

# Design Research for a Context-aware Capture System to Support Biology Education

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## ABSTRACT

Automatic capture technology could enable students to record and index much information—both digital and non-digital—with little extra effort. *Can this technology be designed to augment students' education without overwhelming them? Can it be designed to meet educators' goals?* This research will address these questions by studying the information needs and educational practices of undergraduate biology students. Findings will provide a foundation for the design of capture systems that can enhance education and support effective e-Portfolios.

## Author Keywords

Fieldwork, education, learning design

## ACM Classification Keywords

H.5.2 [User Interfaces]: User-centered design

## PROBLEM STATEMENT

Many college students are required to own laptops, and sophisticated approaches to digital classwork are emerging [e.g., 2]. Researchers and institutions are even beginning to develop fully digital personal educational portfolios [3], containing students' notes, paper drafts, assignments, and other documentation, with integrated access or links to official course materials (such as lecture notes, slides, videos, lesson plans, and assigned readings). The digital educational record is becoming so rich that organization and retrieval are looming problems for students, educators, and administrators. At the same time, extensive amounts of educational information are also created and disseminated outside of this digital workflow—for example, lectures and class discussions, notes and conversations in study groups, brainstorming on whiteboards, or images and artifacts from field trips.

Automatic capture technology [1] could enable students to record and index much of this information—both digital and non-digital—with little extra effort. *Can this technology be designed to augment students' education without overwhelming them? Can it be designed to meet*

*educators' goals for a useful record of students' work?*

These questions have motivated our research, which seeks to understand the information needs of undergraduate biology students, and enable the design of an automatic capture system that can improve their education while meeting the goals of universities. This system will combine automatic capture with context-awareness, including recognition of where a student is, what class she is enrolled in, what activity she is participating in, and so forth. The following scenario indicates one type of educational activity such a system could support:

## Example Scenario

Steve is a student in Biology 043, "Local Flora." In this class, he learns to identify trees and plants in the wild. Fieldwork is an integral part of the class. Steve has been assigned to explore the Coker Arboretum, and identify plans and trees there. Steve wears a camera around his neck that periodically takes pictures of his surroundings. He also carries an audio recorder that records conversations and ambient sounds. An automatic capture system stores all of these inputs and makes them available to Steve upon command. Later, in his dorm room, Steve uses the system to review images of his fieldwork. He listens to a conversation he had with his professor about a particularly complex leaf structure, and is able to identify the image of the plant and note its scientific name.

## RESEARCH QUESTIONS

1. What information do undergraduate biology students need and use during their classwork? How do they find this information? How do they use it (collect, organize, retrieve, share, analyze, annotate, incorporate, delete, etc.)?
2. What media or information can be automatically captured and tagged to support learning processes? How will the media or information be cataloged and accessed?
3. How can automatic capture improve on or extend existing practices (such as note-taking, email, etc.)? What tagging structure and processes are needed to make the captured information useful to students?

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4. How do students use the capture technology in the context of their educational practices and needs? Is the technology effective, promising, limited?

### CONTRIBUTION

The technology behind automatic capture systems has advanced rapidly—but understanding of their use has not. Personal reports from intrepid researchers [1] are interesting but do not speak to how more ordinary individuals would make use of the technology. This research will ground the design of capture systems in actual practices and information needs within a particular domain.

This research will also contribute to design science and practice by investigating the use of a deployed system to capture user behavior and information use which can inform the system's design. While deploying specially instrumented systems in the field is common, this research would treat the system itself as the instrument—the data captured by users in ordinary use for their own purposes could also serve as research data to assess the usefulness of the system and inform its design.

In addition, this research will combine different research perspectives—including information behavior [6], learning science, and HCI—to uncover new opportunities for design.

### SOLUTIONS

#### Methods

The methods for this research are still being developed. We plan to combine multiple qualitative methods [as in 4, 5, 7] to gain a detailed understanding of students' practices and needs. Specific methods will likely include:

**Shadowing and immersion.** Spending time with students (shadowing), and participating in class activities (immersion), will enable a deeper understanding of what biology education is currently like, and uncover patterns of information use.

**Interviews.** Interviews provide more extended opportunities to discuss and probe students' information use.

**Artifact analysis.** Collecting and analyzing educational artifacts (such as field notes, class notes, quizzes and exams, readings, etc.) will complement interviews, and offer insight into areas that students do not or cannot introspect upon.

**Diaries and media diaries.** Textual diaries (typically based on worksheets with a mix of closed and open-ended questions) and media diaries (using multimedia inputs, such as voicemail or voice recorders, cameras, etc.) provide a

way to capture ongoing behavior beyond what the researcher can observe.

### Status

We are beginning exploratory research with students, focusing on interviews and shadowing, as well as interviews with biology instructors. Results from exploratory studies will be used to refine the research questions and methods. Current work also includes review of relevant literature, such as context-awareness systems and theory, e-Portfolios, and IT for biology research.

### Future work

Our ultimate goal is to enable the design of a context-aware automatic capture system that undergraduate biology students can use to improve their education, and help them build an e-Portfolio useful for both students and educators. We will undertake more intensive fieldwork to better understand student practices, design the capture system and retrieval interface to match their needs, and evaluate the system with students in class and in the field. So, the output of this research will include analysis of students' practices and needs, a metadata schema based on their needs, the prototype system, and results of evaluation.

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