Designing Online Environments to Support Studio-Based Learning in Computing Education

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Abstract

In order to improve student retention and preparation for professional careers, we have been exploring the potential for the **studio-based learning** (SBL) model—the centerpiece of architecture education for over a century—to transform computing education. While our results have been promising, the SBL model proves logistically challenging to implement within traditional computing courses. To address these challenges, we are building an online environment that enables students, instructors, and industry professionals to engage in SBL activities outside of normal class periods.

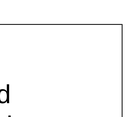
(1) Teaching Leading Edge Knowledge and (3) Active/Self-Directed Learning

Introduction and Objectives

Problems

- Just 21 percent of college students who begin a degree in computer science actually complete the degree within six years [1].
- College graduates may not be adequately prepared for the computing profession, which increasingly emphasizes **soft skills** (e.g,, communication, collaboration, teamwork) not often addressed in computing degree programs [2].

- By emphasizing individual problem-solving and discouraging collaboration, traditional teaching approaches in computing may unwittingly contribute to this state of affairs.



Possible Solution

- Rooted in social learning theory [3], **studio-based learning** (SBL) provides students with opportunities to see peers' work, assess it relative to their own, and help each other out.
- In quasi-experimental studies, SBL promoted significant gains in **peer learning** and **self efficacy** [4], two attitudinal measures that are correlated with student persistence.
- However, because SBL requires larger blocks of time than are available in traditional computing courses, it is **logistically difficult** to implement.

Research Objectives

1. Design an online environment that makes it easy to implement SBL in computing courses.
2. Empirically evaluate the attitudinal outcomes, learning outcomes, learning processes , and retention promoted by the environment.

Studio-Based Learning Activities

The studio-based learning (SBL) model engages students in an iterative process of *solution refinement* through two key learning activities:

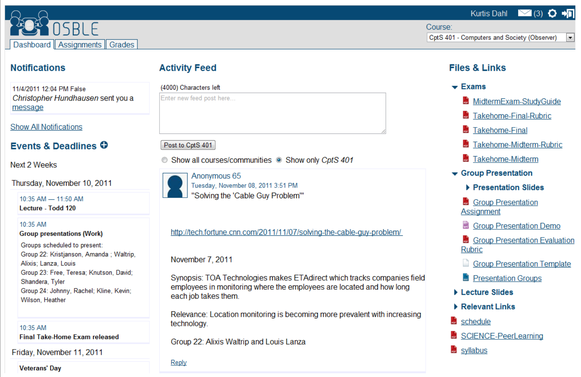
1. *The **design studio**,* a physcal space in which students work on course assignments.

2. ***Design crits**,* in which students present their evolving work to peers, instructors, and industry professionals for critical review .

How might these activities be supported online?

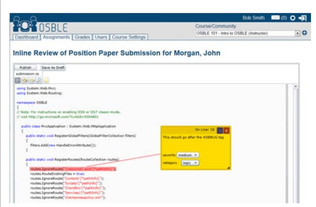
Foundational Technology: OSBLE

In prior work, we have developed OSBLE, an online learning management system:

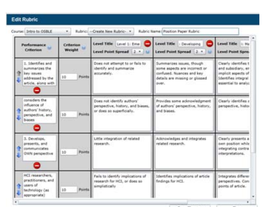


Course dashboard in the Online Studio-Based Learning Environment (OSBLE)

OSBLE is designed specifically to support **online design crits** in which participants can directly annotate student work under review, and fill in associated evaluation rubrics:



OSBLE's Review Interface



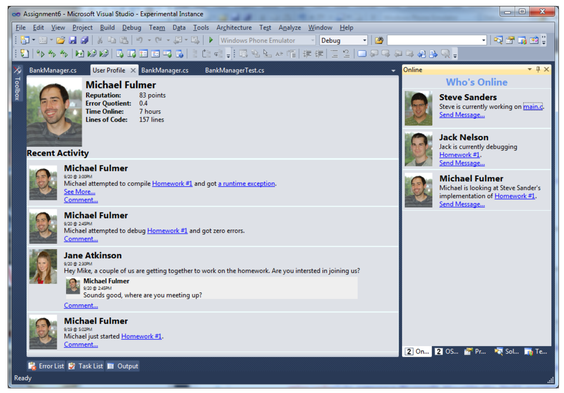
OSBLE's Rubric Creation Tool

OSBLE is free and open source. For more information, visit **http://osble.org**.

Proposed Extension: OSBIDE

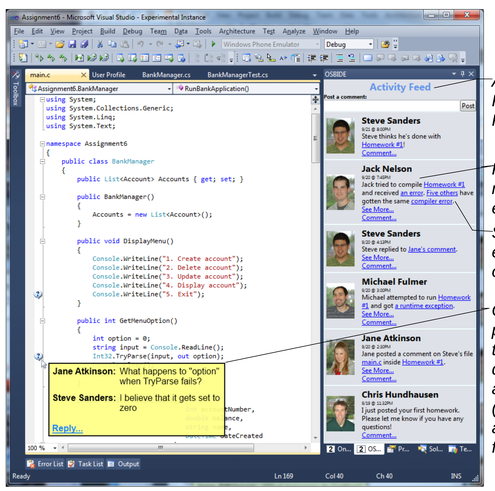
In order to support an online **design studio** for programming assignments in computing courses, we propose to expand OSBLE with OSBIDE, a plug-in for a computer programming environment. In OSBIDE we are exploring the following ***social programming*** features:

1. **Profile Page with Who's online**: Provides digest of a student's recent activity, along with who's online now and what they're up to.



Mock-up of OSBIDE's Profile Page with List of Who's Online

2. **Activity feed**: Provides continuously-updated account of students' key programming events, including file edits, compilations, executions, debugging activities, questions, and answers.
3. **Annotations**: Students can ask and answer questions about their and others' work *in the context of that work* by directly annotating program code, program output, variable windows, and compilation error windows.



Activity Feed Pane

Programming event

Similar events of others

Question posed through direct annotation (appears in activity feed too)

Mock-up of OSBIDE's Activity Feed and Code Annotation Interface

Implementation and Evaluation Plan

- Through a **user-centered design process**, we will implement OSBIDE within Visual Studio®.
- We will evaluate OSBIDE through **quasi-experimental studies** that compare the programming processes, attitudinal outcomes, learning outcomes, and persistence of students in computing courses that use and don't use OSBIDE for their programming assignments.

Key Open Issues

- *Privacy*. How much will students be willing to share? How much control should they have over what is shared? What about anonymity?
- *Activity Feed Composition.* What events should be included? How should events be presented? For a given event, how should we identify and present other similar events?

References

[1] U.S. Dept. of Education, National Center for Education Statistics. *BPS: 2009 Beginning Postsecondary Students.*
[2] Begel, A., andSimon, B. "Novice software developers, all over again." In *Proc. ICER* '08, ACM, New York, 3-14.
[3] Lave, J., and Wenger, E. (1991). Situated Learning. New York: Cambridge University Press.
[4] Hundhausen, C., Agrawal, A., Fairbrother, D., and Trevisan, M. Does studio-based instruction work in CS 1? An empirical comparison with a traditional approach. In *Proc. SIGCSE '10.* ACM, New York, 2010, 500-504.

Acknowledgments

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