

Do open-ended assignments improve novices' learning?

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I am stealing the structure from Tammy, as she was the first person to post a research study. Thanks ☺

1. Introduction

In creating our Alice course, Wanda Dann and I have tended to use open-ended assignments rather than specific ones. What I mean by open-ended is something like: "Create a greeting card (a la www.bluemountain.com) that contains at least two methods called from the main. At least one of the methods must have a parameter, and this method is to be called twice, with different argument values." I have never used open-ended assignments before in introductory computer science, or really in any of my CS classes before. Certainly, using Alice makes this reasonably easy to accomplish. I am not sure that my CS1 students would get that excited about an assignment: "Create a program that includes two methods. At least one of the methods must have a parameter, and this method is to be called twice, with different argument values." However, I think that if some sort of graphics package/environment were available (something such as Dean Sander's Jeroo, Richard Rasala's Java Power Tools, Kim Bruce's event libraries, or perhaps something similar to what Mark Guzdial is doing in his media computation course), such a question would perhaps be reasonable.

As our materials (lectures, labs, etc.) are beginning to see wider usage, it seems that this open-ended question approach to assignments is our most controversial aspect of our work. Some folks have adopted our approach, while many others have stuck to more traditional specific assignments. The reason I am thinking about this now is that we are going to be running a series of workshops this summer to teach faculty at several varied colleges about Alice. As part of the workshop, we'll be encouraging them to participate in a fairly large study (details below) of the general results of using Alice in a couple of different environments. It seems to me to be reasonably easy to look at differences (between control and treatment groups, or just among treatment groups) between schools that choose to use open-ended assignments in Alice versus those who do not.

2. Related work

I haven't really done my homework for this yet. I recall a paper at ITiCSE 2003 by Parker and Becker examining different types of assignments. Eric Roberts had a paper in SIGCSE 2000 (2001???) that looked at using open-ended assignments in CS1, though I believe he did it as part of extra-credit. I am sure that there are many other CS educators who have looked at using open-ended assignments, but have not yet done a literature search for their work.

3. Research Questions

I guess the current version of my research question (which I am not exactly happy about) is phrased in my title: Do open-ended assignments in computer science improve student learning? I will specifically be looking at novices. I am expecting Alice to be used in 3 different types of courses, to 3 different audiences: 1) In an introductory course targeting computing majors, 2) In an introductory class targeting non-majors, and 3) as a problem-solving component of a computer literacy course, often taken as a general education course by non-majors.

I have to think about what I mean by “student learning”. I think it will be different across the three courses. Right now, I think I am more interested in the first two. There, I am considering learning to consist of concept mastery – how well students understand object-oriented programming concepts. As part of our studies, I’ll also be collecting data concerning changes in student attitudes, as well as getting transcripts of student and teacher interviews. I am guessing I can probably tease something out of these data, but haven’t yet thought a lot about it.

4. Evidence

I expect evidence to include the following:

- Time on task. Alice stores information about how long a world has been open. This is not a precise measurement. The reason is that a student can open an Alice world and then go to work on something else. However, I am not too concerned about this. There are two reasons: 1) when an Alice world is open, all of your other applications run much slower, so there is a certain disincentive for student to have an Alice world open when not working on it, and 2) if a student opens an Alice world, and then leaves the computer, the screen-saver causes Alice to crash, so again there is a disincentive for students to have opened an Alice world and not be working on it. This piece of evidence is a bit questionable – one would naturally expect students to work longer and harder on something in which they are more interested and/or invested.
- Student performance across pre and post concept tests. Is there a larger delta (or a larger delta relative to control sections) between those using open-ended questions and those not using them?
- Student self-efficacy. We’ll be collecting data concerning student attitudes towards computers and computing. Do things like confidence and the amount they like the subject change more for students using open-ended assignments?
- ????

Concerns:

I’d like to be able to look at use/non-use of open-ended questions across a single institution. But, in most cases, I expect Alice to be used in only a single section of a course. Or, when Alice is used in several sections, I expect all of the instructors to adopt the same policy concerning the approach to assignments.

As such, there are a lot of variables I won't be able to control for. Schools vary significantly in their makeup, and in the types of students they attract. I will likely not be able to find 2 identical schools except for their use/non-use of open-ended questions. Best for me is if different instructors at a given school choose differently towards using/not using open-ended questions. This is most likely to happen within computer literacy sections, the group I am least interested in studying.

Other variables will include students working individually versus those working in pairs versus those working in teams. Alice is likely to be used for different durations and at different times in the semester. And courses across institutions are likely not going to be closely matched.

5. Methods

6. Analysis procedures

7. Future Studies

References