Gender differences in the effectiveness of Google Forms in class

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ABSTRACT

A classroom response system (CRS) involves the use of remote devices allowing all students in a class to respond to questions displayed on a projection screen. A CRS instantly collects, tallies, and shows students' answers to a question on a classroom projection screen—a similar system used in the TV show "*Who wants to be a millionaire*" to collect audience responses. In this paper, the author proposed a comparable technology—Google Forms—that can be used in a computer lab and then studied gender differences in the relationship between the use of Google Forms and performance changes. Performance was measured by both the letter grades distribution and raw exam scores. The initial results suggested that the use of Google Form did not make any difference in the performances measured by the letter grades distribution. However, when the raw exam scores were compared with a covariate of calculus grades, the results suggest that the use of Google Forms resulted in improved performance. Further, the performance improvement of male students was greater than that of female students. Discussions and areas for future research are also presented.

Keywords: classroom response system, gender, performance, calculus, ANCOVA, Google Forms

INTRODUCTION

To improve student learning, various technologies have been developed and used in colleges and universities, from overhead projectors, to LCD projectors, online testing, and classroom response systems (CRS) (MacGeorge et al., 2007). In a CRS, students respond to questions posed by an instructor using a handheld device known as a clicker. Input capability of a typical clicker is very limited—only a few buttons representing letters (e.g., A through E) (Hanley & Jackson, 2006). As a result, the questions used in a CRS are mostly limited to true-false or multiple choice questions. A CRS instantly collects, tallies, and shows students' answers to a question on a classroom projection screen—a similar system used in the TV show "*Who wants to be a millionaire*" to collect audience responses (Caldwell, 2007).

Benefits of using a CRS in classes are well documented in academic research (See, for example, d' Inverno, Davis, & White, 2003; Hatch, Jensen, & Moore, 2005; Wood, 2004). One important benefit of using a CRS is that it makes a class interactive with longer sustained attention from students and thereby motivates students to participate in class discussion (Stowell & Nelson, 2007) and activates students' thinking (Collins, 2007). Through interactive sessions by using such a system, instructors can gauge students' understanding of materials during class and provide prompt feedback (Caldwell, 2007; Martyn, 2007; Trees & Jackson, 2007). These benefits of a CRS are also related to five of Chickering and Gamson's (1987) seven principles for good practice in undergraduate education: active learning, prompt feedback, student-faculty communication, and cooperation among students. The recent popularity of a CRS, or clickers, in college classrooms is then at least partly due to these reported benefits.

In this study, the author proposes a computer technology—Google Forms—that may supplant a CRS in a computer lab. Therefore, Google Forms, like a CRS, can be used in class to aid students' learning and to promote a more interactive classroom environment. Google Forms is a free service from Google, which emulates an on-line survey system. It supports various types of questions: text, paragraph, multiple choice, choose from a list, checkboxes, scale, and grid. A text type is used for short text answer questions and a paragraph type for longer text answer (or essay) questions. In both types, respondents can type any text they want, unlike a typical CRS. Multiple choice and choose from a list are for questions in which respondents are allowed to choose only one item as their answer. A checkboxes type, on the other hand, allows respondents to choose more than one item. Scale and grid types are for Likert-scale questions. By using one or more question types, instructors can make a set of questions which are then posted on webpages. Students access these webpages using their computer workstations in a lab classroom. They choose or type their answers using a keyboard and mouse. This process is similar to that of filling out on-line questionnaires.

Many reported benefits associated with the use of a CRS are often based on the students' perception. However, such perceived benefits may not always be realized as performance improvement, including higher exam scores (Draper & Brown, 2004; Judson & Sawada, 2002). King and Josh (2008) studied students' performance on exams. They found that active participation in the clicker response questioning often led to better performance, and the effect was stronger for male students. They also found that female students used clickers more actively. On the contrary, Morgan (2008) found the use of clicker neither improved the grade distribution nor lowered the attrition rate (i.e., percentage of students who dropped the course). In fact, the grades of the classes using clickers were worse than those of the classes not using clickers even though the difference was not statistically significant.

These findings suggest that, while the incorporation of Google Forms or clickers creates an opportunity for all students to participate actively in the learning process, there is no guarantee every student will benefit from the technology. Many studies pointed out gender difference in utilizing classroom technologies (Enoch & Soker, 2006; Joanna L., 1999; Kang, Lundeberg, Wolter, delMas, & Herreid, 2011; Robin H., 2009; Sullivan, 2001). For example, Enoch and Soker (2006) found male college students are more comfortable with online course components. Further, gender difference may exist in certain disciplines regardless of technologies used. For example, female students often perform worse than their male counterparts in the STEM (science, technology, engineering, and math) disciplines (Coley, 2001; Kahl, Fleming, & Malone, 1982; Zerega, Haertel, Tsai, & Walberg, 1986). However, there are other studies reporting no significant gender difference in STEM disciplines (Becker & Chang, 1986; Shepardson & Pizzini, 1994).

The goals of this paper are two folds. The first is to introduce Google Forms and to explain its use in class. The second and the main focus is to investigate the effectiveness of Google Forms by genders to see if its use follows a similar pattern to previous clicker research.

METHODOLOGY

The author has been teaching business statistics in a computer lab at an AACSB accredited business school in the southeast US. To promote an interactive class, he introduced Google Forms to his class in spring 2010. Class began with a lecture of about 10 to 15 minutes. During the lecture, main concepts of that day's class were briefly covered along with some example questions. For instance, the definitions of mean, median, and mode were explained. Then, using textbook examples, the instructor explained how to calculate such measures by using Excel. After the lecture, students were asked to access the webpage containing relevant Google Forms questions and to work on them individually or with their immediate neighbors as a group. Once students submitted their answers, the classroom projection screen showed their answers, which the instructor discussed. After discussion of the answers, the instructor moved to another topic and started a new cycle. That is, he lectured new topics for 10 to 15 minutes, asked students to answer the Google Forms questions, and discussed the their answers. More detailed description of how the author used Google Forms can be found in _____[1].

Data were collected from 81 students who registered for business statistics courses in fall 2009 (F09) and spring 2010 (S10). There were two regular (i.e., non-online) sections in each semester. Google Forms was not used in class in F09, but was implemented in S10. Of the 81 students, seven students withdrew from the courses. The numbers of male and female students per semester are shown in Table 1(The numbers in the parentheses are the number of students who withdrew from the course.).

The business statistics at the author's institution requires a calculus course as a prerequisite. That is, all students in the sample had taken a calculus course and passed with a grade of C or better before they registered for the business statistics course. As a control variable, the mean grade points[2] for the calculus course for all student (i.e., ignoring the gender) were compared between semesters (see Table 2), and there was no significant difference ($t = 0.3063$, $df = 79$, $p = 0.6199$). Further, the mean grade point of female students in F09 was compared with

[1] Self-citation. Omitted for review
[2] A = 4, B = 3, C = 2

that of female students in S10, and no significant difference was found (t = -0.4926, df = 28, p = 0.3131). Similarly the mean grade point of male students in F09 was compared with that of male students in S10, and again no significant difference was found (t = 0.9784, df = 49, p = 0.8337).

To determine the effectiveness of Google Forms in the statistics class, distributions of the letter grades earned by students in F09 and S10 were compared. The grade distributions are shown in Table 3. At first glance, the grade distribution of S10 appeared to be worse than that of F09 as fewer A's and more C's were given in S10. The chi-square test revealed, however, that there was no significant difference (χ^2 = 4.06, df = 5, p = 0.54). Additionally, the grade distributions of the two semesters were compared by gender. Neither female nor male students showed significant differences between F09 and S10 (female: χ^2 = 5.28, df = 5, p = 0.38; male: χ^2 = 4.95, df = 5, p = 0.42) .

Even though Google Forms was used throughout in S10, it was utilized most heavily on the materials for the second exam (henceforth, the exam), which covered probability and probability distributions. According to the raw scores, this exam was the most difficult exam among all exams in author's statistics class.[3] Among the 81 students, 77 students (95%) took the exam.

The mean scores on the exam for both male and female students are shown in Table 4. When the overall mean score of F09 and that of S10 was compared, there was no significant difference (t = -0.5492, df = 75, p=0.2923) even though the mean score of S10 was slightly higher than that of F09. This suggests that Google Forms did not improve the students' exam score significantly when both genders were combined.

To assess whether or not there was a gender effect, a general linear model (GLM) was run with the exam score as the dependent variable. A calculus grade point was used as a covariate. Independent variables were gender (0 = female, 1 = male), semester (0 = Fall 09, 1 = Spring 10), and their interaction. The model is shown below:

$$\text{Exam 2 score} = \beta_0 + \beta_1\text{Calculus} + \beta_2\text{Gender} + \beta_3\text{Semester} + \beta_4\text{Gender}\times\text{Semester} + \varepsilon$$

The analysis revealed that the calculus grade was positively related with the exam score (β_1 = 5.642, p = .004). It also showed that the interaction between gender and semester (i.e., Google Forms) was significant (p = .031). The graph in Figure 1 shows that Google Forms is more effective for male students, which means the simple effect of Google Forms was greater for male students. Note that without controlling for the prerequisite calculus grades, the mean scores on the exam for female students, as shown in

Table 4, indicated that Google Forms actually worsened female students' score in S10. However, when the exam scores were controlled for the calculus grades, female students' grades were higher in S10 with Google Forms (Figure 1).

The significant main effect of semester (i.e., Google Forms) indicated that the mean exam scores of S10 was greater than that of F09 when the gender was ignored and the scores were controlled for the calculus grade. Therefore, the analysis suggests that Google Forms is effective overall, and its effectiveness is higher for male students.

[3] The final exam was not cumulative.

DISCUSSION

The purpose of this study was to examine gender differences in the relationship between the use of Google Forms and performance improvement. The present study suggests that the students' performance was better when Google Forms was used. This result is encouraging in that Google Forms can be a zero cost replacement for a CRS if a class is taught in a computer lab. Its positive effect on the performance, however, was not initially obvious.

When the grades for courses (Table 3) were compared between the two semesters, there was no significant difference. That is, the use of Google Forms did not result in the performance improvement as measured by grade distribution. Further, there was no significant gender effect. However, it should be noted that the letter grades for the course can be influenced by non-objective factors, such as curving and class participation score.

To minimize the effect of such non-objective factors on the study, non-curved scores of the exam were compared between the two semesters. The results of the GLM analysis with gender and calculus grades suggested that the effect of Google Forms was positive, that is, it increased the students' performance. More data are needed to determine, however, if this result is applicable to other student populations or to other courses.

An interesting finding of this study is that Google Forms helped male students more than female students. Even though the reason for this is not clear, one may speculate that such a discrepancy is at least partly due to the nature of the statistics course. There are many studies that point out male students perform better than female students in the STEM disciplines (Coley, 2001; Kahl et al., 1982; Zerega et al., 1986). There are some findings in the literature indicating that male students may be able to take advantage of classroom technology, such as Google Forms, better than female students (King & Joshi, 2008). Further, male students may have perceived the usefulness of a CRS, such as Google Forms, more than female students (Kay, 2009).

However, the lesser effect of Google Forms for female students found in the current study may be simply from poor participation or adoption from female students, which cannot be tested since the current study did not collect the information on the frequency of usage of Google Forms by gender. King and Josh (2008), who studied the effectiveness of clickers, also found similar results and determined the positive relationship between active participation and improved performance was stronger for male students than for female students.

In adopting information technology, the gender difference has been investigated and found to be significant in many studies. For example, Venkatesh and his colleagues (2003) found the positive effect of perceived usefulness of the information technology on intention to adopt is moderated by gender and the effect is greater for male; and the positive effect of perceived ease of use of the information technology on intention to adopt is also moderated by gender and the effect is greater for female. If the female students participated less frequently in the current study, it could be due the perceived difficulty of use of Google Form. To test such a claim, the future studies should investigate whether or not female students are less likely to adopt Google Forms than male students through the lens of other theories, such as the technology adoption model.

Another avenue for future study is to investigate the use of Google Forms in online courses and its effectiveness—especially because comparable technologies are few in online classrooms. Google Forms utilizes webpages to post questions and they can be accessed as long as there is a computer device, including smartphones and tablets, with Internet access. One

student in the author's class commented, "The best part of this technology was that it was available from home or school or any remote place." Since instructors cannot monitor students in online classrooms as well as in regular classrooms, they often rely heavily on various out-of-class assignments to ensure that students follow class materials. Such many assignments can be a burden to students as well as to an instructor. Comparison between an on-line course with and without Google Forms can provide an insight on whether one can reduce the number of assignment, if desired, without hurting student performance.

TABLES AND FIGURES

Table 1. Sample demographics by semester and gender

	Female	Male	Total
Fall 2009	12 (1)	25 (1)	37 (2)
Spring 2010	18 (2)	26 (3)	44 (5)
Total	30 (3)	51 (4)	81 (7)

Table 2. Mean grade point of the pre-requisite calculus course on a 4.0 scale

	Female	Male	Overall
Fall 2009	2.75	2.72	2.73
Spring 2010	2.89	2.54	2.68

Table 3. Grade distribution of the sample

Grades	Gender	A	B	C	D	F	W	Total
Fall 2009	Female	4	3	3	1	0	0	11
	Male	4	11	7	1	1	1	25
	Total	8	14	10	2	1	2	37
Spring 2010	Female	1	8	3	3	1	1	17
	Male	3	6	14	0	0	0	24
	Total	4	14	17	3	1	5	44

Table 4. Mean scores on the exam

	Female	**Male**	**Overall**
Fall 2009	67.2	61.0	62.9
Spring 2010	61.3	67.1	64.7

Table 5. General linear model analysis output

Source	Type III SS	df	Mean Square	F	P-value
Corrected Model	5787.422	4	1446.855	11.082	.000
Intercept	7117.999	1	7117.999	54.520	.000
Calculus	1132.515	1	1132.515	8.674	.004
Gender	61.614	1	61.614	.472	.494
Semester	3138.073	1	3138.073	24.036	**.000**
Gender × Semester	643.481	1	631.481	4.837	**.031**
Error	9400.169	72	130.558		
Total	257369.444	77			
Correct Total	15187.590	76			

R^2 = .381

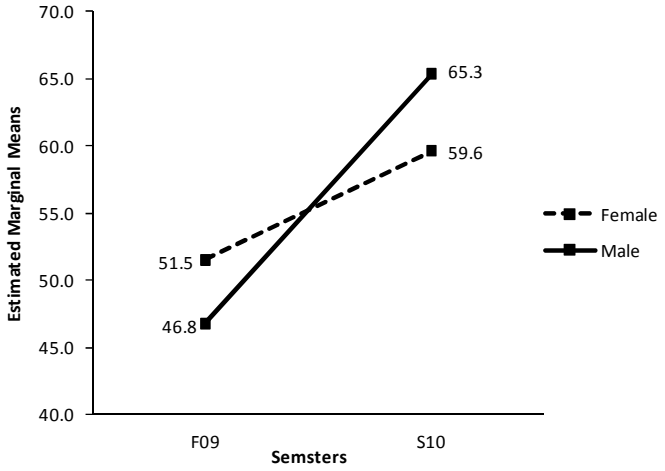

Figure 1. Estimated marginal means of exam 2

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