Undetectable, Hands-Free Always-On Technology in the Classroom

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Abstract

Hands Free Always On (HFAO) technology, such as the next generation of smart glasses, will likely become invisible and undetectable, turn up in classrooms in the near future, and change teaching and learning. An exploratory study analyzed four focus groups with faculty members at a research university. The focus group process and the data analysis were guided by four research questions: (1) How will undetectable HFAO technology affect students' learning? (2) How will it affect professors' teaching? (3) How will it affect assessment? (4) What would make faculty embrace this technology? We summarize participants' insights showing that the perceived effects of HFAO technology in classrooms were mixed. Initial comments from student focus groups had similar results.

Introduction

As personal, wearable technology becomes more invisible, students and instructors will be coming to the classroom in a few years fully connected, yet in undetectable manner. Thus, one would not know when the other students in the classroom are connected, or even the instructor, and whether they are looking up information, collaborating with someone else, or recording the class session, or whether they are simply distracting themselves or others.

During class they could, for example: (1) record and share the lecture; (2) look up information through an invisible built-in display; (3) listen to people or audio through an invisible audio interface; (4) wirelessly communicate with others through subvocalizing or speech-to-text; and (5) enter queries through an invisible input device or small gestures.

The purpose of this research is to conduct exploratory research in preparation for pilot studies in which we study the inevitable use of such undetectable technology, with the future goal of structuring and scaffolding it, to guide classroom participants in order to evolve and improve learning and teaching. The current study's purpose is to explore how university-level professors might teach in this new environment, students might learn, and HFAO technology will affect both.

Four research questions guided this exploratory research: (1) How will HFAO technology affect students' learning? (2) How will it affect professors' teaching? (3) How will it affect assessment? (4) What would make faculty embrace this technology? After reviewing the literature, we describe our Focus Group procedure, summarize the main themes that emerged relevant to the research questions, and discuss findings, limitations, and potential future research.

Related Work

The importance of student interaction has been strongly stated in studies involving computer-based instruction that actively engage and motivate students (Crossgrove et al. 2008, Moredich 2007, Roderick et al. 2001, Roth et al. 1991, White 1989, Wigfield et al. 2000). Since the HFAO technology that we explore in this study has many properties similar to laptops (Perse et al. 1992, Levine 2002, Rockman 1997), we assume that it could also facilitate student collaboration and have a positive impact on teaching and learning. However, with many differences from laptops, such as invisibility to others and the always-on property, we need to further explore its potential impact on classroom education.

Novel wearable devices such as smart glasses will provide further possibilities to enhance the teaching process in the future. For example, Google Glass is a well-known, web-connected wearable computer with an optical-mounted display, which is a precursor to our definition of HFAO technology, which can facilitate teaching and learning (Parslow 2014). Educators could access information during a talk, lecture, or discussion, demonstrate specific skills, interview experts, and allow students to view distant sites. They argue that that Glass' value may lie with using the device in conjunction with an integrated platform where information and ideas can be exchanged in a public or private setting (Vallurupalli 2013).

Methodology

We conducted two initial focus groups (Berg 2001) as a pilot to test our initial questions and procedures. We then ran four main focus groups with faculty members at a technological university. During the two pilots, we found participants too focused on Google Glass, which had been the only example of HFAO that we provided. The main focus groups were presented more explicit descriptions of different HFAO technologies that could be used inside the classroom, similar to the description in the introduction above. Participants were shown a figure of a normal looking student participating in a lecture while presumably wearing invisible undetectable devices. All focus groups comprised 7-8 experienced faculty. We used topical questions: (1) What will students do differently in the new classroom environment? 2) How could you and students use this invisible technology positively to improve learning in the classroom? 3) How will you accommodate your teaching? 4) How would you assess different aspects of the course or learning objectives? 5) All things considered, what would make you embrace such an environment instead of fighting it? 6) What would be your most pressing concerns?

Data collected (instructor responses) were recorded, transcribed, coded and analyzed, guided by our four main research questions. We aimed at discovering themes from the data that could help explain the instructors' perceptions of this new technology. In reporting findings below we will summarize the main themes of the participants' perceptions gathered from their responses.

HFAO Effects on Students

Our findings revealed mixed results on the projected effects of HFAO on students. Instructors believe that HFAO could facilitate interactivity through collaboration. However it could also potentially present a problem since it adds to the activities that students do in class. The overlap in these activities such as being asked questions privately by other students while listening to the lecture could potentially increase

the amount of distracters for students. The implications of recording and sharing information were uncertain. Thus, there are possible tradeoffs found when utilizing this technology. In addition, the invisible nature of the technology makes it more difficult to discern what students are doing and thus could make professors wary of the activities students do in class.

Our findings revealed mixed results on the effects of HFAO on students. While instructors believe that HFAO could facilitate collaboration, it could also potentially present a problem since it adds to the activities that students do in class. The overlap in these activities such as being asked questions by other students while listening to the lecture could potentially increase the amount of distracters for students. Thus, there are possible tradeoffs found when utilizing this technology. In addition, the invisible nature of the technology makes it more difficult to discern what students are doing and thus could make professors wary of the activities students do in class.

HFAO Effects on Professors

Projected HFAO effects on professors also had mixed results. On one hand HFAO could indeed help instructors change the way they give lectures. Removing static location constraints could benefit students with a more hands-on experience in more fitting locations. Even if the lecture were to be given inside a traditional classroom, augmented reality could allow instructors to present a better perspective on the subject being taught. By providing more resources and increasing collaboration with students, professors can not only make immediately available any material discussed in class but also students can be active participants in the lecture—for example, in a programming class the professor could have students write a program collaboratively instead of having the professor do all the coding himself and have students watch passively. Professors could create *ad hoc* groups for activities without the need to physically rearrange the class layout. However, there are also potential issues to consider such as cheating in class, which we will analyze in a later section. In addition, since HFAO makes recording easier, copyright can be more easily violated and in some cases without the consent and knowledge of individuals, which presents an issue for professors and students alike. Finally, control issues are somewhat mixed because even if special control technology were available to potentially help faculty monitor students, professors were wary of it being on all the time.

How HFAO Impacts Assessment

A combination of factors influences the potential effect of HFAO on assessment. These refer to the type of assessment and of the course being taught because different courses may utilize different assessment methods. For courses that allow students to use resources like open book exams or those requiring creative answers instead of facts, participants stated that HFAO may not be an issue. However, other participants expressed concern when evaluating individuals due to the open communication nature of the technology, including communication with students outside the classroom, which may hinder the evaluation process. Solutions proposed by instructors include group examinations, open-ended or more specialized examinations in which each assignment would be different. However, each solution had its own set of issues such as increase in instructors' workload. Lack of control may play an important role since we stipulated the premise of not being able to turn off the technology, in which case some

instructors may have trouble assessing students. While it probably would not be possible, instructors want a higher degree of control over this technology to be able to tailor it to their assessment methods.

Reasons to Embrace HFAO

When asked what would make them embrace HFAO, professors stated that enhancing class delivery and promoting learning would be significant factors. Thus, in order to promote the use of this technology in the classroom, as designers we should consider ways that HFAO could impact class lectures while demonstrating its effectiveness in increasing learning opportunities. Another factor stated was the ability to control this technology. Therefore, an important design aspect would be the amount of control given to instructors that could be exercised during class lectures. Finally, skill development is an important aspect to consider, which is related to enhanced learning. Therefore, when promoting HFAO to instructors and educators, it would be important to demonstrate how skills integrate not only with the current curriculum but also with the current classroom and potential extended work environment.

Student Feedback

As follow-on research we are conducting focus groups with students to determine their opinions of how HFAO will affect learning in the classroom. Table 1 contains some representative comments pro- and con- for each of our research questions. (For students we would adjust research question 4 to examine what would make students excited about using this technology for learning.) While a formal analysis will be future research, initially it seems students are focused on similar issues as professors.

Table 1: Representative student comments categorized by the 4 Research Questions

Topic: HFAO Effects on Students Student Comments: You could see your notes all the time. Most people will multitask such as watching movies and not paying attention to professors. Recording could be positive or negative. Students could just record the class and not pay attention.
Topic: HFAO Effects on Professors Student Comments: Professor wouldn't be able to tell who is engaged and who is not. Would be difficult for professors to know who is using it or not.
Topic: How HFAO Impacts Assessment Student Comments: People shouldn't be tested on facts but how they apply something. Exams should be open ended. If using all same questions in an exam it would be easier to cheat.

Topic: Reasons to be Excited about HFAO
Student Comments:
This could be used as a resource rather than cheating. If regulated in class it could improve the way we learn. Privacy issues are a concern, but if taken care of, it could be useful for learning.

Regarding usage of undetectable HFAO in classroom, students reported that it could have the potential to distract them. Students raised questions of privacy. However, students also saw potential for educational purposes such as providing facilities for augmented reality and 3d modeling, note taking and communication. Regarding the effect on professors, students' also believed that HFAO would affect both class recitation and assessment in the similar way that professors commented in instructor focus groups. For assessment, students believe that, given the open nature of the availability of information, that exams had to assess the application of knowledge rather than remembering facts. In addition, the open communication would make individual assessment more difficult and thus would require professors to personalize the exams, hence increasing professors' workload. In terms of reasons to embrace this technology, students believed that if it helps them learn then it would be a positive influence. However, the privacy concerns were an issue for most and that should be addressed before embracing it. Another reasons to do embrace HFAO was that this technology would prepare them for the future workplace as it could help them get accustomed to tools that could be available in their jobs.

Contributions, Limitations and Conclusions

Contributions

To the best of our knowledge this is the first qualitative study that aims at understanding instructors' perceptions of undetectable wearable computer technology in classroom settings, and how they would deal with such a change. This study summarizes how HFAO could potentially affect the interaction between students and instructors in terms of class lectures and assessment. Our four research questions provide a starting point for future studies. In addition, the findings provide insights and considerations for developers on possible uses and issues that may arise from the likely inevitable future integration and use of HFAO in classrooms.

Limitations and Future Research

Limitations include the lack of fully undetectable HFAO technology and limited experience with partially detectable HFAO. We conducted focus groups at a single technologically focused, higher educational institution. The results of student focus groups still needs to be analyzed. Thus, this study presents an only an initial exploration of possible HFAO effects. Yet we are at the dawn of this ubiquitous technology availability, which surely will make its widespread invisible appearance in our classrooms in the years to come.

We hope to utilize these results to run pilots as technology appears and study the behavioral issues, and develop scaffolds to best support learning in the inevitable HFAO classroom of the not to distant future.

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