Automatic Teacher Modeling from Live Classroom Audio

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Abstract

We investigate automatic analysis of teachers' instructional strategies from audio recordings collected in live classrooms. We collected a data set of teacher audio and human-coded instructional activities (e.g., lecture, question and answer, group work) in 76 middle school literature, language arts, and civics classes from eleven teachers across six schools. We automatically segment teacher audio to analyze speech vs. rest patterns, generate automatic transcripts of the teachers' speech to extract natural language features, and compute low-level acoustic features. We train supervised machine learning models to identify occurrences of five key instructional segments (Question & Answer, Procedures and Directions, Supervised Seatwork, Small Group Work, and Lecture) that collectively comprise 76% of the data. Models are validated independently of teacher in order to increase generalizability to new teachers from the same sample. We were able to identify the five instructional segments above chance levels with F_1 scores ranging from 0.64 to 0.78. We discuss key findings in the context of teacher modeling for formative assessment and professional development.

Overview

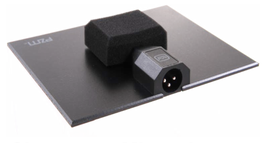
- Dialogic instruction is a powerful predictor of student engagement and achievement.
- This project focuses on automatic analysis of types of classroom instruction solely from audio recordings.

Data Collection

- Teachers wore a portable headset microphone to capture high fidelity speech.
- Dialogic instruction was annotated by trained observers.
- 76 sessions collected, totaling 76 hours, averaging 60±20 minutes each session, from 11 teachers.

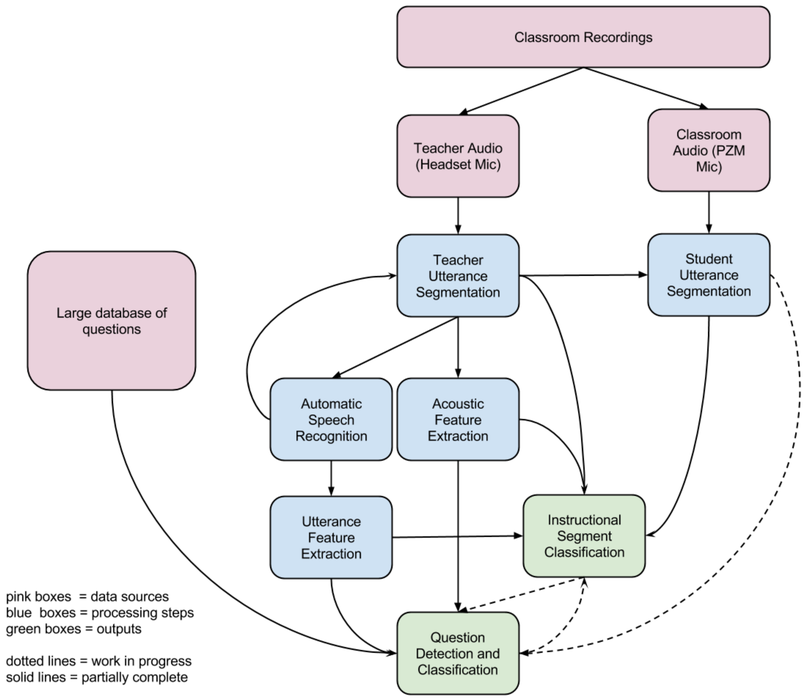


Teacher's Microphone

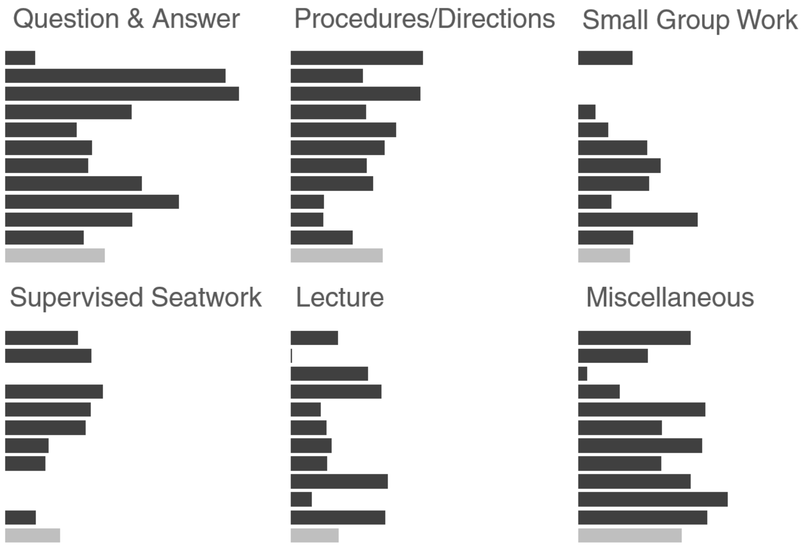


Classroom Microphone

Technical Approach



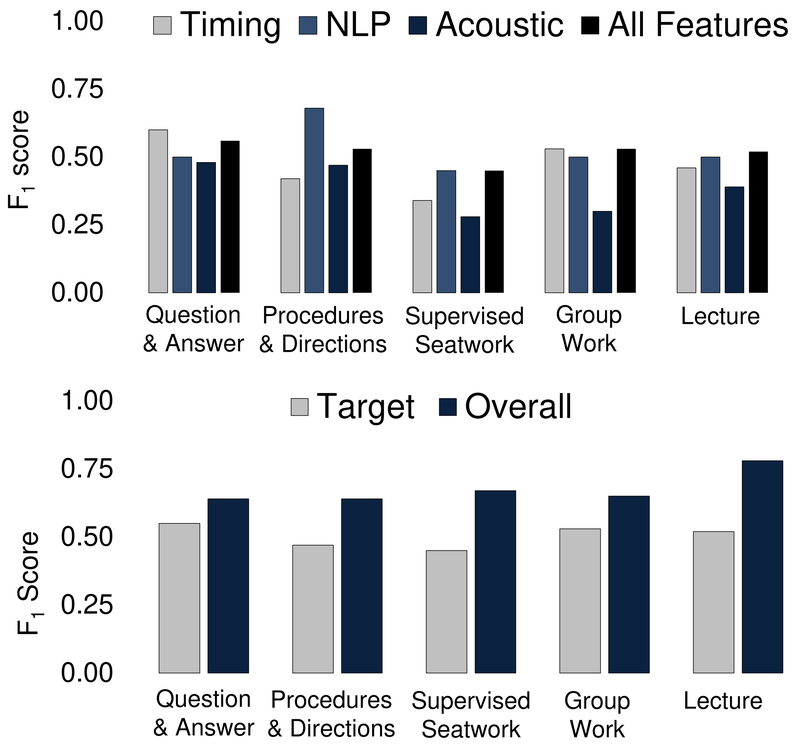
Classroom Activities



Individual teachers appropriate class time very differently

Results

- Classroom recordings are analyzed for temporal, acoustic, spectral, and natural language features.
- Machine learning models are trained to identify instructional segments and are validated independently of the teacher.



F_1 score balances precision (relevance) and recall (specificity).

Next Steps

- Collecting recordings of general classroom activity.
- Modeling use of instructional segments over time.
- Dissemination of software/hardware to teachers, researchers, and professional development specialists.

This research was supported by the Institute of Education Sciences (R305A130030)

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