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A Case Study on the Visual Attention of Students during Science Class

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Abstract

In this study, we used eye-tracker to measure student A's visual attention during a science class. The results showed that the ratio of the total number of fixations and the total fixation duration was different in the learning tool area and the teacher area. In addition, 18 minutes after the class started, the first fixation occurred in the back student area. These results showed that the information provided by the teacher is more difficult for the student than the information provided by the learning tool. The student's visual attention decreased as the science class continued. Therefore, science teachers should try to make it easier for students to understand the information provided by teachers, and they should take action to gain the students' attention periodically during class.

Keywords: *Science class, Student, visual attention, Eye-tracking*

1. Introduction

In the classroom, various information (such as the teacher's lecture, behaviors, and textbooks) are provided to the student. The students' attention is very important because it determines the selection, processing, and recall of the information [1]. Particularly in the case of science classes, students' visual attention is necessary because various illustrations, photographs, and videos are used to explain natural phenomena; these methods of teaching contain a lot of information [2]. However, previous research on science education has only focused on visual attention in simple learning situations, such as viewing illustrations or reading textbooks [3]. Therefore, if the characteristics of students' visual attention in a real science class are studied, it can provide basic data for developing consulting strategies for teachers to improve their teaching behaviors or to create a classroom environment improvement plan.

There are various methods to measure the visual attention, such as interview, questionnaire. And the eye tracking technology is widely used to measure human visual attention, and visual attention can be quantitatively identified through the analysis of eye movement data [4]. Therefore, in this study, we try to analyze visual attention by measuring the gaze of a student during a science class with an eye tracker.

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2. Method

2.1. Procedure

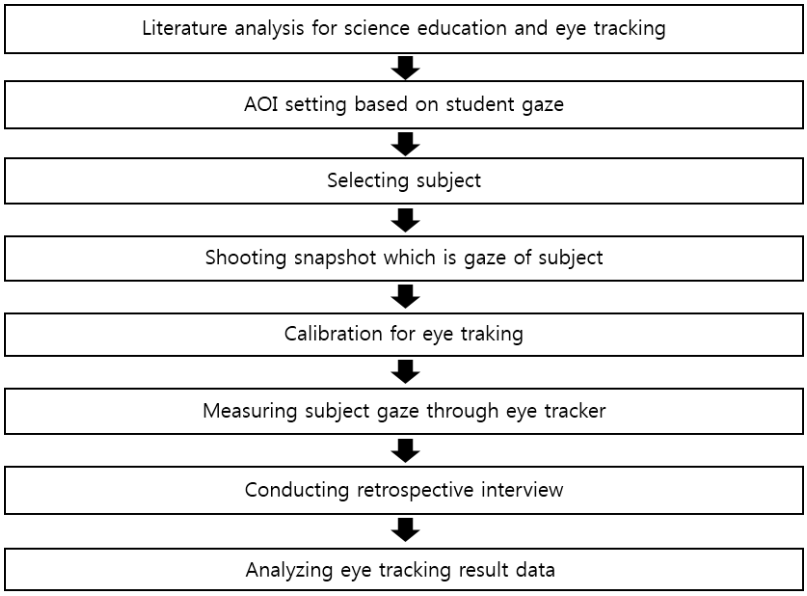

Figure 1. Research procedure

To analyze visual attention of student during a science class, the progress of the research process is shown as [Figure 1].

2.2. Participant and eye-tracking data collecting

In this study, student A, who is a second grade student attending a high school in Chungbuk, was recruited as a participant. To minimize the influence of student A's location in the classroom on their gaze behavior, student A was placed in the center of the classroom, and the eye tracking was performed during a science class. The eye tracker used in this study was Tobii's Pro Glasses 2.0, which collects gaze data at a speed of 50 Hz. Because the eye tracker used in this study is made in the form of glasses and does not restrict the subject's behavior, this is suitable for measuring the student's gaze during the class.

After performing calibration to correct errors that may occur with eyeball individual differences, the student A's gaze were measured by eye tracker for 50 minutes of the physical lesson.

2.3. Data analysis

We used Tobii's Pro Glasses Analyzer 1.27 to analyze the gaze data. To distinguish between fixation and saccade, we used the attention filter provided by the Pro Glasses Analyzer. With this filter, gazes that are slower than 100°/sec are classified as fixation. In this study, areas of interest (AOIs) were defined as teachers, students, blackboards, learning tools, experimental tools, and environment areas which is shown as Figure 2.; this was similar to the study which analyzed the students' visual attention during a science class [5].

Figure 2. AOI in the stuent A's view

3. Results and discussion

3.1. Total fixation number and fixation duration for each AOI

Figure 3. The heatmap based on total fixation number

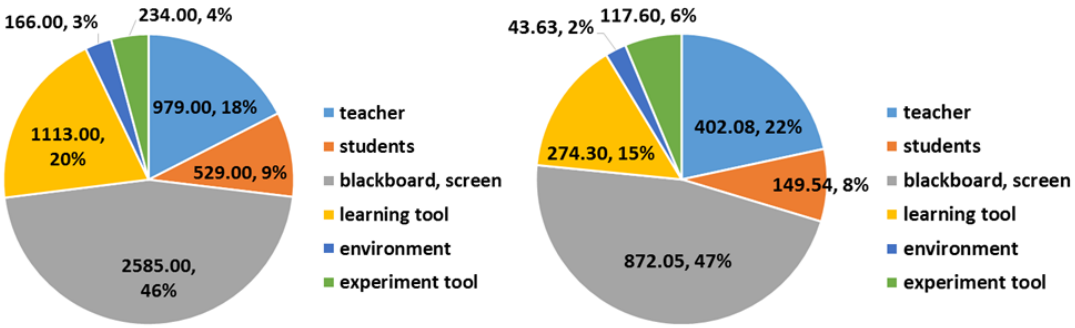

Figure 4. Left) Total fixation number in each AOI, Right) Total fixation duration for each AOI

[Figure 3] shows a heatmap based on total fixation number and [Figure 4] shows graph of the total fixation number and the total fixation duration for each AOI. In general, the total fixation number reflects the importance of the information in the area, and a long fixation duration means that there is a deep cognitive processing of the area [6][7].

In the learning tool area, the total fixation number is 20%, which is 5% higher than the total fixation duration for the area. This means that the learning tool has a lot of important information, such as the problems that the student has to solve. However, the information of the learning tool can also be provided on the blackboard or screen so that the deep cognitive processing did not require.

In the teacher area, the total fixation number was 18%, which was lower than the total fixation number in teaching tools area. However, the total fixation duration for the teacher area was 22%, which was higher than the total fixation duration in the teaching tools area. This means that the information conveyed through the teacher's face or body is relatively less important than the information in the learning tools area. However, student A performed deep cognitive processing on the information received from the teacher's expression or gestures. These results can be explained by the fact that facial expressions and gestures contain more complex information than text, which takes a long time to process [8].

3.2. Time to first fixation in each AOI

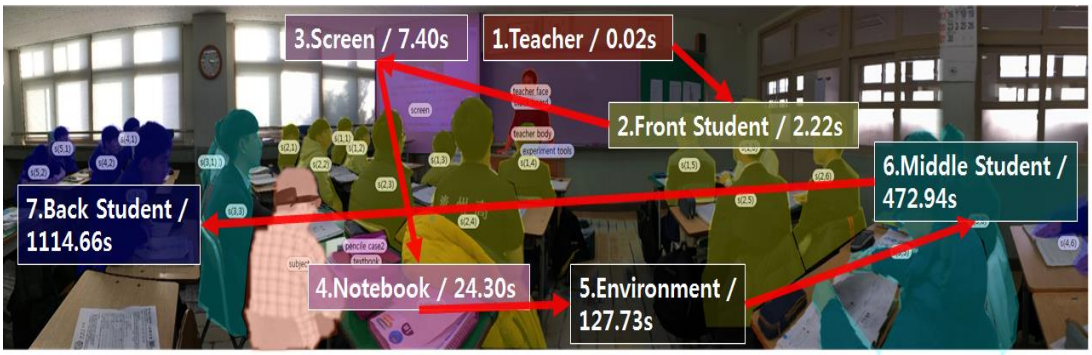

Figure 5. Time to first fixation in each AOI

[Figure 5] shows the time at which the first fixation occurred in each AOI. If student A paid attention throughout an entire class, he would have looked forward or looked at his learning tools. However, 472.94 seconds after the class started, the first fixation occurred in the middle student area; furthermore, 1114.66 seconds after the student's class started, the first fixation occurred for the back student area. This means that student A's visual attention was disturbed at 1114.66 seconds, and this is consistent with the findings that students' concentration falls 15-20 minutes into the class [9].

4. Conclusion

In this study, we analyzed the characteristics of student A's visual attention during a science class by using an eye tracker. We reached two conclusions about the visual attention of student A in the science class. First, student A had difficulty in processing information provided by the teacher in the science class. Second, student A's visual attention decreased 18 minutes after the class started.

This study raises two suggestions for the teachers to improve the students' visual attention. First, the science teacher should explain the contents of the lesson in relation to the learning contents that students have learned before, or the teacher should give real-life examples to help students understand the contents. Second, the science teacher should periodically take action during the class to capture students' attention.

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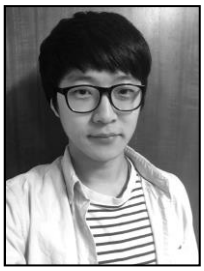

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