NATURAL LANGUAGE PROCESSING TECHNOLOGIES TO INFORM PRACTICES IN SCIENCE (NLP-TIPS)

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SUMMARY

Middle school science teachers want technology to amplify their impact on the hundreds of students with multiple, diverse ideas in their classes. By exploiting advances in natural language processing (NLP), this project detects the rich ideas that students develop during everyday experience. The project takes advantage of NLP methods for detecting student ideas to design adaptive guidance that gets each student started on reconsidering their own ideas and pursuing deeper understanding. This work continues a successful partnership between University of California, Berkeley, Educational Testing Service (ETS), and science teachers and paraprofessionals from six middle schools enrolling students from diverse racial, ethnic, and linguistic groups whose cultural experiences may be neglected in science instruction.

The partnership will conduct a comprehensive research program to develop NLP technology and adaptive guidance that detects student ideas and empowers students to use their ideas as a starting point for deepening science understanding. Prior work in automated scoring has primarily identified incorrect responses to specific questions or the overall knowledge level in a student explanation. This project identifies *specific ideas* in open-ended science questions. Moreover, the idea detection technology goes beyond a student's general knowledge level, to adapt to a student's cultural and linguistic entry points into the topic.

The partnership leverages a powerful, open-source, web-based platform, the Web-based Inquiry Science Environment (WISE) to implement adaptive guidance designs endorsed by teachers that feature dialog and peer interaction. These guidance designs encourage students to distinguish among their ideas rather than accumulating fragmented ideas as often happens in science. Further, the platform features Teacher Tools that can detect when an adaptive guidance interaction is stagnating and alert the teacher. Teachers' responses to these alerts help shape the NLP technology to detect ideas that are valued but may be infrequent.

Funding from the NSF Discovery Research PreK-12 Program supports the development of this NLP-based technological innovation to strengthen science education. It also supports research that tailors the innovation to teacher' needs. The innovation helps teachers encourage students to express their ideas and enables teachers to respond to contributions from each student, including those whose ideas may have otherwise been overlooked.