Collaborative Computer Science Education (CCSE)

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Abstract

The Collaborative Computer Science Education (CCSE) project creates lesson incubators, which are close-knit groups of computer science teachers and an online system which helps them build outstanding lesson materials. Computer science course materials change rapidly, with new programming languages, software upgrades and professional best practices changing almost as fast as curricula can be developed. Computer science teachers must work together to keep their materials up-to-date. CCSE builds computer science education materials, not only for students in the classroom, but also materials for teachers to continuously improve their domain-specific skills in both technology and pedagogy. Audience: CS teachers and students. Goals: highly rated lesson materials, as perceived by teachers and students, and a system for continuous improvement. Outcomes: higher performance scores by students, more time for one-on-one instruction by teachers.

Need, Goals and Objectives

Need: Computer science course material changes rapidly, with new programming languages, software upgrades and professional best practices changing almost as fast as curricula can be developed. We need new, computer science education materials, not only in the development of classroom materials for students but also in materials for teachers. Collaboration is required for two reasons: (1) to keep materials up-to-date and (2) to provide the foundation for a shift in underlying motivations and beliefs among both students and teachers about how computer science learning happens.

Goals and objectives: The purpose of this project is to mini-crowd source computer science teaching. The crowd would not be everyone, only members of a select community. This is necessary so that trust can be developed between the participants so that suggestions can be made without fear of getting "flamed." The goal is to get teachers to collaborate, to share materials, and to share ideas for continuous improvement.

Consider a typical 14-week course, which meets 2 days per week for a total of 28 class sessions. Traditional teachers would develop lesson plans for all 28 courses, sharing nothing. If the proposed plan succeeds, instead of one teacher developing 28 mediocre lessons, 14 teachers would each develop 2 awesome lessons and all 14 teachers would share all 28 lessons. Student feedback would be aggregated and teachers who used the lessons could suggest or even make improvements.

Background and Context

Collaborative computer science education is a relatively well-known need. Collaborative teaching has been recognized by researchers as a promising new direction to improve quality

of instruction and teaching productivity [1]. The National science Foundation (NSF) has invested more than $100 million to expand and diversify collaborative computer science education [8]. Computer science has been identified as a critical target for expansion by educators at state [2] and national [3] levels. Motivations and belief systems can affect achievement of educational outcomes [4] [5] [6]. And discipline-specific approaches have proven especially effective [7].

The proposed project bears some similarities with what by Dr. Aman Yadav at Michigan State University has been studying [8] [9] [10]. As part of CS10K, a project to train 10,000 high school teachers in computer science, and partnered with Project Lead The Way, a STEM-promoting non-profit organization, Yadav is developing materials to train new computer science teachers.

This proposal differs in that its goal is not quantity, but quality. This research intends to identify and demonstrate a computer science "lesson incubator" called *Teacherati*. The idea is for each collaborator to contribute one or more of the following: classroom assignments, student and teacher instructions, video lessons and evaluation materials in the form of multiple-choice quizzes. See diagrams in Figure 1.

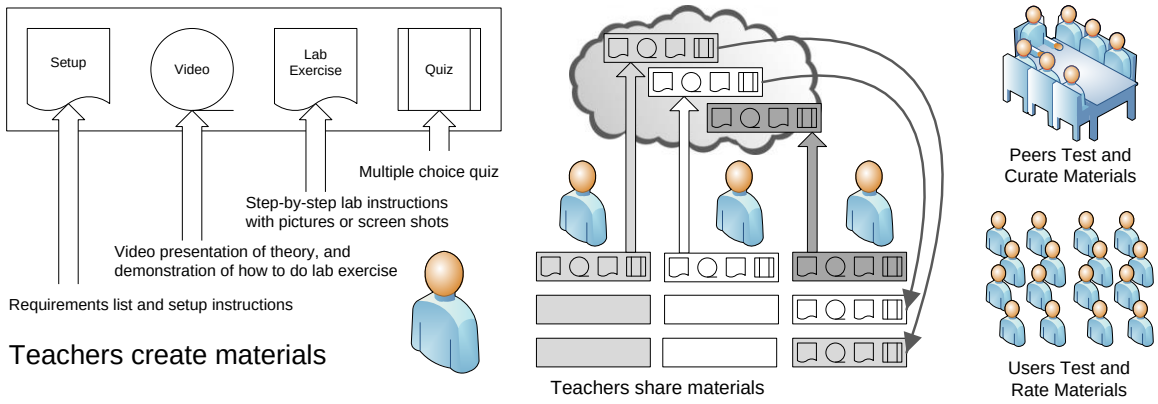

Figure 1. OSCAR diagram showing students (teachers) creating, sharing and evaluating course materials

Significance and Impact

Productivity: Computer science teachers must find ways to get more done in less time. A teacher with 28 lessons per course and 3 courses per semester must prepare 84 lessons per semester—a major time issue. If there are graded assignments for all 84 lessons, then grading becomes a time issue, too. For subjects whose material is static, after several years of service the teacher may not need to prepare lessons as often. But in fields where content changes frequently productivity must be accelerated. Working together, collaborative teaching, is one way to achieve this.

Personalized Instruction: Most people can point to teachers in their pasts who went out of their way to help them. This may be difficult for teachers who are overladen with lesson preparation and grading. Personalized feedback has been shown to be one of the top indicators of

improved student outcomes [11]. The proposed activity would be high-impact to the extent collaboration saves time and provides more time for one-on-one student feedback.

Timeline

The project will take one year to complete, from May 1, 2015 through April 30, 2016. Over the summer of 2015, two teacher groups will be identified, a test group and a control group. The control group need do nothing but report as it normally would. The test group will meet regularly (monthly) as time and budget permit.

Project Evaluation

The work will be evaluated using Slavich and Zimbardo's basic principles of transformational teaching [6]. The first, mastery, will be evaluated using 10-question quizzes standardized by the participants in the lesson incubator group. The second, skills for learning, will be evaluated using small projects which require students to solve previously unseen problems. The third, attitude, values and beliefs, will be evaluated using attendance (objective) and opinion surveys (subjective). The development of these materials is part of the project.

If successful, the project will be used as the basis for an NSF grant to disseminate more widely.

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Budget

Narrative: The budget is for mileage, refreshments for meetings, and printing and supplies. The latter may include website services to host the teacherati system.

Item	Qty	Rate	Subtotal
Mileage	2000 miles	0.50 / mile	$1000.00
Food	6 meetings	$500.00 / meeting	3000.00
Printing / Supplies	Est.	Est.	$1000.00
TOTAL			**$5000.00**