

Probing Student Online Discussion Behavior with a Course Blog in Introductory Physics

Gintaras Duda and Katherine Garrett

Creighton University, 2500 California Plaza, Omaha NE 68178, USA

Abstract. Since fall of 2005 a course blog has been used in introductory physics courses at Creighton University to discuss real-world applications of physics and engage students in discussion and thinking outside of class. Specifically, the blog was created to address elements of the “hidden curriculum” that are difficult to cover in class, and a previous work showed that students who posted to and read the blog did not suffer a deterioration in attitude/expectations as seen elsewhere using the MPEX or CLASS instrument. Here we analyze the content of student posts to the blog along several dimensions: student interactivity, the introduction of new knowledge, application of knowledge to real-life situations or other disciplines, self-disclosure of prior knowledge, and fascination/interest. Students’ online discussion behavior is analyzed and compared to results on the FMCE (The Force and Motion Conceptual Evaluation) to determine if certain types of discussion behavior are correlated with student learning. We also present several interesting gender differences in students’ online discussion behaviors.

Keywords: Blogs, online discussions, evaluation of online discussions, asynchronous discussion
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INTRODUCTION

The “hidden curriculum”, a phrase first applied to physics by Redish et al., encompasses an appreciation of how physicists think and operate, the value of physics as it applies to other fields such as engineering, biology, medicine, etc., and the applicability of physics to everyday life [1]. Unfortunately, instruments such as the MPEX and CLASS in probing this “hidden curriculum” consistently measure substantial deterioration in students’ attitudes towards physics after instruction [1-2]. This is a concern to instructors on many levels, but most alarming is the fact that educational research has long shown a link between student attitude and learning. In response to this dilemma, a course blog was first introduced in an introductory physics class at Creighton University in fall 2005 primarily as a way of affecting student attitude and touching upon the elusive “hidden curriculum”. In a previous work [3] we found that a course blog, which primarily discussed real-world applications of physics and its applicability to other fields, helped significantly to combat this deterioration in attitude; students who read and posted to the blog maintained their initially positive attitudes about physics.

The goal of this current work is four-fold: (1) to examine the actual discussion behavior of students as

they post comments to a course blog using qualitative analysis tools, (2) to determine if blogs are indeed an effective way to increase student interactivity and move discussion outside the classroom as claimed by Ferdig and Trammel [4], (3) to determine if there is any correlation between certain types of discussion behavior on the blog and student learning as measured by the FMCE instrument [5], and (4) to use the blog as a probe for gender differences. Although it will not be possible at this stage to completely establish a causal relation between discussion behavior and learning, understanding the link between the two will allow us to identify successful student behavior to model for future students. Additionally, this work will serve as a bridge and necessary step between the first work on how a course blog can improve students’ attitudes towards physics and the ultimate goal which is a definitive exploration of the effect a course blog has on student learning.

BACKGROUND

There has been a great deal of interest in the recent literature in online discussions as a way of probing both student understanding and learning. For example, in the physics education literature Kortemeyer has studied student online discussions of homework problems using the LON-CAPA system, examining

both the nature of these online discussions and their correlation with standard assessment instruments [6]. Intriguingly, Kortemeyer found that online discussion was a better predictor of student learning than certain assessment instruments. In the broader education literature, chat boards and distance learning courses have received a great deal of attention (see [7] for an excellent review). However, there has been little work on the discussion behavior of students on blogs, particularly in physics and other sciences, or on the link between a course blog and learning. We hope this work will help address this deficiency as well as to help lay the foundation for further research into this topic.

THE COURSE BLOG: IMPLEMENTATION

Although a full explanation of the utilization of the course blog in introductory physics can be found in a previous work [3], we give a brief overview here for the sake of clarity. The course blog or weblog is basically an online journal which holds diary-like posts; students have the ability to comment on these posts and can see and respond to other students' comments. In terms of course implementation, the course instructor placed several posts (generally about 1 page in length) a week to the blog which dealt with real-world applications of the physics currently being studied in class. For example, a post about friction discussed how geckos are able to scale walls, and a post about electricity featured a YouTube video of lightning striking a car with a subsequent discussion of Faraday cages. Students received a few points of extra credit per week for (1) reading the posts to the course blog during the week and (2) for posting comments to one or more posts. The criteria for student comments were that they be a thoughtful and articulate reflection on the blog post, about a paragraph in length that tied in outside information relevant to the topic in question; the outside information usually resulted in additional research on the topic by students.

ANALYZING STUDENT COMMENTS

Student comments were evaluated in a thematic analysis using the technique of emergent coding [8]. This approach has the advantage of not limiting the analysis due to adopting any one theoretical framework; it also lets students speak through their own work while minimizing (though certainly not eliminating completely) instructor biases. After performing the emergent coding analysis we determined the relevant and most interesting

dimensions to be (1) the degree of student interactivity provided by the blog, (2) the introduction of new knowledge in posts by students, (3) how well students related the contents of the post to the course material, real-life, or other disciplines, (4) self-disclosure of prior knowledge or admission of learning, and (5) an expressed fascination/interest in the post or in physics in general. These themes were well matched with the learning objectives set for the course (particularly the blog). Table 1 shows the coding employed.

Each individual code was split into a + (high) and – (low) sub-category indicating degree; for example, if a student linked to new information from a website, their comment might be coded as a N- whereas a student who included both a comment and a cogent explanation might receive a N+. The introduction of new knowledge (N) and application of knowledge (L) categories were further subdivided in the coding process (e.g., internet, media, or print); however, these subdivisions proved unimportant in the overall analysis.

TABLE 1. Comment Thematic Analysis

Theme	Codes
Student Interaction	Q: Student asked a question A: Student answered another student's question P: Student refers to/builds off of another comment
Introduction of New Knowledge	N: New knowledge added from the internet, media, or other sources
Application of Knowledge	L: Comment ties to lecture material, real-life situation, or physical concept
Self-Disclosure of Knowledge	SD: Student indicates prior Knowledge
Interest/Fascination	I: Interest in the post/physics

DATA ANALYSIS AND RESULTS

Student blog comments were analyzed and coded for three semesters: fall 2005, 2006, and 2007. Since the enrollment in introductory physics at Creighton is typically 130 students per semester (and not all chose to participate in the blog), we have grouped the three semesters in our data analysis to increase our statistics and to be able to probe gender effects. Student comments to the blog in spring semesters were not included due to subtle differences between fall and spring semesters. We also excluded from our analysis students who posted on the blog five or fewer times over a semester. Table 2 below gives the total number of students and student comments per semester with the corresponding totals.

TABLE 2. Number of Students and Comments

Semester	Students	Comments
Fall 2005		
Males	9	86
Females	34	349
Fall 2006		
Males	22	217
Females	35	348
Fall 2007		
Males	19	194
Females	27	254
Total	146	1448

Table 3 below gives the results of our thematic analysis of student blog comments for each coding category, both in number of occurrences and as a percentage of all posts (percentages do not add up to 100% since a post can have multiples codes).

TABLE 3. Classification of Student Comments

Theme	Number of Posts	% of Total Posts
Student Interaction: Total	385	27
N+	261	18
N-	163	11
New Knowledge: Total	424	29
L+	78	5
L-	139	10
Application: Total	217	15
SD+	52	4
SD-	302	21
Self-Disclosure: Total	354	24
Interest/Fascination: Total	629	43

In examining the actual discussion behavior of students on the blog, we were gratified to see several types of behavior. Students overwhelmingly expressed interest in the blog posts and in the physics presented (43% of the total number of posts). Students were also quite free in admitting how little they knew about various topics and how much they learned from reading the blog; in a sense, this admission is a strong qualitative measure of student learning. The blog also provided students an opportunity to interact outside of class; 27% of posts involved some form of student interaction, interaction that probably wouldn't have occurred without the blog. In commenting on the blog, students also searched for, processed, and explained new knowledge; 29% of comments involved material that students added to the conversation.

One interesting facet of student discussion behavior is the lack of comments that fall into the application of new knowledge category. We know from educational research that applying knowledge is inherently a more difficult task for students (for example, it sits higher on Bloom's taxonomy [9]). However, this was a particularly important learning outcome for the blog; we hoped that students would see physics acting in the

real-world and be able to apply it to new phenomenon and other disciplines.

We also investigated whether particular student commenting behaviors were positively correlated with gains on the FMCE exam (which we consider to be an independent measure of student learning in the fall semester). We find that discussion behaviors on the whole were correlated very weakly or not at all with student performance on the FMCE. A lack of a strong correlation here is not surprising; the blog dealt with real-world examples of physics and the FMCE is a highly conceptual examination. In contrast, Kortemeyer found a strong correlation between online discussions and performance on the FCI [6]; however, these discussion revolved around physics concepts and problem solving, unlike the discussion we analyze here. This leads us to consider the creation of a new assessment instrument which probes students' understanding of the real-world applications of physics; this new instrument might be a better measure of the blog's impact on this type of student learning.

However, certain types of discussion behaviors showed an interesting link with gains on the FMCE.

Table 4. Correlation between discussion behavior and gains on the FMCE

Type of Comments	Correlation Coefficient R	95% C.L. Interval
New Knowledge (N+)	0.16	0 to 0.3
Application (L+)	0.18	0.02 to 0.33

As can be seen above in Table 4, students whose comments showed the acquisition of new knowledge or knowledge which was applied to course material, real-life or other disciplines (and as the + indicates, also took the time to explain their findings to other students) tended to have higher gains on the FMCE. A word of caution: this correlation is weak and of course does not demonstrate a causal link; however, it does point out a way in which the blog might be used to affect student learning more concretely. This is particularly crucial in light of the lack of student application-type comments. Ways to encourage and help students synthesize the material to write application-type comments (modeling for students, providing examples, structuring the blog towards this end, etc.) will be considered for future implementations of the blog.

GENDER DIFFERENCES

In analyzing student blog comments we noticed several interesting gender differences. The most obvious was that more female students chose to

participate in the blog; 60% of female students commented more than five times to the blog, whereas only 38% of males did so. At the end of the academic year, students who read the blog filled out a brief questionnaire about their blog experience; questions dealt with how valuable students found the blog was to their overall learning experience in the course (the full survey is given as Table VI in [3]). Female students responded much more favorably on these survey items, as shown in Figure 1; favorable female responses outweighed favorable male responses 63% to 44%.

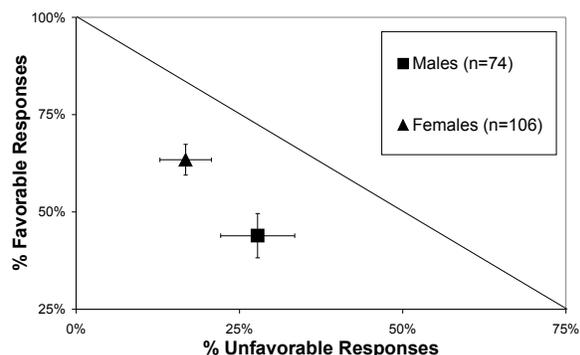


Figure 1. Student agree-disagree values for questions relating to the blog (error bars are computed as in Ref. [1]).

Male and female students also displayed differences in the nature of their comments. Male students were much more likely to share newly obtained outside information and female students more often expressed an interest in the posts' contents as well as personal knowledge or ignorance. Also, gains on the FMCE for male students (n=50) were correlated more strongly with their posting behavior; $R = 0.28$ ($.02 \rightarrow 0.50$ at 95% C.L.) for application type posts. It is interesting to note that female students had no correlations between discussion behavior and FMCE gains despite the fact that they claimed that the blog contributed to their learning at a higher level.

But perhaps the most intriguing gender difference lies in the students' normalized gains on the FMCE. On average, males had significantly higher gains than females (males: 0.65, females: 0.54 with $p < 0.05$) for roughly 300 students. This gender gap has of course been reported before. However, when splitting the students based on blog participation, females and males who blogged no longer had a statistically significant difference in their average gains as can be seen in Table 5. This effect could be due to a number of different factors. Student self-selection, however, does not appear to be significant since blog participation has been shown to be very weakly

correlated with overall course grade; "A" students and "C" students participate in roughly equal numbers [3]. Thus a blog may be a useful tool in reducing the gender gap in physics classroom, and deserves further study.

TABLE 5. Gender differences in assessment gains

Students	Normalized gain	p-value
Non-blogging		
Males (n=82)	0.669	< 0.05 (significant)
Females (n=63)	0.493	
Blogging		
Males (n=50)	0.629	0.165
Females (n=96)	0.564	(not significant)

CONCLUSIONS

A qualitative analysis of student comments on a course blog has shown that a blog is an excellent tool for increasing student interactivity and the acquisition of new knowledge outside of class. Although most forms of commenting behavior were shown to have weak or non-existent correlation with gains on the FMCE, posting new knowledge or applying new knowledge outside of physics seemed to help increase student learning; this points to ways in which the blog might be refined in the future to more directly impact learning. In terms of gender differences, female students felt the blog impacted their learning more so than males, and female students who "blogged" showed equivalent gains on the FMCE as compared to their male classmates.

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