

Whitebox: A Device To Assist Group Work Evaluation

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ABSTRACT

With the growing trend of Active Learning, group work is becoming increasingly common among education of all ages. Among the many advantages of group works, we have also witnessed how difficult it is for teachers to keep an eye on the activities within each group, thereby turning the group work process itself into a black box from the teachers' perspective. In order to propose a solution for this problem, this study introduces Whitebox, a device that discreetly gathers several types of data within group work, which are then visualized for the teacher to reference after the group work. The user study with high school students showed that group work analysis by Whitebox led to deeper understanding of how each student performed within their group.

1. INTRODUCTION

Considering the fact that there can be more than 30 students in a typical high school class in Japan, it is highly difficult for teachers to look over the activities within each group during group work. In other words, the students' processes of their group work remain a blackbox for teachers. In addition, how we evaluate group work is still an often debated issue, especially in formal education where a standard evaluation method is required. Whitebox was developed in order to suggest a solution towards such obstacles for schools in adopting group work. By placing the Whitebox in the middle of a group work table, it tracks the activities within the group. Later the recorded data will be visualized for the teacher to check, enabling teachers to get a rough idea of what kind of process each group went through without being physically present all the time. Furthermore, Whitebox quantifies the group work process by measuring talking ratios, volumes, etc., suggesting novel evaluation measurement units for group work, which can be used as the future standard.

2. LITERATURE REVIEW

While many of EDM / LA related researches have been limited to online or digital learning environments, recent studies have stepped in to face-to-face classroom activities with the help of advanced sensors and devices. Martinez-Maldonado et al. [1] created a realtime feedback system for teachers to provide feedback just at the right time using the data obtained from MTClassroom, a multi-touch tabletop that analyzes the strategies of student groups. Evans et al. [2] also proposed to identify touch patterns of students on an interactive tabletop to analyze the quality of collaboration. Whitebox aims to provide similar feedback to the teachers without relying heavily on each hardware. In terms of providing measurement units for conversation and collaboration, Lederman et al. [3] proposed Open Badges, an open source toolkit to measure face to face interaction and human engagement in real-time with custom hardware. Olguin et al. [4] states that such sociometric badges can make group collaborations more efficient by providing context, but such badges are mainly used for business and work environments, and they must be designed alongside students and teachers if it were to be used in a classroom setting.

3. SYSTEM DESCRIPTION

Initially, Whitebox used Kinect's mic arrays to determine which direction the audio is coming from, thereby distinguishing who is currently speaking. Following the feedbacks from a pilot test, however, audio recording was also done with separate pin microphones attached to the students' clothing. The attained audio is processed to obtain the volume as well. Using Kinect's depth camera, Whitebox also obtains the participants' body skeletons, allowing it to track their hand coordinates and their posture angles. Due to the way the current system is designed, Whitebox can only track the participants' data when they are sitting down and are not moving around or switching positions. The entire group work is also recorded, and when the group work is finished the audio data is converted into text using Google Cloud Speech API.

4. USER STUDY

A user study was conducted during a 4 day Design Thinking workshop at Tokyo Metropolitan College of Industrial Technology high school. In this user study, we especially focused on one group of four students, student A, B, C and D, and recorded only those 4 students' activities. After the workshop, the 4 visualizations and speech-to-texts were shown to both teachers and students separately, followed by an hour long discussion each on what those data meant to them.

Figure1 shows the study setup.



Figure 1: User study setup

The data acquired from the 4 workshops was processed, then visualized in to A4 infographic posters as shown in Figure 2.



Figure 2: visualizations from user study

To provide a more fine grained analysis of each session, we also provided additional visualization that plotted the students' audio data, posture data and hand position data along the timeline of the workshop. Figure 3 is an examples of the additional visualization.

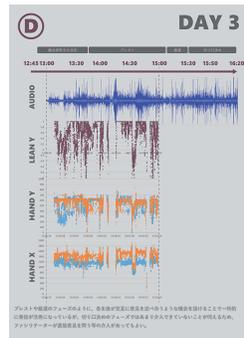


Figure 3: additional visualization of student D from day 3

By visualizing the data from all four sessions, it was possible to get a grasp of how each student behaved in the workshops. It is important to note here that what the visualizations suggested matched with the thoughts of facilitators who were in charge of this group (e.g. that student D would speak the least and student B would take charge of the overall discussion), meaning that Whitebox would be able to assist teachers to evaluate group work without them having to be present at each group's table all the time. As for

the speech-to-text, it helped the teachers to see what words were mentioned most frequently. With improved conversion accuracy, it would become possible to process the text to search the most frequently mentioned conjunctive phrases per student in order to see the characteristics of their contributions.

By post processing the audio data recorded, we were also able to provide visualizations on the order of conversational turn taking during the discussion. The data was plotted for each 30 seconds of conversation. This enables the teacher to examine specific points in a discussion and analyse how it transitioned between the group members. An example is shown in Figure 4.

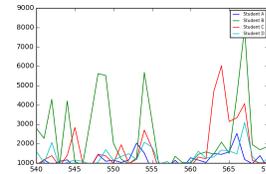


Figure 4: conversation transition

5. CONCLUSION

In this study we proposed Whitebox, a device that tracks the activities within a group work. Through the discussions with the teachers, we were able to see that Whitebox analysis certainly functioned as a guideline for a deeper understanding of the group and its students, and it also functioned as signs for what was and was not working in the group work, ultimately leading to improvements in the design of the class. Although not all the data we recorded seemed useful to the teachers, the measurements that Whitebox proposed, especially talking ratios, volumes and posture were valuable information for the teachers, uncovering the activities within the group that they otherwise would have missed. By using these measurements continuously, they can become a standard measurement unit in assessing group work.

6. REFERENCES

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