

A Method of Estimating Cooperative Activities in Collaborative Learning based on Participants' Spatial Relationships

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Abstract

Collaborative learning has become more and more important in education area. In most collaborative works, students are separated into groups, where the possible scope of teachers might be strongly limited. Therefore, automatic feedback based on sensing the state of students during collaborative work is helpful for effective educational guidance. In this work, we focus on the spatial relationships of each participant pair and tried to examine the feasibility of estimating learners' cooperative activities. To achieve this purpose, KINECT is used to record space coordinates of learners during collaborative works. As the objective evaluation, average distances between students were calculated in every 10 seconds based on the recorded data. On the other hand, the subjective evaluation was performed by 6 researchers with monitoring the collaborative work video and giving a 5-grade mark for each pair of students in every 10 seconds.

In order to verify the effectiveness of the spatial measurement, we calculated the correlation coefficient between objective and subjective evaluation within a one-minute time window, which is shifted by 10 seconds through the collaborative work (ca. 5 minutes). The result shows that the 1-minute time spans with correlation coefficients of 0.5-0.85 occupied around 47% (in average) of the whole collaborative work, during which students are cooperatively learning. This suggests that the spatial relationship is able to estimate the existence of cooperative activities between students, and is able to be used for online student state detection. In our future work, students' posture, gesture and verbal data should be also involved.

Keywords: Collaborative learning, correlation coefficient.

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Introduction

"The principle goal of education is to create men who are capable of doing new things, not simply of repeating what other generations have done - men who are creative, inventive and discovers." Developing meta cognitive, creative, and communicative skills is still an educational goal today, and one that should view learning as a process of acquiring and building knowledge with a strong social and experiential component.

Learning to work with others and collaborate has become an extremely important skill.

In most collaborative learning cases, students are separated into groups, where the possible scope of teachers might be strongly limited. Therefore, automatic feedback based on sensing the state of students during collaborative learning helps make educational guidance effective and efficient.

Approach

In this ongoing study, we focus on the spatial relationships of each participant pair and tried to examine the feasibility of estimating their cooperative activities.

To achieve our purpose, KINECT is used to record space coordinates of learners during collaborative learning. As the objective evaluation, average distances between two students were calculated in every 10 seconds based on the data recorded by KINECT. On the other hand, the subjective evaluation was performed by 6 researchers, monitoring the collaborative learning video and giving a 5-grade mark for each pair of students in every 10 seconds.

Experiments and results

In order to verify the effectiveness of the spatial measurement, we calculated the correlation coefficient between objective and subjective evaluation within a one-minute time window, which is shifted by 10 seconds through the collaborative learning.

47% (in average) of the whole collaborative learning process were detected to correlate with subjective evaluation, in which correlation coefficients were 0.5-0.85. Due to less movement of students or noise data, the proposed scheme need to be improved to extract exact state of students.

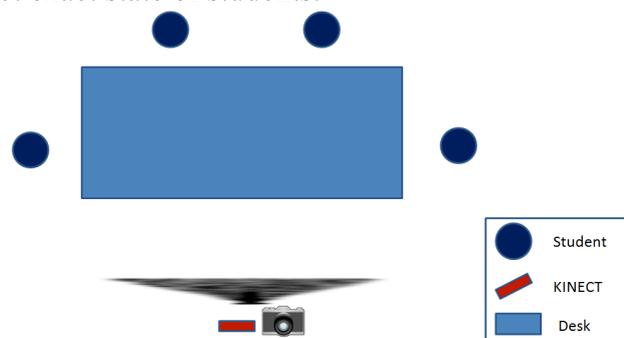


Figure 1: Experiment setting of collaborative learning.

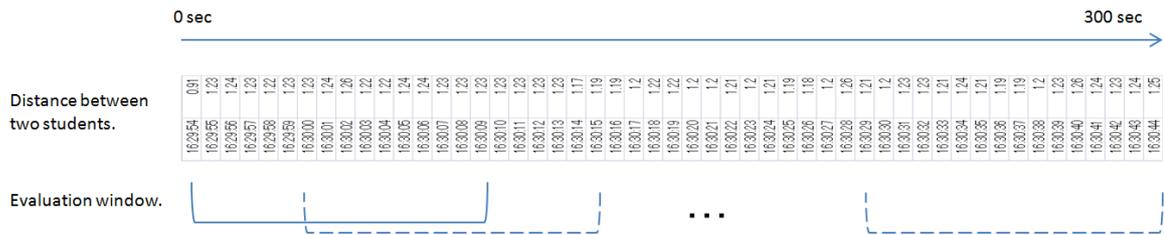


Figure 2: Objective evaluation based on KINECT log data.

Table 1: Subjective evaluation grades.

Grades	Collaborative relation
5	Strong
4	Weak
3	Unknown
2	None
1	Self-contained

Table 2: Results of subjective and objective evaluation

Grades of B-C.	Average distance (metre).
3	0.93
4	0.88
4	0.884
5	0.876
5	0.862
5	0.88
4	0.905
4	0.961
3	0.98
...	...

Conclusion

The results suggest that the spatial relationship is able to estimate the existence of cooperative activities between students, and is able to be used for online student state detection.

In our future work, students' posture, gesture and verbal data are going to be involved. Interaction between students should be considered as well.

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