Using Speech Recognition Technology in the Classroom: An Experiment in Computer-Supported Collaborative Learning

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Abstract: This paper will report on a design and development project that aims to enrich face-to-face classroom contexts using the latest developments in information and communications technology. The Meety project, when used by students in a classroom with laptop computers, captures the verbal utterances of the classroom context and uses it to supply real-time information resources to the students in the classroom. Students have the option of contributing to the information resources and rating the utility of the resources supplied. This project discusses the design and development of the project as well as a simulated trial to test its efficacy.

Introduction and Purpose
The sociotechnical arrangement of university classrooms has changed little over the last several decades, despite widespread changes in the emerging and evolving environment available to students and instructors outside of the classroom. For example, technologies such as blogs and wikis, and services such as YouTube, Wikipedia and Facebook, have awakened the public to new ways of interacting with media that radically diverge from the transmission model that has characterized the so-called ‘consumer culture’. Changes in the culture outside of the classroom, which has been characterized as taking on more participatory tendencies (Jenkins, 2006), is leading researchers and developers to think of new ways in which classroom contexts can be augmented and enriched using new pervasive communications and computing technologies. This is one such project, which is an experiment in enriching face-to-face classroom contexts using a tool that takes advantage of some of the latest developments in computing and communication technologies. In particular, this project will describe and test the efficacy of Meety, a project developed at EdLab, Teachers College, Columbia University, which is designed to augment student and instructor interactions in classroom-based contexts. Meety is a sophisticated web-based application that combines video, sound, collaboration features, and speech recognition into a single package. The Meety project, when used by students in a classroom with laptop computers, captures the verbal utterances of the classroom context and uses it to supply information resources to the students in the classroom. Students have the option of contributing to the information resources, and rating the utility of the resources supplied. A typical use of Meety in a classroom-based context includes the following:

- One or more students in a course, using their laptop computer and webcam, record the proceedings of the class. Using an Internet connection available in a wireless classroom, the real-time, live recording is available for viewing by other students and the teacher within the course using a laptop computer.
- While the recording is in-progress, Meety is listening to the classroom-based interaction and providing real-time knowledge resources it thinks will be useful to the students and teacher. Students and the teacher can rate the resources. Meety will then alter the resources it provides based on these ratings. This set of resources are called “Meety-made” notes.
- In addition to “Meety-made” notes, users can create their own notes which get shared with the class. These notes act as a “back-chat” for further discussing the classroom-based content, the knowledge resources Meety provides, and other related issues.
- After the class ends, Meety can be used as an archive of the classroom-based interaction, with the full audio and video of the course available for playback. Additionally, all the notes generated by students, the instructor and Meety are made available.

In sum, Meety provides a venue for enhanced student participation in the knowledge sharing and creation process. This can be accomplished through the following activities:

- The activity of collaboratively-filtering the knowledge resources Meety produces requires students to be critical of the knowledge presented to them. For example, the presentation of knowledge resources should cause the student to ask, is this piece of content relevant to the discussion at-hand? Is this a worthwhile resource for my peers and myself to view?
- In addition to providing an opportunity for being critical, the knowledge resources provided can be used to augment the student’s knowledge on the topic being discussed. For example, Meety may bring...
up an article that provides an opposing viewpoint to the one being discussed in the physical classroom context. This should cause the student to think: does this discussion cover all the possible perspectives on the issue?

- The back-chat allows students to collectively discuss some topic outside the verbal discussion taking place in the physical classroom. The back-chat allows students to clarify different points, augment positions with evidence from the web, ask questions for the teacher, or question the resources Meety provides.

A beta version of Meety is currently available on the Internet for use in classrooms (http://meety.tc-library.org). The purpose of this paper and presentation is to report on the design and development of Meety as well as report on a simulated trial of a classroom context. The hope of this project is to further experiment with the model of information delivery within a classroom context: how do embedding knowledge resources within real-time classroom-context impact the traditional face-to-face context? Further, is the model of providing information resources that can be interacted with in a classroom a model worthy of greater consideration?

**Literature Review**

There are many projects being produced and that have been produced that look to augment classroom contexts using pervasive computing technologies, in particular technologies that employ speech recognition technology to adapt to the situated context. For example, the Liberated Learning Project aims to use speech recognition technology to create class notes for those students who have disability issues (Bain, Basson & Wald, 2002). Other projects have used speech recognition with secondary school students, such as a project by O’Hare and McTear (1999) who used it as a way for transcribing the stories of children. And further projects have augmented speech recognition with other technologies, such as computer-vision and agents, to create a richer tele-education system for distance learning contexts. For example, a project based at Tsinghua University in China uses all the aforementioned technologies to create a Smart Classroom that “bridges the gap between tele-education and traditional classroom activities in terms of teacher’s experience and seamlessly integrates these two currently separate educational practices” (Shi et al., 2003). Like the smart classroom project, others look to use speech recognition in ways that break-free of the desktop computing model. For example, Furui (2000) proposes a system that creates a wearable device for creating meeting minutes that can then be transmitted to a central repository. Each of these projects are very interesting but face a similar set of challenges, such as the accuracy and speed of the speech recognition engine as well as the usability and utility of the dictation. As speech recognition technology advances and these issues slowly resolve themselves, the applications for education and learning will continue to grow.

**Designing the Tool**

The Meety user interface includes two sides, a left and a right. To view the interface, visit http://meety.tc-library.org. On the left of the screen, the system captures the audio and video of the face-to-face meeting. On the right side of the screen, the system displays the notes it has created based-off of the verbal utterances it has recorded and transcribed. The user has the option of viewing “Meety-made” notes, which are generated by the system speech-recognition system, “Meeters-made” notes, which are the notes created by people in the class, or “All notes” together in a single view. The students and instructors also have the option of rating up or down information resources that are supplied by Meety or by fellow Meeters. This type of system, often called collaborative filtering, allows those notes that are most useful to be more visibly present, while those least useful are buried to the bottom (Resnick & Varian, 1997).

Meety uses the newest developments in speech recognition technology, notably Microsoft’s Speech API that is included with the release of Microsoft Windows Vista. Microsoft has used this same engine to provide speech recognition capabilities for navigating the GUI of the Vista operating system (Odell & Mukerjee, 2007). For this particular investigation, Meety’s analysis engine that extracts keywords from the dictation uses the Google search engine to search the Internet for relevant resources (rather than other possible search engines, such as Google Scholar or a library federated search engine).

**Research Methods**

A simulated user trial was conducted to test the efficacy of Meety. The trial was designed in the following way: a podcast was played to Meety as if Meety was present in the lecture hall (e.g., as if a student was recording the proceedings). The knowledge resources that Meety provides was collected and coded by the researcher on a 5-point Likert scale from one-to-five which measured the extent to which the resource was relevant to understanding the content of the lecture. Since this project is only a pilot for testing the efficacy of Meety, only a single coder was employed; however, in a more extensive project independent coders would be employed and inter-rater reliability be sought. The lecture used was a 50 minute lecture by Steven Stiglitz of Columbia
University on the “Credit Crunch” of 2008, available from iTunes University (Stiglitz, 2008). The coding of the resources aimed to measure the extent to which the resources Meety provided were relevant to understanding the complex economic issues that Stiglitz discusses or to provide additional resources for learning more about the economic issues. Items rated low are completely unrelated or useless, where items rated high are very useful resources for understanding the issues Stiglitz discusses.

Results and Conclusion
During the 50-minute lecture, 90 web resources were collected by Meety. The mean score of the resources was 2.46 (1 = low relevance, 5 = high relevance) with a standard deviation of 1.87. From this, we can conclude that the average resource that Meety provided was of medium utility to the discussion at-hand. Despite this medium score, there were many high-quality resources (18 with a score of 5 and 12 with a score of 4). These resources included such things as news articles related to the economic crisis and Wikipedia entries on such things as “Market Failure,” “Great Depression,” “Credit rating agency,” “Government bond,” and “Emergency Economic Stabilization Act of 2008,” all of which would have been very useful for someone unfamiliar with such economic concepts and events. Results indicate that the algorithm for choosing resources should be refined to eliminate resources that are tangential to the discussion at hand. Further, the results indicate that the social component of collaborative filtering (although not specifically studied here) would add a layer of utility and refinement to the results. Additional research is needed to explore Meety’s utility in a real classroom context with student attending a lecture, creating their own notes, and collaboratively filtering Meety-made notes as well as the notes from their peers.

References