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Scaffolding to Improve Writing Skills in Computer Science Literacy Course

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Abstract: Writing has been recognized as an important skill in the technology field. This paper reports a study that uses a scaffolding approach to improve student writing skills in a computer science literacy course. While the quantitative results do not show a significant impact of scaffolding in individual paper assignment on the subsequent group wiki assignment, the student feedback in end-of-semester evaluations strongly indicated that scaffolding indeed helped improve their writing.

Introduction

Writing has been recognized as an important skill in the technology field. There is a strong need for students in the Information Technology (IT) and Computer Science (CS) programs to improve their disciplinary writing skills. IT and CS undergraduate students typically spend a lot of time studying a variety of technologies and programming languages in their upper-level courses. They are usually competent at writing programs in programming languages, creating databases, configuring networks, and designing websites. However, our past teaching experience revealed that many IT and CS students lack sufficient technical writing skills and often have difficulty in preparing written technical materials and writing user manuals. For example, they often abuse jargons or use technical terms improperly in their written reports. Due to a lack of practice in writing, we found that many IT and CS students also had difficulty expressing technology concepts and skills properly through their written assignments.

In an effort to address this issue, we used a scaffolding-based strategy to engage IT and CS upper-division undergraduate students in 300 and 400-level courses to improve their disciplinary writing skills. We use scaffolding to varying degrees in blogging, wiki, and research paper assignments.

Background

Scaffolding is support that helps students engage in and gain skill at tasks that are beyond their unassisted capabilities. Bruner (1978) describes scaffolding as:

... the steps taken to reduce the degrees of freedom taken in carrying out some task so that the child can concentrate on the difficult skill she is in the process of acquiring.

Scaffolding is typically expressed in the form of a step-by-step procedure and provides students hints through a stepwise process of how to solve problems, complete a task or develop new understandings. Scaffolding can help average students transfer elements of their pre-existing knowledge structures to solve a new and different problem (Jonassen, 2003; Vygotsky, 1978). Davis et al. (1993) suggest that novices need more scaffolded instruction to construct mental models and enhance understanding. Providing sufficient scaffolding enable students to relieve cognitive resources from the task of simply

solving the problem correctly and focus instead on reflecting on the problems thereby facilitating the development of deeper conceptual schema and allows learners to develop more advanced understanding (Kirschner et al., 2006).

A typical writing process consists of a few steps such as brainstorming, outline, initial draft, evaluation and final draft. Scaffolding can be used as a structured method to help teachers organize a writing activity and help students to develop skills for writing a cohesive paper. IT and CS students are known for their preference in working with emerging technologies (Zhang & Olfman, 2010; Hsu & Lin, 2008). Our literature review shows that few articles discuss how IT and CS programs in particular use technology and a scaffolding-based approach systemically to improve students' disciplinary writing skills.

Approach

For our experiment reported in this paper, we selected the computer science course 'Computers in Society' given to juniors (students in their 3rd year of study) open to all students at Old Dominion university. In the course students explore the impact computers have on society. Their assignments include writing a blog, creating a wiki collaboratively in groups, develop a presentation on a topic relevant to computers and society, and write a research paper on a topic of their choosing within the area covered by the course.

Students are assigned to groups and each group has a separate calendar that spreads out the assignments such that in any week different groups have different types of assignments due. Thus different groups will have different ordering of the due dates of the major assignments. Table 1 shows this ordering for the spring 2014 offering.

Table 1: Ordering of major assignments

Group	Assign. 1	Assign. 2	Assign. 3
1	Wiki	Blog *	Paper
2	Wiki	Blog *	Paper
3	Wiki	Blog *	Paper
4	Paper	Blog+	Wiki
5	Blog	Paper	Wiki
6	Paper	Blog *	Wiki

* Blog is overlapping with 1st week of Paper cycle
 + Blog is overlapping with 2nd week of Paper cycle

Criteria	Levels of Achievement	
	Satisfies Requirement	Mostly Satisfies Requirement
Introduction - Thesis is debatable and takes a stand	1 Points Satisfactory.	0.75 Points
Introduction - Thesis provides clues to the argument's development	1 Points Satisfactory.	0.75 Points
Body - Societal issue(s) addressed / opposing argument engaged	2 Points Satisfactory.	1.5 Points
Body - Development uses well defined assumptions and logical approach	2 Points Satisfactory.	1.5 Points
Body - Claims supported by evidence	2 Points Satisfactory.	1.5 Points One offer
Body - Supporting evidence is credible, factual and relevant	2 Points Satisfactory.	1.5 Points One offer

Figure 1: Part of rubric for research paper

The experiment was designed to provide scaffolding to support the learning of the students for writing the paper by constraining the process significantly. First, students have to select a thesis and an outline. We provide a 10-point checklist with questions such as: Is your thesis controversial? Is your thesis debatable? Is there plenty of evidence to support your thesis? Next we provide feedback on the thesis and outline. Besides the usual statements about grammar and style in the requirements document we provide a three page scaffolding rubric that describes in detail what the scorer is going to look for when grading the research paper. Figure 1 shows a part of this rubric. The other assignments simply listed the requirements and the score they would obtain. Our thesis is that students who go through the process of writing the paper with a significant scaffold first will improve their writing skill and thus score higher on wikis and blogs.

Statistical Analysis

We have collected data for CS300, “Computers in Society” class at the Old Dominion University during Fall 2013 and Spring 2014 semesters. Out of the 328 students, 157 students worked on group wiki before the scaffolded paper and had an average score of 13.10 in wiki assignment, 171 students worked on group wiki after the scaffolded paper assignment and had a slightly higher average score of 13.11 in wiki assignment. While the students who worked on the scaffolded paper first had a higher average score in the group wiki assignment, the score difference is not statistically according to a two-sample t-test (Table 2).

Table 2: Wiki scores before and after scaffolded paper

	<i>before Paper</i>	<i>after Paper</i>
Mean wiki score	13.09617834	13.10964912
Variance	2.740754532	2.924303406
Observations	157	171
Pooled Variance	2.836470202	
P(T<=t) one-tail	0.471178836	(not significant)

Conclusion and Future Work

While the quantitative results do not show a significant impact of scaffolding in individual paper assignment on the subsequent group wiki assignment, the student feedback in end-of-semester evaluations strongly indicated that scaffolding indeed helped improve their writing. We believe that group wiki quality depends on team work and does not measure individual writing skills reliably. In future semesters we will focus on studying the effect of paper scaffolding on blog quality, where both paper and blog are individual assignments. We will also try to increase the time window between paper and blog/wiki assignments to reduce the potential fatigue factor.

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