learning on research based and confirmed that the changed behaviour of the number corresponded to the difficulty of the problems to some extent. In this experiment, we issued YouTube as the educational tool and investigated the correlation between biological data, blinking eyes, facial surface temperature measured by infrared thermography and students' psychological behaviors. The blinking eyes behavior seemed to reflect the examinees' confusion at the initial stage of the video session. On the other hand, the measurement of facial surface temperatures should be revised and modified, since the current methods did not take the effect of external temperatures and also the appropriateness of sampling into account. However, we presume at least that the blinking eyes could be applied to the feedback tool of students' responses also in the e-learning by YouTube video sessions.


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## 1. Introduction

Nowadays, e-learning and the application of ICT to learning in various ways are going to move to the forefront of education due to various reasons.[1]-[8] For the purpose, the drastically developed social networking services (SNS) will and should play an important key role for the future of e-learning.[9]-[12] YouTube has been obviously one of them. When the classroom with YouTube would be based on Web 1.0 concept, students would be passive (Fig.1-(1))[13]. However, the mutual exchange of informative education would be possible, when the concept would be enlarged to Web 2.0 or 3.0, as shown in Fig.1-(2) and (3)[14]-[17]. In such a case, it is very important for teachers to get the feedback online how students would respond to a teacher's action. And it may be important also for students to know the teacher's reaction. For the purpose, biological information would be very useful and important[18]-[21]. However, the basic information and correlation between the biological information and the students' psychological situations in concrete classes have been lacking in most cases, unfortunately.

In our previous studies[22]-[26], some of the authors issued the distance education by Metaverse (Three Dimensional Virtual Space where avatars are active on behalf of users. Second Life is the most famous and successful one.)[27] and focused on the feedback function using eye blinking, one of the biological information sources. And they succeeded in showing a certain correlation between the biological information and students psychology[28]. Then a special application attached to the Metaverse was used to evaluate the feedback. Even though the experimental results were very useful for the e-learning and distance one, the results and system were restricted to Metaverse. In this study, we focused on YouTube. YouTube will be one of the useful e-learning tools, when it would not be used as unidirectional video-educational material, but as mutual communication ones through it. Generally, such a utility form for web based educational materials is called Web 2.0.[29]-[31] We focused on YouTube videos as e-learning in this experiment to confirm the general tendency of biological data for other e-learning tools other.

## 2. Experimental

Eight students were chosen as examinee totally. The groups were divided into two groups. The first 4 students belonged to NIT, Gifu College and other the 4 to NIT, Suzuka College. Their ages ranged from 18 to 20 years old and genders were not fixed. Their fields were also different from each other. Therefore, the problems were chosen from fundamental mathematics familiar to everyone.

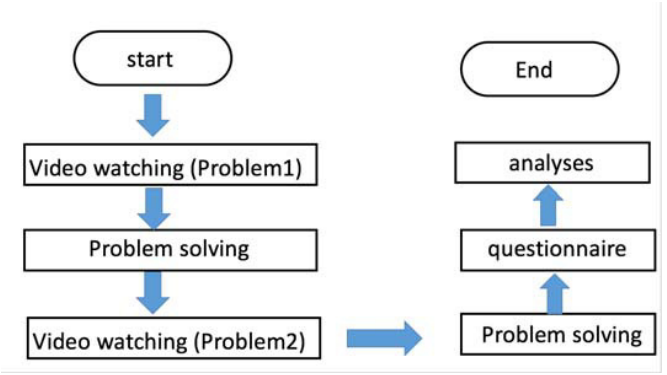
The experimental procedure was as follows.

#1: A fundamental mathematical problem was proposed by YouTube[32]. All of the students as examinees watched the video in about three minutes. During the process, the number of blinking eyes for examinees were recorded as video and counted later. At the same time, the surface temperature of their side faces were measured by infrared thermography (FL-IR, E6 for Suzuka group) for references. Then the process was stopped and students were required to answer the questions from the video. The answers were written on a paper on the desk in front of them. The video was produced in Japanese and students answered in Japanese. The problem is shown in Appendix 1.
The expression for the problem is written in English in this paper. However, it was written in Japanese, when students tackled with it.

#2: Then students were required to watch another video about fundamental mathematics[33]. They watched it for about 3minutes and then they answered questions provided by the teacher in the video. Even though their answers were also written in Japanese, the video was written in English. The number of blinking eyes and the surface temperature of students' side faces were measured in the same way with the first video session. The problem is shown in Fig.3.

#3: Finally, the questionnaires were provided to each student. Questionnaires were composed of 8 questions basically.

Q1: Could you understand the video session 1?
Q2: Could you understand the video session 2?
Q3: Could you understand the meaning of the problem in the video session 1?
Q4: Could you understand the meaning of the problem in the video session 2?
Q5: Are you confident with your answer for the problem in session 1?
Q6: Are you confident with your answer for the problem in session 2?




Q7: Were you relaxing when you solved the problem in session 1?
Q8: Were you relaxing when you solved the problems in session 2?
On the other hand, those questions were evaluated by five scales. #1: Very much, #2: Pretty much. #3: Neutral, #4: Not so much, #5: Not at all.
From all of these data, we analyzed and discussed the effectiveness and applicability of biological data to YouTube lessons. Fig.1 shows the flow chart of the experiment procedure in this study.

Fig.1 The flow chart of experimental procedure.

## 3. Results and discussion

### *3.1 The number of blinking eyes*

The number of blinking eyes were measured during the video and the results were obtained as follows.

Those results from Fig.2 to Fig.5 belong to the students from Gifu College. According to their impressions obtained from the survey, they felt the problems were too easy for them, even though the video was made in Japanese or English. Some students wrote that they could reach the answers very easily during the video. Therefore, their blinking numbers were relatively small, compared with those of students from Suzuka College. Actually, their ratios of positive answers were 100%. Therefore, we can conclude clearly that the results mentioned above did not have any relations with their difficulties to answer. Therefore, their responses of eye blinking could reflect their relaxation, satisfaction, confusion, worries etc. directly. According to their questionnaire results, most of them seemed to be relaxed. However, the number of blinking eyes was slightly higher in the first video session than that in the second session in most cases, when we focused on the initial stage of the video session. (The case of examinee D in Fig.5 was only an exception.) The tendency suggests that students felt embarrassed and it was reflected on the blinking number.

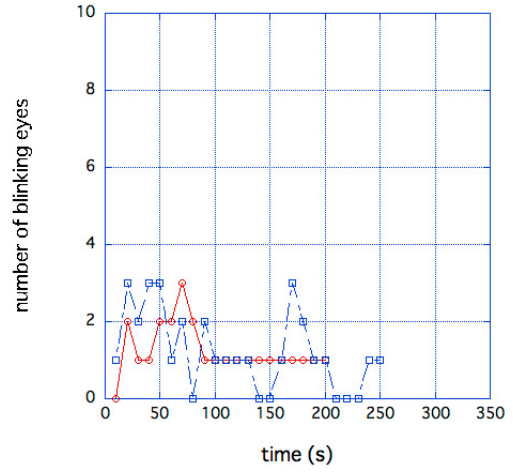



Fig.2 The blinking behavior of examinee A.
◯The first video ☐ The second video

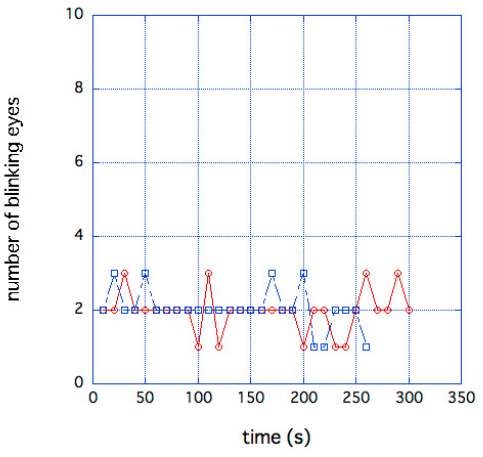



Fig. 3 The blinking behavior of examinee B.
◯The first video ☐ The second video

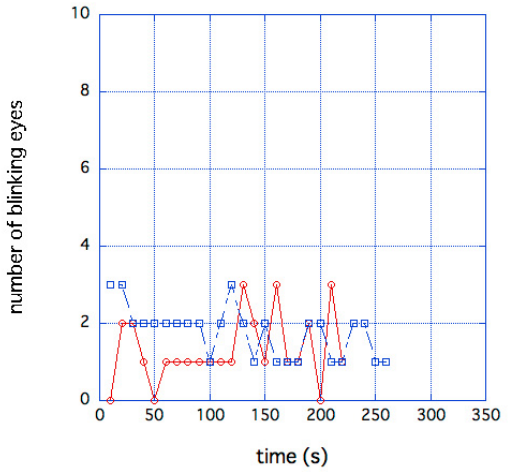



Fig.4 The blinking behavior of examinee C.
○the first video, □the second video

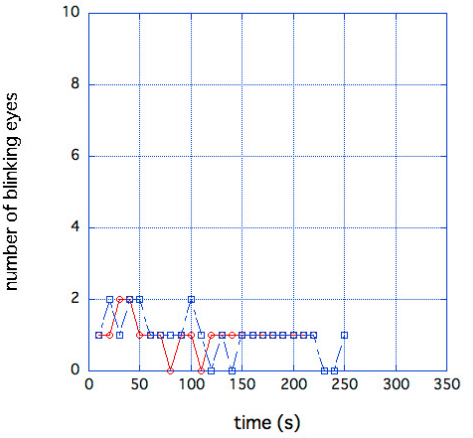



Fig.5 The blinking behavior of examinee D.
○the first video, □the second video

Fig.6 shows the results of their questionnaires. For most of the questions their responses were very positive. Only for questions 7 and 8, their responses were slightly scattered. However, we could conclude that all of their responses were positive and they could relax during the video sessions in both cases. On the other hand, Fig.7 shows the results of a questionnaire for Suzuka College. The results also show almost the same tendency with that in Gifu College. In these cases, their ratios of positive answers were 100%. Therefore, we could also conclude that the eye blinking behaviors corresponded to their emotional responses apart from the problem difficulties. Most of their responses were positive during both video sessions.

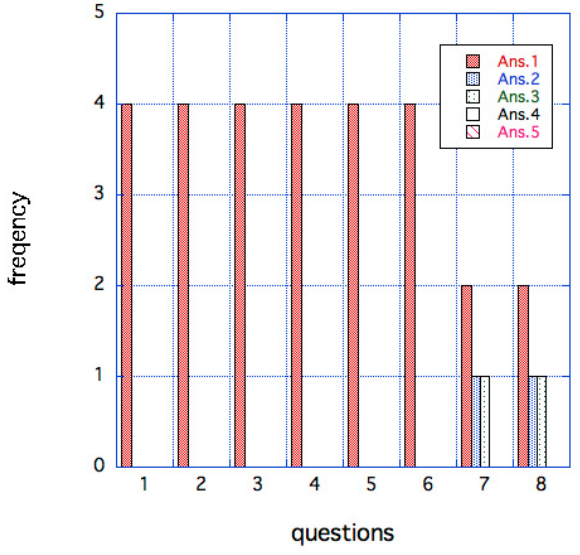



Fig.6 The questionnaire results for students in Gifu College

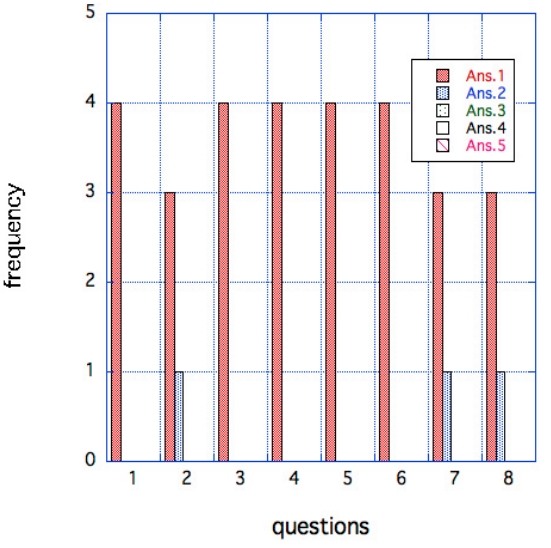



Fig.7 The questionnaire results for students in Suzuka College

From Fig.8 to Fig.11, the eye blinking behaviors for examinees from Suzuka College are shown. The number of blinking eyes fluctuated with time. However, also in these cases of Suzuka College, the numbers of blinking eyes were higher in the second video session than that in the first session, when we focused on the initial stages for the examinee F and G. It seems like they felt confused about the English session, since they did not expect it at all. However, their confusions were disappearing with time. The examinee E showed the different tendency and the blinking eye decreased in the second English session. Since he was very good at English, he did not feel any confusion. And as for the examinee H, the tendency was different from the other ones. Since her number of blinking eyes was relatively high in the first session, it suggests that she felt anxieties about the video sessions themselves. However, it disappeared with time by getting comfortable, and it was reflected on the eye blinking behavior.

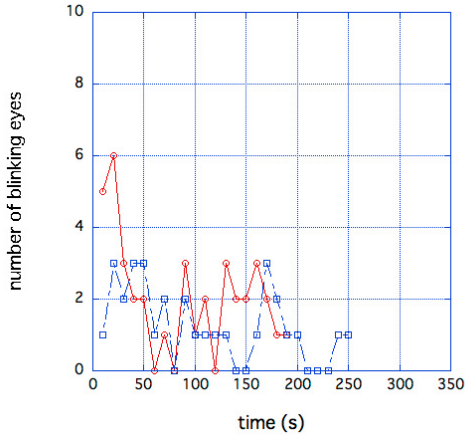



Fig.8 The blinking behavior of examinee E.

○the first video, □the second video

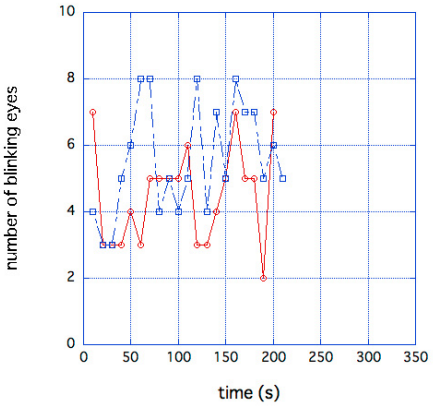



Fig.9 The blinking behavior of examinee F.

○the first video, □the second video

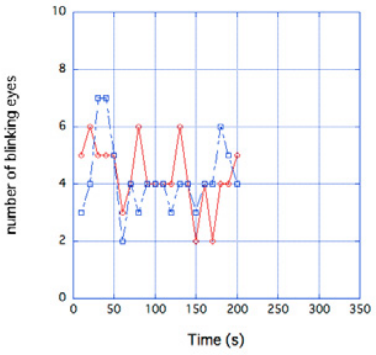



Fig.10 The blinking behavior of examinee G.
○the first video, □the second video

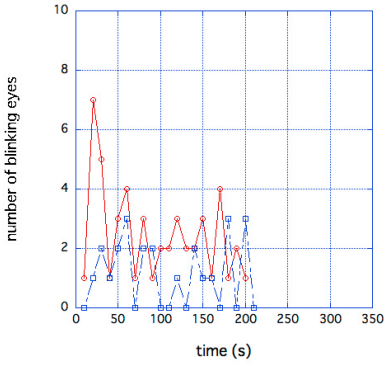



Fig.11 The blinking behavior of examinee H.
○the first video, □the second video

### *3.2 Facial surface temperatures*

Only for examinees in Suzuka College, their facial surface temperatures were measured by thermography to seek for other kinds of biological information and also to compare the applicability with that by blinking eyes. The temperature was measured at the same side face and the data was sampled every 30 seconds during the video session. And the final data was adopted as an average value. Fig. 12 show examples for the examinee F in Suzuka College. And Fig.13 shows the final data as an average.

The temperatures changed for the first and second sessions in all four examinees. However, the systematic changes could not be observed, unfortunately. Probably, the reason could be attributed to two reasons mainly. The first reason is the effect of fluctuations of external temperatures. For examinees E and F, they had time enough to adjust the room temperatures before the sessions, while examinees G and H did not. The measurements were carried out early in the Spring and the outside temperature was still low. The second reason is insufficient sampling. Just like the measurement of blinking eyes, the data should have been sampled more often. Such detailed data could provide the correct information about the students' behaviors. However, we expect that the measurement might lead to another powerful tool for the feedback in the future, after the data sampling would be carried out more systematically. Therefore, we could conclude that the method should be our future mission.

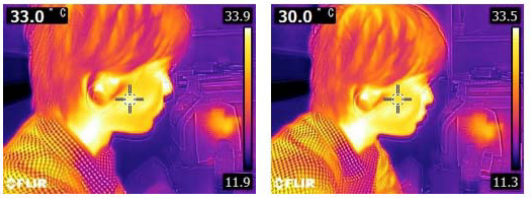



Fig.12 Examples of facial temperature measurement By thermograaphy

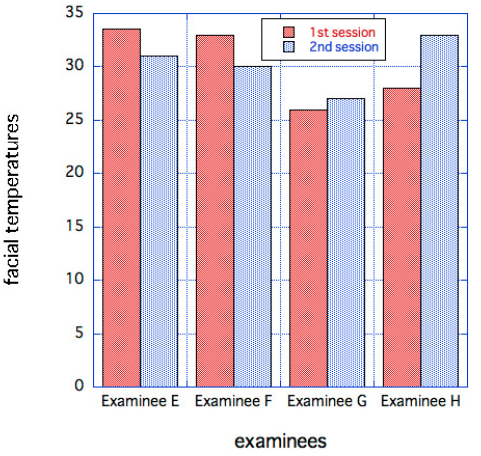



Fig.13 The average facial temperatures and their changes.

## 4. Conclusions

In this experiment, we issued YouTube as educational tool and investigated the correlation between biological data, blinking eyes, facial surface temperature measured by infrared thermography and students' psychological behaviors. Students watched two kinds of video sessions. One of them was a Japanese video and the other was an English one. They watched the videos, solved the problems and answered the questionnaires. And the following results were obtained.

#1: Students could answer the problems proposed by videos very easily. And the ratios of their positive answers were 100%. Therefore, the biological data clearly showed that their emotional responses clearly corresponded particularly to the number of blinking eyes.

#2: The blinking eyes behavior seemed to reflect the examinees' confusion at the initial stage of the video session.

#3: On the other hand, the measurement of facial surface temperatures should be revised and modified, since the current methods did not take the effect of external temperatures and also the appropriateness of sampling into account.

#4: However, we presume at least that the blinking eyes could be applied to the feedback tool of students' responses also in the e-learning by YouTube video sessions.

For the future, we will devise an online feedback system for eye blinking detection as well as a rigorous measurement system by thermography and seek for the reasonable and effective utilization of biological data.

## Appendix

Problem 1. After watching the video, fill the appropriate figures in the blank columns.

| X minutes | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Water volume yL | 4 | | | |

Problem 2
Solve the following equations and seek for the values, a and b, in the same way with that In the video you watched just right now.

$$6a + 4b = 26$$
$$3a - 2b = 5$$

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