DON'T WASTE STUDENT WORK: USING CLASSROOM ASSIGNMENTS TO CONTRIBUTE TO ONLINE RESOURCES

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ABSTRACT

Millions of hours are spent on assignments in university education every year. This exploratory paper describes ways in which instructors can create assignments that not only educate students, but also create lasting online contributions for use by scholars and future students. I describe case studies of assignment types I have used effectively: Paper Summaries, Contributions to Wikibooks, Creation of Mnemonics for a Wiki, Online Flash Cards, and Actual Research. Although formal study has yet to be conducted on these methods, in addition to making external contributions these assignments appear to have the benefits of higher motivation and greater exposure to scholarly research.

KEYWORDS

University, post-secondary education, productivity, motivation.

1. INTRODUCTION

As of 2011 there were 23.8 million college and graduate students in the United States alone (U.S. Census Bureau, 2012). Every year, these students work on millions of assignments, and instructors and teaching assistants spend millions of hours grading them. The vast majority of these assignments help the students learn, but do no good for anybody else. The *products* of these assignments are usually discarded. This is an enormous waste of resources. I argue that not only should assignments help students learn, but they should also benefit the wider educational and research communities.

In this short paper I will describe a number of assignment types I have introduced over the past years that I believe 1) facilitate learning, 2) are particularly motivating, and 3) contribute to the greater educational and research communities. Although this chapter will focus on my field, cognitive science and artificial intelligence, with some creativity most of the methods will translate to other fields in university education.

2. ASSIGNMENT TYPES

I will describe five project types that I have used effectively: Paper Summaries, Contributions to Wikibooks, Creation of Mnemonics for a Wiki, Online Flash Cards, and Actual Research.

2.1 Paper Summaries

For classes with fewer than forty students, I assign the creation of a paper summary. When they are turned in the summaries are graded, edited, and put on a website I maintain (Davies, 1999). The students must summarize a piece of scholarly work that has not yet been summarized on the website.

The summary is supposed to include the basic claims of the paper, and the evidence or arguments for those claims. The students are given a standard template to use so summaries include similar kinds of information. First is complete citation information, in two formats, the American Psychological Association (APA) and BibTeX (for users of the LaTeX typesetting language used in computer science and other technical fields.) This makes it easy for other researchers to copy and paste the reference into their own papers.

Next comes the name of the author of the summary, and his or her permanent email address. I tell my students that unless they say otherwise, their assignments will be put on the website, and if they don't want their names on it, I will publish the summary author name as "anonymous." Approximately 5% of students wish to be anonymous.

I also require the students to include a list of specific things one could cite the paper for. For example, in the summary (Davies, 2000) of Larry Barsalou's paper on Perceptual Symbol Systems, the statement "Amodal symbols are redundant if they just link to the percepts" is in the "cite this paper for" section. It is for claims, argument conclusions, original ideas, names of software systems reported, quotable wording, etc. The motivation for this is search: if you read a fact or claim but cannot remember where you read it, a web search for that fact might turn up the summary, allowing you to cite the paper.

Finally, there is the summary itself, which I allow the students to structure any way they see fit, except that I ask them to associate page numbers with statements, so that readers of the summary can easily find what's being summarized in the original paper.

Approximately 95% of the summaries I have collected in this manner have been of high enough quality to put on the site, mostly with only minor alterations—usually formatting.

This kind of assignment has several educational advantages. First, because students find their own paper to summarize, they get experience looking through journals, giving some idea of the state of the art. Second, they read several abstracts, and finally choose a paper they are really interested in, which is motivating. Third, they get exposure to real research, reading non-textbook science and understanding an actual scientific paper, which many second-year undergraduates, for example, have never done. Finally, knowing that their work will be on the web is further motivation to do a good job.

Since all fields have scholarly papers, this method applies to any discipline.

2.2 Wikibooks

The Wikimedia foundation, which manages the Wikipedia, also has a series of wikis called "Wikibooks," which are for the creation of free content textbooks that anyone can edit from a web browser. I require students in my artificial intelligence classes to write chapters or chapter sections for the Artificial Intelligence Wikibook (Wikimedia Foundation, 2009a). One year I assigned each student to write a piece about a search strategy that had not already been covered in the Wikibook. Perhaps, in ten years or so, the book will be sufficiently mature so that my AI students will not need to purchase a textbook at all.

As with the summaries, any field can use this method, contributing to (or starting) an online textbook.

2.3 Creation of Mnemonics for a Wiki

One of the most difficult parts of cognitive science education is the memorization of brain areas, in terms of location, name, and function. Most students learn these things through repetitive drilling of the information, rather than using mnemonics, which have proven to be very effective for memorization. Unfortunately, text books and teachers rarely give students mnemonics to use. Because creating mnemonics requires both knowledge of their effectiveness and a good amount of effort, they are rarely created by students on their own.

For each fact that needs to be memorized, however, the whole world only needs a single good mnemonic. The famous "Roy G. Biv" helps everyone remember the colors in the spectrum-- it is not that each person needs to create his or her own mnemonic for the colors.

This is the motivation behind the Brain Areas Mnemonics Wiki project (Davies, 2009). The wiki is a place where one can find mnemonics for remembering what brain areas are associated with what functions.

Students are required to look at the wiki and see which brain areas have not been addressed, find three unaddressed brain areas, and create mnemonics for remembering the functions in which those areas are implicated. They present these in class, and as a group we improve them before publishing them to the web. A class of 15 students will create 45 mnemonic devices in a single semester.

One student created a textual mnemonic for the association of the Basal Ganglia with motor control, cognition, emotions, and learning. The mnemonic was this: Imagine a person trying to **learn** to **dance**, unsuccessfully, next to a bee hive. The sudden **movements** make the **B**ee **G**ang (Basal Ganglia) **angry** and decide to attack.

Anyone can start a wiki, free, with Peanut Butter Wiki[1].

2.4 Online Flash Cards

Anki is a member of a family of programs that implement spaced learning in an electronic flash card format. Anki, the open source system I use, is a program designed to be used every day. The key point is that the software, rather than the user, decides which cards are to be reviewed each day. The software keeps track of which facts you got right and wrong to determine how long you should wait before reviewing that fact again. The idea is that the best time to review a fact is just before you're likely to forget it. So if you get a flash card correct, it might present it to you again in two days, and if you get it correct again it will present four days from then, then eight days, etc. The problem with traditional flash cards is that you waste a great deal of time reviewing flash cards you already know very well.

Certain domains require a good deal of memorization (e.g., medicine, biological sciences, foreign languages, law), and programs like this can be of enormous value. With Anki, users can create decks of cards and share them with other users. Any time one wants to remember a fact, one can type it into the program in a question and answer format.

In my assignment, I asked each student to pick one lecture from the class and to make a deck that covered all of the factual information from that lecture. In a single year all of my classes had on-line flash card decks for all lectures.

Like mnemonics, the flash cards only need to be created once for everyone to benefit. Anyone can download decks of cards to memorize the facts therein. After only two years of teaching and assigning the creation of cards, all the notes from lectures and readings were in flash card form for future students to use. Since creating Anki cards does not require any computer science-specific knowledge, this assignment can be used in any discipline.

A final benefit of this kind of assignment is that students are introduced to programs like Anki, which can help them in their schoolwork in general.

2.5 Actual Research

Finally, students can be assigned to conduct actual scientific research as a class assignment. The feasibility of this method varies greatly from discipline to discipline. In high-energy physics, for example, being able to do new scientific research requires years of graduate training and very expensive equipment. In contrast, for artificial intelligence it's relatively easy, since there are a great many problems that have *never* been addressed by anyone.

Any project that requires computer **programming** can be broken into assignment-sized chunks. This requires some software engineering and up-front planning by the course instructor, so that the assignment is well-defined in terms of the assigned code's input and output. But with careful planning, a large relatively large piece of software can be built gradually by students completing class assignments.

One downside to this is that since all of the students, or student groups, are doing different assignments (having them all do the same assignment wastes work), the grading is more challenging. On the other hand, the instructor can view such grading as doing research.

For several years in my artificial intelligence class, I gave an assignment to write a function to detect a spatial relationship between two objects in a photograph. Each student did a different relation (e.g., one did “above-below,” and another “occlusion.”) This work led to a publication (Smith et al., 2010).

[1] http://www.pbworks.com/

Not all fields require programming, nor do all students have programming knowledge. However, many fields have some kind of data collection that can be conducted with student assignments, and all fields can benefit from literature reviews, which I will describe next.

Students can be assigned to **write literature reviews** for topics that need them. However, writing literature reviews for some large topics can be too big a job for a class assignment. There are a few solutions to this.

First, papers can be written by groups of students. This will make some topics manageable.

Second, students can write first drafts of papers, at a high level of abstraction. For example, one can assign students to write a six-page paper that gives a very general overview of a complicated topic. This forces them to synthesize information and to be concise. Then, the next time the course is taught, an instructor can assign students to expand the paper into a 20-page paper with more detail. This new batch of students will have experience reviewing and re-writing other students' texts, which is also a valuable learning experience.

A downside to writing programs and literature reviews is that it's sometimes difficult to know ahead of time whether all of the assignments are of equal difficulty. Some software ends up being very complicated, and others nearly trivial. An instructor might assign a literature review on a topic for which there is very little published. One solution is to keep in touch with the student projects as they progress, and see if the work is too little. If it is, the instructor should step in and expand the assignment. I require my students to give an in-class oral proposal of their project before too long, by which time they are usually clear about what it will take to complete it. After watching the presentation, the instructor can recommend that they do the original project, plus this or that extension, or perhaps something smaller.

3. CONCLUSION

My teaching philosophy is to not waste student work. To this end I have devised a number of class projects that contribute not only to the education of the students who do them, but for the broader educational and scholarly communities. My hope is that other instructors will use similar methods in their own classrooms to promote this kind of indirect collaboration. Before the World Wide Web, there was no mechanism for sharing the products of student assignments. Now that anyone can publish online, there is no excuse for wasting the millions of hours our students spend working on class assignments.

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