Improving Teaching and Learning through Video Summaries of Student Engagement

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Abstract

Student in-class engagement is an important indicator of student success. However, it is difficult for a teacher to continually assess student engagement during class, especially in a large classroom. We propose supporting teachers’ post-hoc reflection on their effectiveness in stimulating student engagement by providing video summaries from in-classroom cameras. Future iterations of the approach could include automatic vision-based assessment for objective, longitudinal measurement of student engagement across classrooms, subjects and teaching styles.

Decades of research on education have established a strong link between student engagement and student learning outcomes [2]. The research shows that students who are more engaged than their peers earn higher grades. The established importance of student engagement suggests that teachers should aim to increase student engagement by improving their teaching practices as necessary. However, to understand and assess the effectiveness of their teaching practices, teachers first need to know how engaged their students actually are. A teacher’s own ability to visually measure engagement may be sufficient for a small class size, but we believe that teachers cannot accurately measure student engagement when the class size is large.

Larger class sizes require greater orchestration effort to conduct a class session [3]. In a large class, even teachers who are skilled assessors of engagement are strained by the effort required to juggle lecture, management of class activities and assessment and/or recording of individual student engagement. Teachers are often compelled to compromise by giving the greatest attention to the front rows of the classroom and engagement is rarely recorded.

While many tools for rigorous assessment of in-classroom student engagement exist [4], they typically require the involvement of one or more human assessors focused on a single student for long periods of time. Such approaches are not cost-effective or scalable enough to provide regular and complete feedback to a teacher. Instead, we propose introducing camera-based classroom monitoring as a cost-effective, automatic, and continuously available method for providing feedback to the teacher about student engagement.

In this abstract we describe an initial approach in which the teacher reviews video summaries to assess individual and aggregate student engagement in different activities during a class period. We also discuss the potential for vision-based estimation of student engagement to reduce the manual effort required and support automated data analysis.

1. Video Summaries for Engagement Assessment

Our system setup is as follows. A camera with a fisheye lens is placed at the front of the classroom, pointing toward the students. Figure 1 shows two example frames recorded in a university classroom. The viewpoint and wide field-of-view enables us to capture each student’s face, body posture, and surroundings in order to give the teacher ample information to assess engagement.

One frame is captured every ten seconds to produce a quick 30 frames per second video summary of student behavior. The teacher can review these video summaries after the lecture in order to focus on the engagement assessment and recording task, without needing to manage it along with other teaching duties during lecture. With this measurement of student engagement, a teacher can evaluate how modifications to teaching style affect student engagement in their particular class.

In the first frame in Figure 1, most students have their heads down; in the second frame, most students are looking to the lecturer at the front of the classroom. Without understanding the context of the video, the natural interpretation is that students are disengaged in the first frame and engaged in the second.

However, the context is critical here – in the first frame,
the students are working on an in-class quiz question, whereas in the second, the lecturer is speaking. This shows the importance of providing the video summary with context to inform the engagement assessment. For example, we could also provide the lecture slides, lecture audio and/or a transcript, synchronized with the video summary.

1.1. Testing Assessment Accuracy

Our hypothesis is that video summaries enable a teacher to accurately assess aggregate student engagement. To test of this hypothesis, we are planning a small experiment to compare student-reported engagement levels with teachers’ perceptions.

We recorded video summaries in a university classroom in five-minute intervals. At the end of each interval, we surveyed the class using a clicker interface and asked them, “How engaged in learning were you in the last five minutes?” Their responses were marked on a five-point Likert scale ranging from “Very engaged” to “Very disengaged.” This procedure was repeated six times to produce six video summaries and six survey results. We also noted the in-class activity occurring during each interval.

We plan to ask a group of faculty members to watch the summary videos and, at the end of each video, to estimate what percentage of students responded 1-5. The agreement between faculty estimates and student’s self-reports will give us evidence on the usefulness of video summaries for assessing student engagement.

2. Vision-based Engagement Assessment

While video summaries provide a fairly efficient means of manually assessing engagement, in future work we would like to explore automatic engagement assessment by means of computer vision.

Bidwell and Fuchs [1] made an early attempt at computer-based automated assessment of student engagement by employing five color cameras and four Microsoft Kinect depth-sensing cameras in a small third-grade classroom. High-resolution images of each student allowed for estimation of eye-based gaze angles. Detailed estimation of eye/head angle was used to classify student behaviors into one of eight levels of engagement. More recent work [5] uses a series of four or five blackboard-mounted cameras to measure classroom attention and engagement.

Building on this previous work, we plan to use all visible body movement data in our analysis; for example, detecting hand motions that indicate note taking. To captured such detailed motion, we intend to use very high resolution imagery as afforded by modern cameras. In large classrooms and lecture halls, simultaneous use of several cameras may be needed to help manage partial obstructions and ensure sufficient image resolution on each student.

3. Outlook

We strongly believe that, provided with complete and objective data on engagement, teachers will be empowered to experiment with and improve upon their teaching practices with confidence. Video summaries and, in the future, automatic video analysis, could provide a useful tool for providing such data and feedback to teachers, and could ultimately lead to increased student engagement and better student outcomes.

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References