Evaluating the Affection of Eye Blinking in the Virtual Learning Environment

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Abstract

Communication is one of the main elements in the educational process and the non-verbal communication including eye blink, which is one of the key non-verbal method, owns the highest portion of the communication. The objective of this paper is to evaluate the role of eye blink in the Virtual Learning Environment (VLE). The eye blink is introduced in the VLE and the role of the eye blinking in the VLE is discussed. A system was established to visualize the eye blink of the real user in the VLE through an avatar. An experiment was conducted with e-Learners and the result shows that the performance of the e-Learners can be enhanced with the implementation of eye blink in VLE and e-Learners prefer the VLE with an eye blinking avatar especially during the group discussion. In addition, there was a mirror eye blink relation between the teacher and the e-Learner.

Keywords: *Eye blinking, Virtual learning environment (VLE), e-Learning, Non-verbal communication*

1. Introduction

Interactive communication between a teacher and a student is very important in delivering and obtaining the knowledge exactly in the educational process. Communication is a joint process where two or more people engage in communication in order to achieve mutual goals [1]. The communication process involves not only linguistic but also psychological, emotional and social aspects of interaction. Communication happens through the verbally, non-verbally and utilizing the tone [2]. The aim of the teacher's verbal behavior in the classroom is to give content to improve the knowledge of the student especially cognitive learning. Non-verbal behavior in the classroom helps to improve students' perception on the subject matter, teacher, and the session. Moreover, it can boost up the enthusiasm of the students. Non-verbal communication owns highest portion in the communication process [2]. The major connection between the speaker and the listener is established especially through the non-verbal communication and it has got a vital importance in the communication process [3].

The influence of non-verbal communication in the real world education is investigated and it has been identified that the non-verbal communication is an essential component in the learning process [4, 5]. However the influence of the non-verbal communication in the VLE which is a way to deliver synchronous e-Learning is not investigated completely yet due to its novelty and lack of non-verbal communication in VLE. Currently the virtual environments are utilized for different types of pedagogical purposes and the numbers of virtual schools, colleges, universities have increased day by day with the increase of online users [6]. Different types of classrooms, buildings and equipment, which have emerged with the educational environment, can be built in the VLE. Fig. 1 shows the appearance of the virtual classes. The education mediated by the computer will become the powerful way of delivering knowledge in the future. It is better to investigate the influence of non-verbal communication in the virtual world education.

The non-verbal is a broad area and it includes many features such as posture, eye blink, gestures, speech and
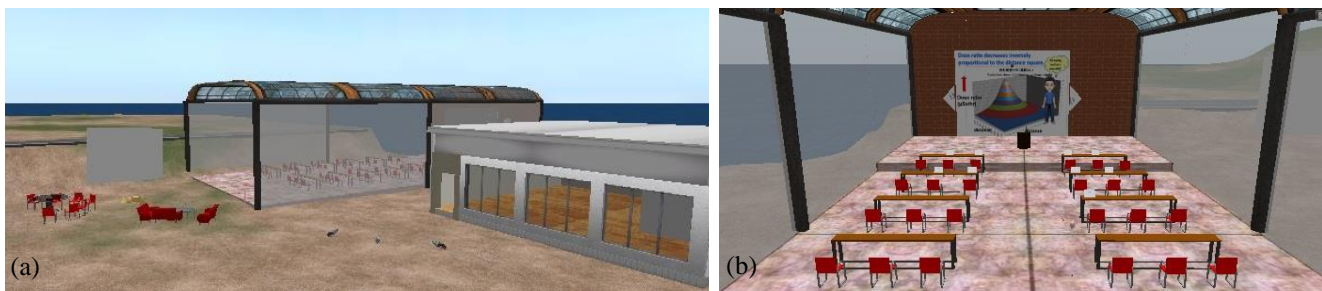

Fig. 1 Virtual learning environment (a) outside of the classrooms (b) Inside of the classrooms.

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tone of voice. This study is confined to investigate, the eye blinking as it is considered as one of the main components of the non-verbal communication. Numerous studies have reported that the behavior of the eye is one of the potent non-verbal signals that have the ability to create impression on people [7]. The eye blinking strongly reflects the psychological states of a person [8]. If the eye blink rate has increased, it reflects stress, tension and attention. When the person in relaxing, the relaxation cause to reduce the blink rate generally [9]. Frequency of a person's blink is also influenced by the impression of the viewer [10].Thus; the eye blinking and its behavior in the education process are discussed in this paper. The eye blinking is evaluated under three criteria; 1) Feeling and attitudes of the e-Learners when they are utilizing the eye blink in VLE, 2) the affection of eye blinks on the e-Learners' performance and 3) the relationship between the teacher and the e-Learner via eye blinks. The importance and the details of these three areas are discussed in the next session.

The objective of this research is to identify the role of eye blinking in the VLE. The attitudes and feelings of the e-Learners when they utilize the eye blink in the virtual world, the affection of the eye blinking on the e-Learners' performance and the relationship between the teacher and the e-Leaner through the eye blinking are investigated in this study.

2. Previous Work

Researchers have found that the non-verbal behavior is the most effective communicative tool for improving student-teacher relationship than the verbal communication through a survey, which was done with the involvement of more than 10,000 teachers in real world education [3]. Thus the investigation of the behavior and the affection of the non-verbal communication in the VLE are considered in this study by covering three areas.

- Attitudes and feelings of e-Learner when they utilize the eye blink in the VLE
- Affection of the eye blinking on the e-Learner performance
- Relationship between the teacher and the e-Learner through the eye blinking

The importance of those areas and the pieces of research related to those areas are discussed in following paragraphs.

In the point of view of the non-verbal communication in the virtual environment, it is necessary to discuss the items that represent the human in that world because it is the element that represents the non-verbal features instead of the real user and it may affect to the feeling and attitude of the participants. Avatar is the item that represents the humans in the VLE. When the non-verbal communication is introduced to the avatar, it creates more alive avatars and helps to establish the natural communication among the users. Specific visual or behavioral characteristics of avatars have impact on differing communication outcomes [11]. Avatar representation may change the e-Learner's feeling and attitudes. Avatar expression and body gestures not only affect the education but also it affect to the field of e-commerce also [12]. Particular facial expressions and body gestures when they were being used individually by a human-like avatar were more attractive and increased users' interest. The presence of avatars with facial expressions has been shown to be the key factor in generating positive feelings that have linked to various considerable outcomes, such as boosting up of confidence, improving interface friendliness, and perceived trustworthiness. Users appeared to be more confident, showing higher levels of content understanding, and devoting less mental work, due to their exposure to a human-like character that speaks and expresses several expressions simultaneously. In addition, as the attractiveness of expressive avatars cannot be ignored, all users felt that the system was obviously very intelligent and had a pleasant appearance [13]. Students prefer teachers who have more non-verbal expressions than teachers without facial expressions when delivering lessons. [3]. Based on the previous findings, the first hypothesis can be build that the implementation of eye blinking in the VLE has a possibility to change the learner's feelings and attitudes positively.

Non-verbal features of the teacher assists in enhancing students' motivation in engaging in discussions and it helps them to improve their performance and understanding [5]. There are some evidences especially in the real world that the student performance increases through the non-verbal features. When the virtual lectures use facial expressions, the students performed better (by 86%) in the lectures compared to the results of the lectures that did not use facial expressions. The appropriate use of smiling increased the interest of the students and consequently their performance [4]. Appropriate use of an avatar's body animation has the possibility to make the students feel more relaxed, focused, enthusiastic and less confused in a virtual environment [4]. The successful connection equipped with non-verbal communication enhances the effectiveness of the learning process. When the teacher uses their facial expressions which is a sub section of non-verbal communication, have shown a higher performance than the session which was conducted without using facial

expression [4]. Based on the previous researchers, the implementation of eye blink in VLE may cause to raise the performance and it is the second hypothesis of this study.

There was an experimental study to identify the non-verbal relationship between the teacher and the students at kindergarten level [14]. There may be a relationship between the e-Learner and the teacher when they communicate through the non-verbal features. Previous researchers found that the mirror behavior between the speaker and the listener. Although speech production and comprehension emerge as an independent process of the individual brains, verbal communication is a mutual activity. Researchers applied functional Magnetic Resonance Imaging (fMRI) to record brain activity of both speakers and listeners during a natural verbal communication. They used the speaker's spatiotemporal brain activity to model listener's brain activity and found that the speaker's activity is spatially and temporally coupled with the listener's activity. This coupling vanishes when participants fail to communicate. Moreover, though on average the listener's brain activity mirrors, the speaker's activity happens with a delay [15]. When a speaker shifts his/her posture, that is often mirrored by the listener. Such posture shifts, both speakers and listeners, tend to occur at discourse segment boundaries and may function to help manage such transitions [16]. Mimicry has been shown in positively influencing the emotional state of the speaker [17]. The eye blink also involves in the communication process and it happens at the time that the less demand the visual attention [18]. Blinking happens due to a combined process inside the body. The eye blink and the mental process of the listener and the speaker have tremendous association during the conversation due to the fact that both processes are sharing a common goal [15]. Based on the description, there may be a relationship between the speaker and the listener in the VLE through the eye blink and that is the third hypothesis.

Previously, the influence of the behavior of non-verbal features especially in the real world is identified under three areas; feelings/attitudes, the performance and relationship between the speaker and the listener when they use one or more non-verbal features. The non-verbal communication has a tremendous impact on the real world application with conventional education. The influence of the non-verbal communication especially the role of eye blink in VLE is investigated in this study and the procedure is explained in next session.

3. Methodology

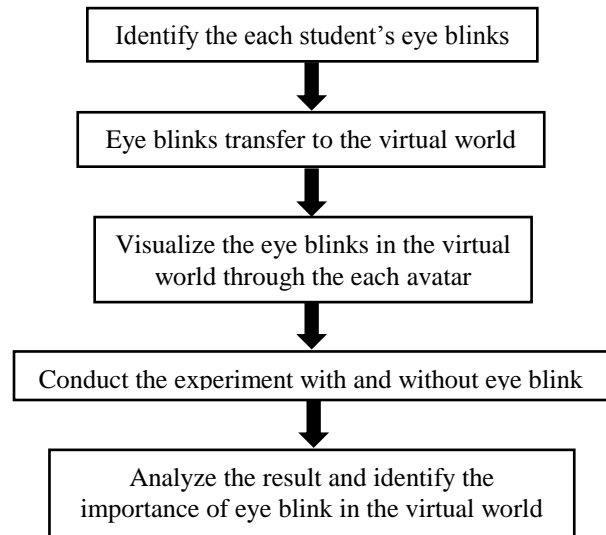To identify the role of the eye blink in the VLE, the eye

Fig. 2 Methodology of the system.

blink should be introduced to the VLE initially due to the lack of non-verbal communication in the VLE. The process of introducing eye blink in the virtual world and identifying the role of eye blinking consists of several steps as shown in Fig. 2.

The first activity is visualizing the eye blinks in the VLE through an avatar. It can be completed fulfilling three activities. The identification of the eye blinks of the each e-Learner, transfer it to the VLE and the modifications of the avatar in the VLE are the three activities.

The next activity is identifying the role of the eye blinking in the VLE. An experiment was conducted as learning sessions in the VLE with and without eye blink to identify the influence of eye blinking in the virtual learning.
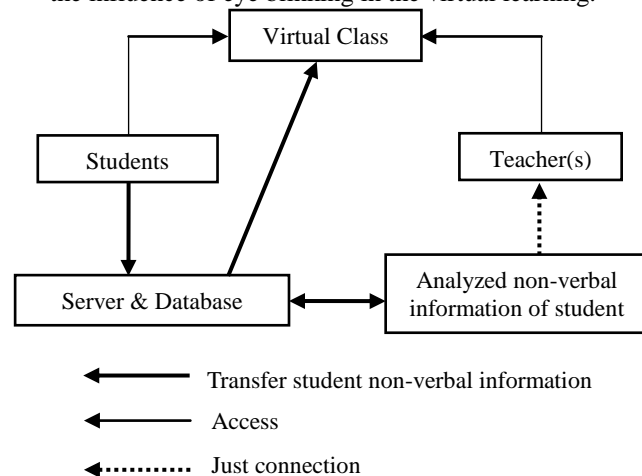

Fig. 3 Overview of the system

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3.1 Architecture of the System

The layout of the whole system is shown in Fig. 3. The teacher and the e-Learners can enter the VLE and integrate with the learning activities. A real time video of the e-Learners and the teacher is obtained during the learning activities through a web-camera continuously. The eye blink detection system is activated and information of the eye blink of the learner is obtained via the real time video. The detail of the eye blinks of each e-Learner is transferred to the VLE. When the real user is blinking eyes, it is appeared in the VLE through an avatar face. The e-Learner can view others' real eye blink even though they are in different locations. The information of the eye blink in the server can be used for the post analysis to identify the role of eye blink in the VLE. The detailed procedure of the visualization of eye blink in the virtual world and identification of the role of the eye blinking in the VLE are explained in next sessions.

3.2 Eye blinks Visualization System

A web-camera, a computer and a person are the basic necessary resources to implement the eye blink in the VLE. The eye blink visualization system consists of mainly three activities.

- Detecting the eye blink of the real user
- Preparing the avatar to represent the eye blinks
- Transferring the e-Learner's eye blink information to the virtual world

The real time video of the e-Learner is obtained continuously through a web-camera during the learning
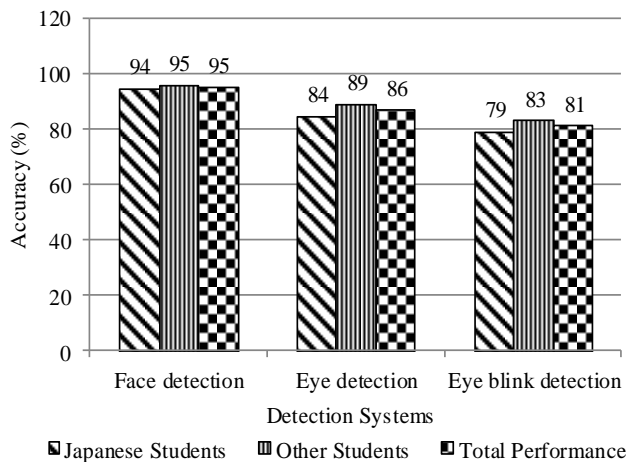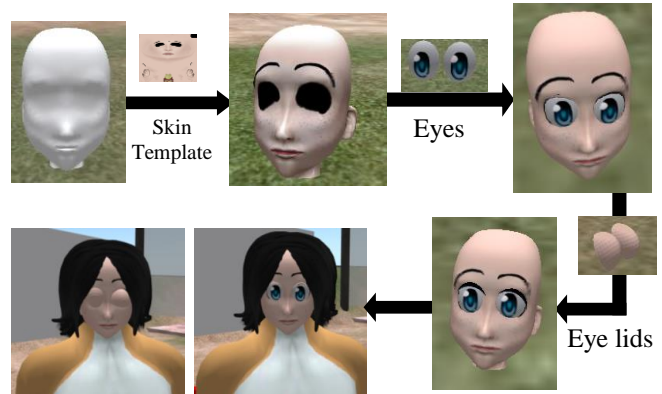

Fig. 5 Avatar modification to represent the eye blink.

activities to detect the eye blink. The video consists of a set of frames and each frame is captured to analyze the information of the image. The face is detected using Haar-feature based cascade classification. When the face is not detected, the procedure is started from the beginning. Otherwise it identifies the eyes of the image. When the face is detected, the region of the eyes can be roughly determined and it is made easier to detect the eyes of the e-Learner. The same method, Haar-feature based on cascade classification is utilized to detect the eyes. When the face is detected and the eyes are not detected it is mentioned as a blink. When the eyes are detected, the status of the eyes should be clarified to identify whether eyes are opened or not. Two measurements, the white and the black pixels of the eye region with threshold mechanism and width to height ratio of the eyes are applied to clarify whether eyes are opened or not. The eye blink detection is completed using this procedure.

The accuracy of the detection systems including face, eyes and the eye blink was checked with the Japanese students and other (International) students as shown in Fig. 4. The accuracy of the face, eyes and blink detection is decreasing slowly respectively. Detection system is good for international students than the Japanese students due to the small size of the eyes of the Japanese students. However the overall performance of the eye blinks detection system is more than the 81%.

An avatar represents the e-Learner in the VLE and it is activated based on the user commands. The avatar is not a fair character to represent the e-Learner and it looks like a puppet without any characteristics of the e-Learner. Therefore, the head model with the features of the face is prepared to represent the eye blink through the avatar as shown in Fig. 5. The head model is prepared in the real world and it is exported to the virtual environment. The skin template is applied to the head model to obtain the
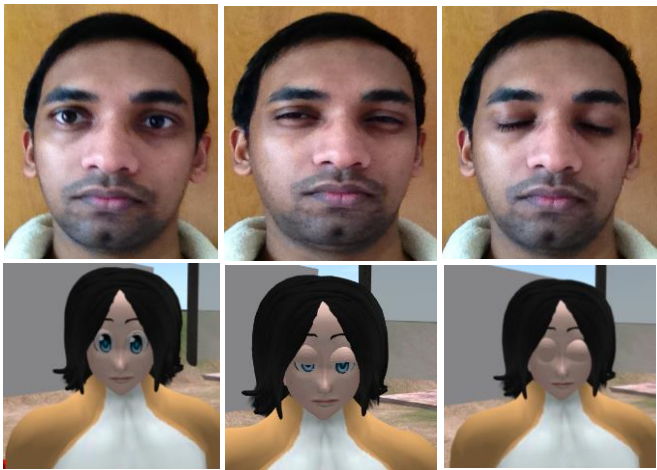

Fig. 4 Accuracy of the detection system.

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The eye blink of the e-Learner in the real world can be visualized in the VLE through the avatar by having completed the three steps: the detection of the eye blink, avatar modification and commutation of eye blink information from real world to virtual world. When the e-Learner is blinking in the real world, it is appeared in the VLE as depicted in Fig. 6.

3.3 Experiment

When an eye blink is visualized in the VLE, the identification of the role of eye blink during the virtual learning through the experiment is possible.

This experiment was conducted to identify the role of the eye blink during virtual learning sessions implementing the eye blink visualization system. Three areas were assessed based on the eye blink. 1) The attitudes and feelings of the e-Learner about the virtual learning sessions with and without eye blinking. In addition, it is needed to clarify 2) whether the performance of the e-Learner depends on the eye blink or not. 3) The relationship between the speaker and the listener through the eye blink is also needed to be clarified.

Based on the literature review, there are three hypotheses that are built for each area as follows. The first hypothesis is, when the e-Learners use the eye blink, the positive feeling and better attitudes of the e-Learners will rise. The second hypnotize is, the e-Learner performance will
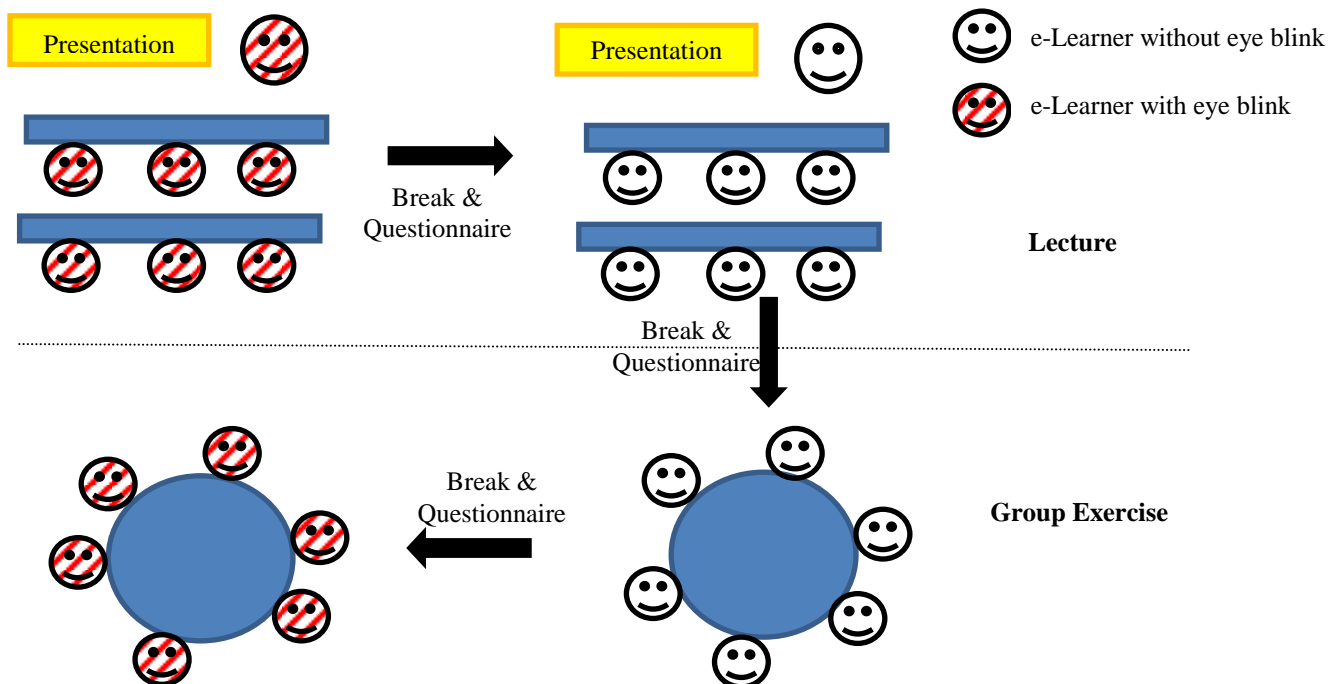

Fig. 6 Visualizing eye blinks in the virtual world

appearance of the real head. Then the eyes and the eyelids which are created using the objects in the VLE are attached to the head model to represent the eye blinks.

When the eye blink information of the e-Learner is obtained, it is transferred to the virtual environment to visualize the eye blink in the VLE. An external server is utilized as an intermediate to transfer the information among the real world and virtual world. PHP, Http requests are also utilized to transfer the information from the real world to the VLE.

Fig. 7 Layout of the experiment

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increase during a learning session with eye blinks than the session without eye blinks. The mirror eye blinks may happen between the speaker and the listener is the third hypothesis.

The experiment is designed with four sessions per group and each group includes six members as shown in Fig. 7. It was mainly consisted of a lecture session and a group exercise with and without eye blinks respectively. The lecture session was consisted of a lecture and an individual exercise. The time for the each session is shown in the Table 1. A questionnaire was delivered after each session with a small break to obtain the ideas of the participants.

There were two places that were prepared to conduct the sessions in the virtual environment as shown in Fig. 8. The lecture and the individual exercise were conducted inside the classroom and the group exercise was held outside the classroom with breezy air. A power point presentation was utilized to explain the lesson and the voice was used to communicate among the participants. An excel worksheet was utilized to solve the problems.

Eighteen e-Learners including three female learners who are following post graduate courses participated in this experiment. These e-Learners belong to different nations namely Sri Lanka, India and Nepal and they utilized English language to communicate.

Two activities were done before starting the experiment. The first activity was to measure the eye blink rate of all the participants in a relaxed state and the second activity was to conduct an introduction session to explain about the purpose of this observation, the way of accessing the virtual environment and the eye blink visualization system.

The responses of the participants were obtained through questionnaires and the information of the eye blinking of
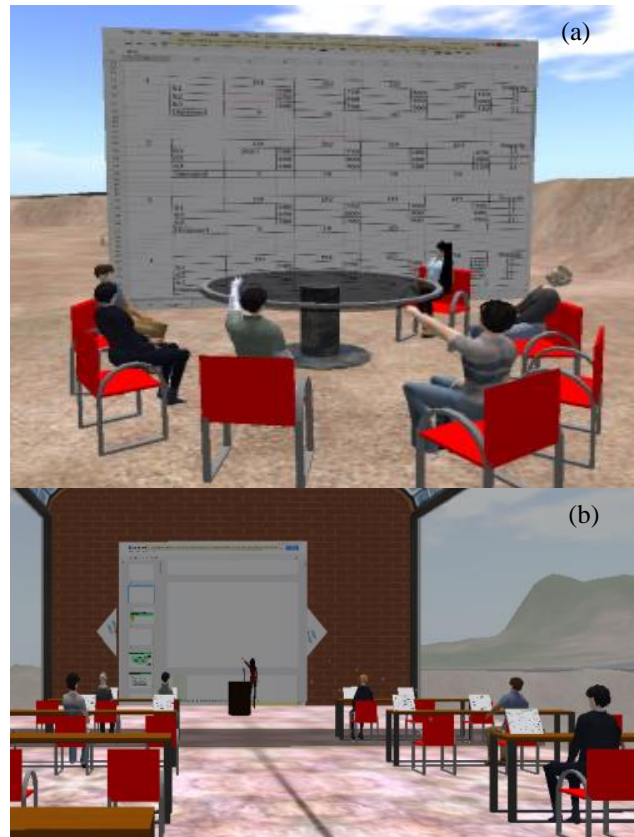

Fig. 8 Students are engaging with a (a) group exercise and a (b) lecture

the e-Learners was also stored in the server for the post analysis. The result of the two exercises including the individual session and the group session were also obtained for the purpose of analyzing.

4. Results and Discussion

The responses for the questionnaire during the lecture session with and without eye blinks were analyzed as shown in Fig. 9. The positive feelings of the e-Learners were high when they were utilizing the eye blink visualization system than the session without the eye blink generally. Most of the factors in the questionnaire were rated high except the "positive look" and "Importance of the non-verbal communication" during the lecture session. When a session conducts without eye blink, the feeling about the "importance of the non-verbal communications" is high and when the eye blink is visualized, the importance become low. It may represent the normal human characteristic that the lack of non-verbal communication is highly felt when the item is absent and the importance is reduced when it is fulfilled. When the eyes are fully opened, the feeling of the student is positive and when the eyes are closed from time to time

Table 1: Time duration for each session

Session		Time duration (min)	
Lecture session	Lecture	25	with and without eye blink
	Individual exercise	15	
Break & questionnaire		5	
Group exercise		25	
Break & questionnaire		5	

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due to the blinking may feel negatively affect to low rate for the "positive look". The factors of "Interesting", "Explanation" were accessed as a same level with and without eye blinks. The highest gap was appeared at the factors of "pleasant" and "avatar gives fair to the real user".

The response of the e-Learners who were engaging in the group discussion was also evaluated and it shows in Fig. 10. All the factors were rated high during the session with eye blink than the session that was not utilized the eye blink visualization system. The highest gap was appeared under the factor "like to engage with communication". E-Learners' attitudes were very positive when they use the eye blink visualization system than the sessions without
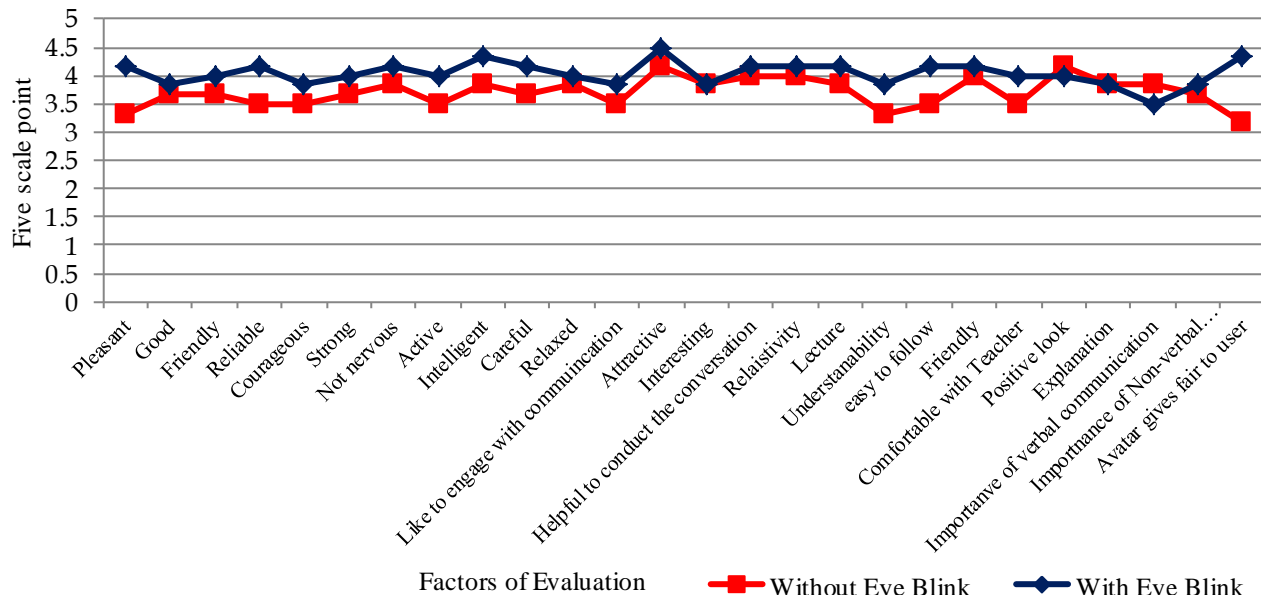

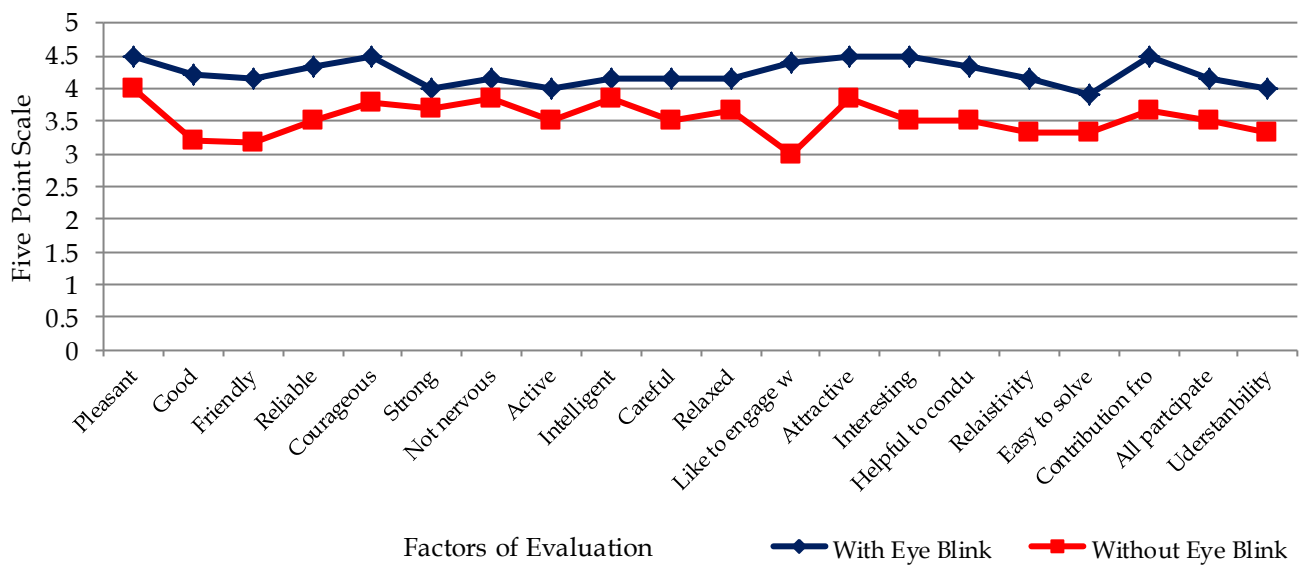Fig. 9 Response of the e-Learners after the lecture session

Fig. 10 Response of the e-Learners after the group exercise

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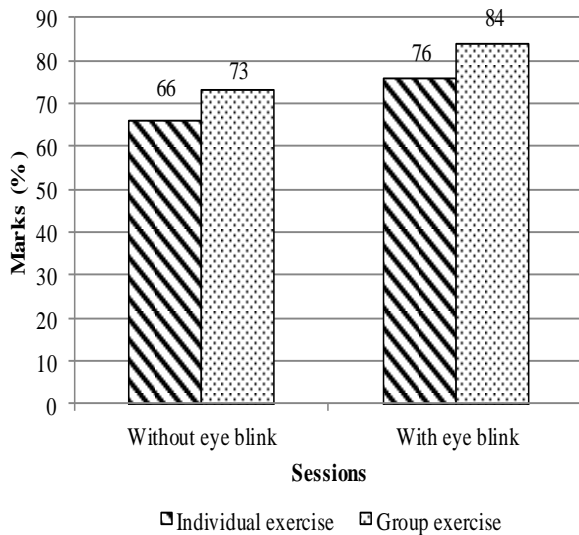ISSN (Print): 1694-0814 | ISSN (Online): 1694-0784
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Fig. 11 Individual & group result of the Student with & without eye blink

eye blinking. Although the few factors were rated negatively in the lecture session, all the factors were positively rated when they used eye blinks during the group exercise. The analysis of the questionnaire is clearly shown that e-Learners were willing to engage in learning activity with the eye blinking, confirming the first hypothesis. The eye blinks highly affected to the group discussion than to the lecture since the eye blink is highly affected to the conversation and the conversation is important during the group discussion than the lecture session.

The e-Learner's performance is evaluated to identify the influence of eye blink for the performance of the e-Learner. An individual exercise was conducted at the end of the lecture session and also a group exercise was held as a separate session with and without eye blinking. The Fig. 11 shows the result of the e-Learners during the two sessions and it is helpful to identify the influence of eye blink on the e-Learner's performance. It shows that the e-Learner performance was high when they used the eye blink than the session without the eye blink. When they utilized the eye blink, e-Learner's individual performance was increased by 10% and the group performance was increased by 11%. In addition, the result was high when they worked as a team than the individuals. Thus the overall performance of the e-Learners could be enhanced implementing the eye blink in the VLE as our second hypothesis.

Then the relationship between the teacher and the e-Learners through the eye blinking was evaluated. The mirror posture is expected among the listener and the speaker based on the hypothesis. The frequency of the teacher's eye blink and the mirror eye blink of the e-Learners were calculated and the result is shown in Fig. 12. The 15% of the teacher's eye blinks happens without any concurrency of the e-Learners. The remaining 85% of the teacher's eye blink was in relation with the e-Learners' eye blinks. It is useful to know how many e-Learners blinked concurrently with the teacher's eye blink to clarify the mirror posture clearly. The Fig. 13 shows the number of e-Learner who blinked when the teacher blinked his/her eyes. The 85% of portion consists of the occurrences that one or more e-Learners blinked with the teacher. This portion is divided by the number of e-Learners. More than half of the blink of teacher (54.8%) occurs with seven or more e-Learners. It means that the mirror posture is occurred during the communication between the teacher and the e-Learners which is congruent with the third hypothesis.

☐ Eye blink of the teacher happen lonely
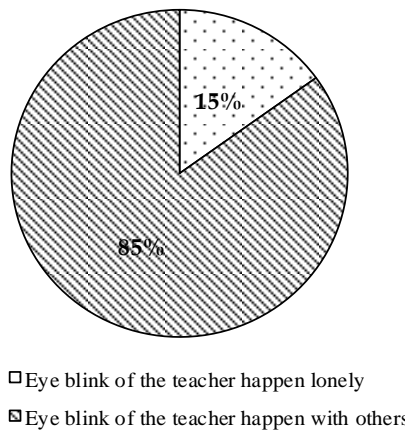
☒ Eye blink of the teacher happen with others

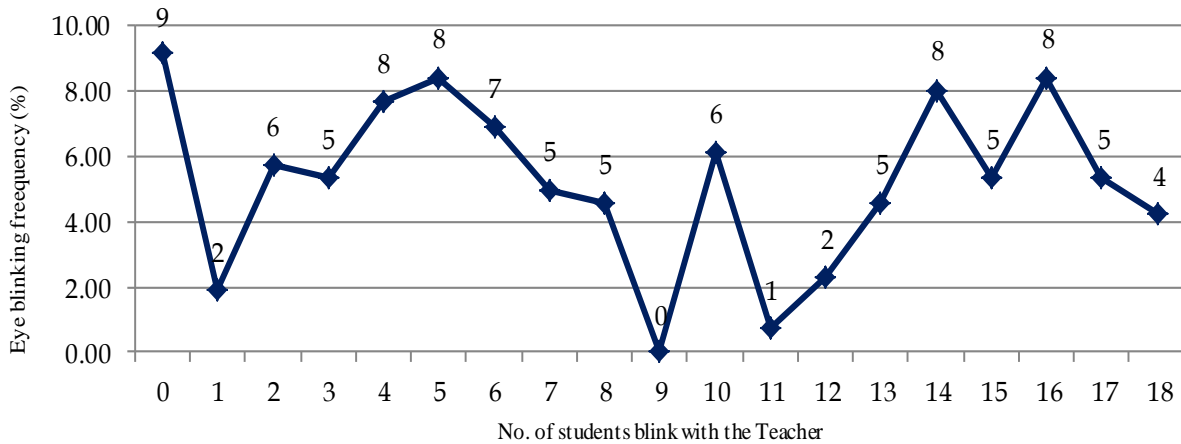Fig. 12 Connection among teacher and student via eye blink.

Fig. 13 Relation of the eye blinks among the speaker and the listener

5. Conclusion

The eye blink, which is one of the main non-verbal components, has been visualized in the VLE and an experiment was conducted to identify the role of the eye blinking in the VLE. The experiment showed that the eye blink was very helpful to enhance the attitude of the e-Learners. Performance of the e-Learners can be enhanced by 10% in individual session and 11% in group session when they utilize the eye blink to obtain the verbal message extremely. The mirror posture appears between the e-Learner and the teacher when they communicate with their eye blinks in the VLE. This study shows that the eye blink has become an essential component for the education in the VLE especially in group work.

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