Cluster Analysis of Learners based on Video Annotations

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Abstract—**The analysis of students' learning behaviors is important to realize adaptive and effective feedback to learners. To realize such feedback for learning job interview, in this paper, we propose to use cluster analysis of learners based on video annotations. The learners are clustered into 3 clusters, and the relationship between clusters and attributes of participants is discussed. The realization of feedback to learners is also discussed.**

Keywords—Video Annotation, Job Interview, Clustering

I. INTRODUCTION

The analysis of students' learning behaviors is important to realize adaptive and effective feedback to learners. For example, Jihyun Park et. al. used clickstream data to detect changes in student behavior [1]. They utilized statistical change detection techniques to investigate students' online behaviors, and showed how these changes are related to other aspects of students' activity and performance. Bouchet et al. employed a differential sequence mining technique to identify activity patterns between student groups [2]. Peckham et al. described how multidimensional k-means clustering combined with Bloom's Taxonomy can be used to determine positive and negative cognitive skill sets [3].

On the other hand, in the job interview scene, not only verbal communication but also non-verbal communication is important. In such a case, by observing and annotating the video, and comparing the descriptions to others, the learner can find what the learner has not noticed. To clarify the patterns of the descriptions, in this paper, we use cluster analysis of learners based on the video annotations. Based on the cluster analysis, we realize prototype feedback interface for learning job interview.

II. VIDEO ANNOTATION TOOL

For the better understanding of job interview, it is useful to watch job interview scenes of others. For this purpose, we developed a video annotation tool as shown in Fig.1. This tool was developed as a standalone application that runs on the Mac OS. Region A of the figure is used to display and control multi-angle video. By pressing buttons in region B of the figure, the start time and the end time of the annotation are captured from the video. In region C of the figure, learners can select one of the multi-angle video, and can mark the region of interest by drawing a rectangle in the video. In region D of the figure, learners can describe what they have noticed by free text. By clicking the bottom "save" button, the descriptions are saved in CSV format, which can be read by statistical analysis tools such as R.

Fig. 1. Video annotation tool.

III. CLUSTER ANALYSIS OF LEARNERS

A. Data Acquisition

To get annotation data, four interview scenes were used; Chinese students (male/female) and Japanese students (male/female). The interview scenes were taken by 3 cameras, which were placed to take interviewer, interviewee, and both of them. The questions asked by the interviewer were shown in Table 1. The number of participants was 21; 7 of them were Japanese students, 7 of them were Chinese students, and the others had experience as interviewers. 375 annotations with timing information were used for the following analysis.

TABLE I.   QUESTIONS IN THE JOB INTERVIEW.

Q1	Please introduce yourself.
Q2	What did you do in your school days?
Q3	What did you major in at university?
Q4	What is the theme of the graduation thesis?
Q5	Do you have any work experience?
Q6	What are you interested in lately?
Q7	What is the reason for you to apply for us?
Q8	What do you want to do with our company?
Q9	Please tell us your vision after 5 years.

B. Clustering of Learners

The number of descriptions for the 9 questions in Table I, the beginning of the interview, and the ending of the interview are counted for each participant. These 11 numbers indicate the part where the learner pays attention. These 11-dimensional vectors for each participant are used for the clustering. The clustering is carried out using k-means method with Hartigan-Wong algorithm. The results of clustering with k=3 are shown in Fig. 2. In this figure, the centroids of each cluster are shown.

The number of descriptions of cluster A is the largest. In particular, Cluster A has many descriptions at the end of the interviews. The number of descriptions of Cluster C is the smallest. However, Cluster C has many descriptions at the beginning of the interviews. In many cases, the number of descriptions of Cluster B is between Cluster A and Cluster C.
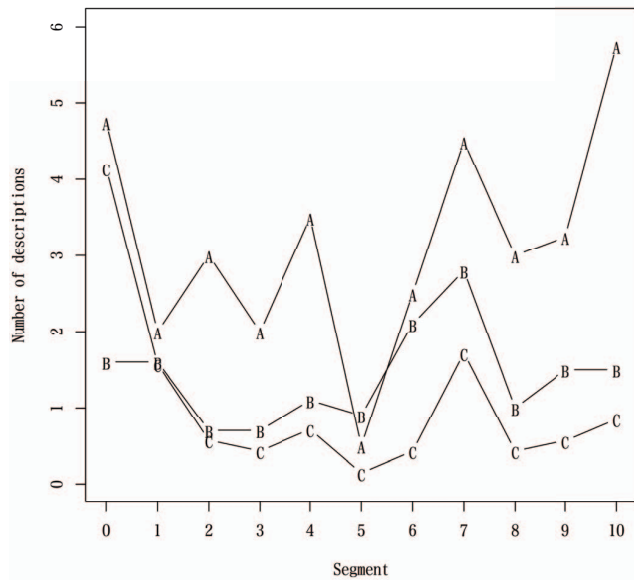

Fig. 2.   Clustering of learners based on video annotations.

To see the relationship between clusters and attributes of participants, the number of participants in each cluster is shown in Table II. 2 Japanese students and 2 Japanese interviewers belong to Cluster A, which has the largest number of descriptions in 3 clusters. None of the Chinese students belong to Cluster A. On the other hand, 5 of the 7 Chinese students belong to Cluster C. The descriptions of Cluster A will help the learners of Cluster C to find what they have not noticed.

TABLE II.   NUMBER OF PARTICIPANTS IN EACH CLUSTER

	Chinese Students	Japanese Students	Japanese Interviewers
Cluster A	0	2	2
Cluster B	2	4	4
Cluster C	5	1	1

C. Feedback to Learners

Fig. 3 shows the prototype of the feedback interface. After the learner annotates videos, in region E, the figure same as Fig. 2 is shown with the number of descriptions of the learner. In this example, the learner can find that the number of descriptions at the end of the interview is smaller than that of others. By clicking the cluster name in the figure, the links to the videos are shown in region F. By clicking CM (Chinese Man) of the participant JO6, the related video and descriptions are shown in region G. By comparing the descriptions, the learner can find the points that the learner has not noticed.
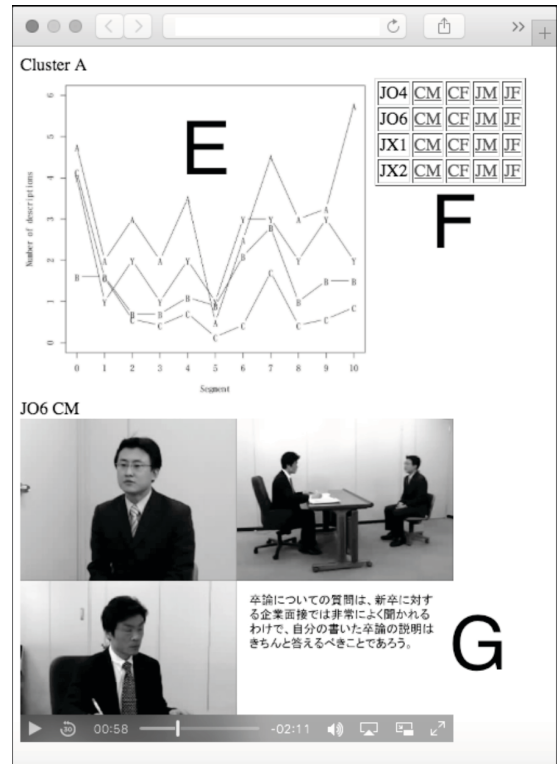

Fig. 3.   Prototype feedback interface.

IV. CONCLUSION

In this paper, cluster analysis of learners based on video annotations is discussed. The learners are clustered into 3 clusters, and the relationship between clusters and attributes of participants is discussed. Detailed evaluation of the feedback interface will be a future work.

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