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Machine Interviewing for Assessing Student Learning

Automatic Interviewer and Past Recorder Technology

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Abstract: This paper describes how computer-based machine interviewing and recording devices can be used as formative and summative assessment tools in schools, in the context of electronic portfolios. We describe demonstration prototype instructional and assessment systems that have been developed at the University of Hawaii, including the Automatic Interviewer and Past Recorder. Instructional applications and future directions are described.

1. INTRODUCTION

This paper explores ways that computer-based machine interviewing and recording devices can be used as formative and summative assessment tools for learning science, especially in the context of electronic portfolios. These devices, which can be utilised by individual teachers as stand-alone devices on individual computers, or as networked tools on the World Wide Web, allow teachers to capture and track students' original conceptions or preconceptions in preparation for science (or other subject matter) instruction. They also act as formative assessments to allow teachers to evaluate and remediate possible misconceptions early in the instruction process, and as summative assessments that show teachers, parents, the students themselves, and others, what students have learned.

Machine interviewing and recording devices enable students whose strengths may not be in traditional writing skills to express their learning in other formats that could more intrinsically motivating for them and less restrictive. The richness of individual differences, including cultural, ability,

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and linguistic diversity can add to the varieties of expression possible in these forums. Additionally, students with disabilities can find modes of expression and note-taking that capitalise upon their strengths and circumvent possible limitations. Machine interviewing and recording devices are consistent with current instructional movements toward non-traditional assessments, such as portfolios, dynamic assessments, and performance assessments. Constructivist teaching practices, project learning and inquiry, and World Wide Web based instruction, and other kinds of distance education, all lend themselves ideally to the incorporation of machine interviewing and recording devices.

Finally, we describe demonstration prototype instructional and assessment systems that are being researched and developed at the Curriculum Research Development Group at the University of Hawaii. These tools are being developed to demonstrate the advantages of employing a distributed computing approach in education and training environments. The devices described and their uses are not an exhaustive list, but serve as the focus of this discussion because of their direct utility as learning and assessment devices in classrooms. The following are being researched, designed, prototyped, and tested: human interaction with machine interviewing, human interactions with past-recording prototype devices, and human interaction with electronic portfolio prototypes. Below, we briefly describe the tools, then we provide research highlights.

1.1 Automatic interviewer

Automatic Interviewer software facilitates machine mediated digital-video interviews with immediate opportunities for self-improvement. The Interviewer serves as a mechanism for teachers to present questions or topics. Students respond to a computer that video-digitises their responses. Students may delete and re-record their own responses until they are satisfied with their own performance. The Automatic Interviewer may be used as a stand-alone application or incorporated into the electronic portfolio by the teacher. Automatic Interviewing is ideally suited to performance assessments and the current movements toward standards-based performance assessments.

1.2 Past recorder

Past Recorder allows selective recording of not only the present, but also the past. Past Recording places audio and, potentially, video events in a small random access memory buffer that is constantly being overwritten. The time duration of the buffer (typically 10 seconds) allows the user to 'reach back

into the past' when they start a recording process that also includes the 'present.' For example, an individual using the Past Recorder in a lecture would have the software constantly audio-recording and overwriting audio in a 10 second buffer. When she hears something important that she would like to retain, she presses the record button and the Past Recorder immediately begins recording, while at the same time retaining the previous 10 seconds that would have been erased.

The advantage is clear – by the time an individual makes a determination that something is important and would start recording on a typical tape recorder or other recording device, a major part of the utterance would have been lost. This technology was developed because we assume that no one intends to record all human and natural events at any specific meeting or classroom lecture (Speitel and Iding 1997). The Past Recorder, like the Automatic Interviewer, can be used as part of the electronic portfolio, or as a stand-alone device.

1.3 Electronic portfolio

The computer-aided electronic portfolio prototype tools were developed for education and training purposes. The portfolio serves as a mechanism for students to demonstrate and record what they know and can do in a way that instructors can categorise, assess and provide critical feedback on an individual or class basis. The systems enable rapid incorporation of classroom, multimedia data and text. The Past Recorder and the Automatic Interviewer can be used as stand-alone devices or incorporated into electronic portfolios, the portfolio is described. Extensive educational research addresses topics relevant to electronic portfolios in general; therefore, only issues related to machine interviewing and recording will be addressed in this paper.

Below, we describe highlights from actual classroom applications and research employing Past Recording and machine interviewing.

2. RESEARCH ON MACHINE INTERVIEWING

Machine interviewing has been employed in several educational contexts, with diverse populations. First, we describe some of the actual contexts or cases in which the Automatic Interviewer was employed then we describe general conclusions and observations that have emerged through our research and development.

2.1 Preservice teachers practice responding to job interview questions

An early implementation involved testing the Automatic Interviewer with preservice teachers in one of their regular classes. Students responded to typical job interview questions posed by the Automatic Interviewer, such as requests to introduce themselves and to describe their teaching philosophies. Student feedback indicated that seeing themselves responding to the interview questions was valuable feedback, as was the opportunity to practice responding to questions by repeatedly recording themselves until they felt completely comfortable with their answers. The Automatic Interviewer was set up in a room away from the rest of the class to provide privacy and quiet while students interviewed. Half of the students were left to work with the computer alone, and the other half were assisted by one of the experimenters, an education professor. Students were more likely to rerecord in the unattended condition.

2.2 Middle school students respond to pre- and post-questions in science

A. University of Hawaii Laboratory School science teacher piloted the use of many of these devices in her science classes. In one of the implementations (also described in Iding, Crosby, Speitel, Shimabuku and Nguyen 2001), the teacher used the Automatic Interviewer to have students describe their initial preconceptions and final conceptions about the relationship of light and heat. After lessons and experiments on the subject, their post-conceptions were recorded. The teacher also used the played the results of pre- and post-instruction to parents at an open house as a continuous video. This provided a clear indication for parents of how students' conceptions changed as a result of instruction.

2.3 Special education students use the automatic interviewer at a science camp

An example of how machine interviewing was used in a special education environment was provided at camp sponsored in part by a grant from the National Science Foundation to the Oceans of Potentiality Project, 'Camp Waianae' in Hawaii. The purpose of this camp was to provide special education students with a chance to learn science in a camp-like setting. As soon as the students arrived at 'Camp Waianae,' they used the Automatic Interviewer to introduce themselves. The interviews were stored on the

computer so that the next day the campers could hear and see their interviews and add or delete information. As the camp progressed, they added more information to their initial interviews. One of the activities that used the Automatic Interviewer involved having the students take apart a computer and listen to a talk on how parts of the computer functioned. This process gave the students an opportunity, during the interview, to explain the functionality of the computer components. Since this information was saved in the computer, instructors could later play the interviews to learn about any student misconceptions.

3. RESPONSES TO MACHINE INTERVIEWING: MOTIVATIONAL AND COGNITIVE ASPECTS

Our research suggests students in high school and college may improve their self-perception and delivery mode when given machine digital-video interviews with immediate opportunity for self-improvement. For example, the majority of high school students responded very positively. When assisted by an adult, a few sometimes appeared self-conscious and concerned about whether their peers were watching them and how their peers might have reacted (typical concerns of adolescents). We concluded that it might be advantageous to provide opportunities for machine interview where students of this age are physically separated from peers (or outside hearing range). From our observations, students seemed more likely to re-record when left to machine interview without an adult or other assistant present.

Students in the special education camp were especially enthusiastic about using the Automatic Interviewer and other technologies. As one of the co-authors who was also present at the camp commented, "The students loved talking to the computer. They especially liked the fact that the software let them immediately see a movie of their interview and remake any portion of it." When asked if the students were open to a machine and under what circumstances, she added, "These students were definitely open to the machine. The hearing-impaired students particularly liked being able to sign their interview and have it recorded in the movie. The translators provided a voice over the movie so that people not able to understand the American Sign Language (ASL) signs could still understand the interview."

From a cognitive perspective, a number of benefits can emerge from the use of machine interviewing technologies like the Automatic Interviewer. First, students can actually see and improve their own performances. This often iterative process includes metacognitive aspects of seeing and self-evaluating one's own level of understanding as well as one's own effectiveness in communicating that level of understanding. Also, being able

to 'erase' and re-record performances allows students to practice their responses and even try different presentation strategies without the pressure of having to produce a single, perfect, final product.

The benefits of machine interviewing devices are consonant with other cognitive, socio-cultural and distributed cognition frameworks and perspectives, depending upon how the instructor structures the learning situation. For example, having students explain or teach other students could be structured to include some of the aspects of Palinscar and Brown's (1984) 'reciprocal teaching,' in which students gradually learned to be more effective teachers and readers.

Additionally, the benefits of students' seeing and explaining their levels of scientific understanding pre- and post-instruction is consistent with constructivist approaches in science education that aim at uncovering and remediating students preconceptions or scientific misconceptions. An effective example was employed by a high school science teacher who had students describe their original conceptions and make predictions about a scientific phenomenon covered in the curriculum via automatic Interviewer ('pretest'); and later their final conceptions and how they have changed. This was originally designed to correspond with Champagne, Gunstone and Klopfer's (1985) description of 'ideational confrontation' (i.e., making predictions about a phenomenon, creating theoretical explanation, doing a demonstration, reconciling original predictions with outcomes of demonstrations).

Clearly, there are other practices consistent with current educational perspectives and practices that could easily be exemplified in the Automatic Interviewer. For example, students' levels of understanding could be 'scaffolded' by the teacher's placement of progressively more difficult or comprehensive questions in the Interviewer. In that sense, the Interviewer could be considered to provide a form of dynamic assessment. Similarly, tasks or questions could be linked to performance standards for students and even for teachers to address in their own instruction.

4. RESEARCH ON PAST RECORDING

Part of the machine-interviewing system involves past recording. This past recording will also be used for more open-ended evaluation procedures to capture and gauge human performance, and for note-taking and general recording purposes.

4.1 Note-taking for high school students

Speitel and Iding (1997) worked with high school sophomores to compare the efficacy of studying science with Past Record versus listening, normal recording, or paper and pencil note-taking. Past Record students averaged more correct responses on a recall test than their peers in the other conditions. Furthermore all information recorded by Past Record students consisted of complete utterances, whereas their 'normal recording' peers were able to only record complete utterances 40% of the time. A Past Record student commented, "I think this is an excellent way of studying. Not only do you record what sounds good, but if you like what you heard previously, you can record that as well. It really helped me in getting the information I wanted to review" (Speitel and Iding 1997, p. 345). Another student said, "Well I think that past recording is very interesting. I think it is better than writing down notes or listening or memorising. Recording is such an easy method because you can listen to what the person is saying and then record it and then go back to it. And you can hear it word for word. Plus you can get a lot more notes on it" (Speitel and Iding 1997, p. 346).

4.2 Peer teaching for high school students

Past Record can also be useful for teaching and performance situations such as the one described by the high school science teacher in which she used the Past Recorder with her ninth grade science students. The students were presenting 'Teacher for a Day' projects. As the teacher explained, "In this project each student group is presenting a different invertebrate phylum. The past recorder enables me to show evidence of each groups' presentation. As I evaluate each group I am able to record important segments of the presentation. I can then play back the recording for the student and use it as a coaching tool. This will be helpful for many reasons; one, the students can learn from their 'mistakes' and because they are able to hear portions of their presentation it allows for reflection. Second, it gives me specific examples as to why the student earned a certain grade for the presentation (example if the student is reading from a paper or if the student is able to present without the use of note-cards). These examples also give the student a chance to hear things that they may have missed during the presentation."

5. RESPONSES TO PAST RECORDING

Speitel and Iding (1997) described some of the difficulties associated with regular note-taking practices, including short term memory limitations

for speech processing (Simon 1974), and lack of completeness of student notes (King 1995). Past recording can be an efficient solution although it might be most beneficial for college-level students who generally do take notes, or as part of an instructional unit on note-taking as a study strategy for high school level students.

In previous research (Speitel, Iding, Crosby and Shimabuku 1999), we described other possible uses for Past Record, including for persons with visual, auditory and other motor impairments that would affect notetaking skills. We also noted that Past Record could be useful for ESL and foreign language teachers and students, and for speech pathologists and linguists interested in recording utterances. We have not yet fully investigated its usefulness for other performance situations besides teaching, although we speculate that this technology would be valuable for those practicing artistic or musical performances, speeches, and story-telling.

6. FUTURE DIRECTIONS

Machine interviewing technologies like the Past Recorder and Automatic Interviewer have great potential as formative and summative assessment tools for students in all content areas, especially when linked to electronic portfolios and even to content performance standards. These technologies are particularly appealing for recording changes in individuals' understandings over time, and for capturing important verbal interchanges and performances that might not as easily be expressed in written form.

Issues that remain to be addressed by future research, especially in instructional contexts, include problems that may be associated with the use of portfolios generally. For example, portfolios (both electronic and paper-based) can be relegated to simple repositories of material unless the selection of materials is done in a thoughtful, reflective, and planned fashion, with clear instructional goals in mind throughout the process. Length of video clips in portfolios is also an important consideration, as very short clips may not adequately capture and convey sufficient information.

Other issues that remain to be addressed with respect to automatic interviewing can include simple aspects of classroom management and noise levels as teachers determine how to most effectively implement activities where many students might be talking simultaneously. Finally, as students articulate their understandings about scientific phenomena, teachers need to carefully monitor students' descriptions, in order to detect and prevent possible misconceptions from becoming deeply entrenched.

Despite these issues, machine interviewing can help organise students' recordings in ways that are meaningful to students and teachers. In

conclusion, these tools are beneficial to all students, particularly those with disabilities.

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BIOGRAPHY

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