Factors Influencing Students' Success in an Online Statistics Course at College-level

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Abstract

Studies about students' performance in a class are very important to an instructor, as it provides a developmental input. Quantitative studies to investigate students' performance are hindered by the lack of statistical procedures, when the asymptotic results are inapplicable. In this qualitative research study, the purpose was to evaluate certain characteristics that could impact on students' performance in an online statistics course. Seven characteristics were selected for this investigation. Due to the small size (N=25) of the online class, an alternative statistical procedure for multiple regressions has been utilized in this study. According to the results, students' gender, prior knowledge in statistics, time gap (in terms of semesters) between the last mathematics class and the online statistics class, and the number of hours (per week) that the students studied for the course have shown significant influences on their performance. While female students demonstrate a better performance than their counterparts, ethnicity of the student also has become a deciding factor as far as the students' success in the online statistics course is concerned.

Introduction

During the recent past years, the rate of the introduction of online courses has increased rapidly (Armstrong, 2011; Allen and Seaman, 2008). There are several reasons for this as the literature indicates. According to the study of Hannay & Newvine (2006), students have largely preferred online courses as they have helped them to balance their other commitments. As Wheatley and Greer (1995) mentioned, cutting down of both the travel-time and the overhead cost of faculty are two of the most important benefits of online education. With the rise of technology, research in the area of online education is leading toward the improvement of the quality of education. Wagner et. al (2011) claimed that online students perform as well as the traditional students do, if they are given proper materials.

As statistics instructors of online classes, we always attempt to enhance the quality of the course. Therefore, research activities that are allied to students' success in online classes are vital. Dell et. al (2010) stated that the methods of instruction play a major role than the delivery platform in online teaching. Graff (2003) reported that the students of online classes have different learning styles and expect the convenience provided by the course. According to the study of Ashong et. al (2012), the gender and the ethnicity influence students' success in online learning. In the literature, research findings show that the African-American students prefer frequent oral communication especially face-to-face instead of online (Merrills, 2010; Ashong et. al, 2012). In the study of Gosmire

et al. (2009), authors mentioned that if the learners have a greater prior exposure to technology, they are more satisfied with the course and consequently, learners' comfort with the course increases. Haverila (2011) found that a student's prior E-learning experience has a significant influence on perceived learning outcomes. As Li and Edmonds (2005) revealed, the older students have navigational issues with online materials. As a remedy, above authors suggest an easy to understand segments in multiple modes in a user friendly manner so that the older student can navigate quite easily. Erickson and Noonan (2010) reported that main barriers for late-career adults to succeed in online education are the technology and digital interaction, and once they have the hands on experience, the authors argued that the above elderly students perform equally or better than younger peers. In their studies, Johnson (2011); Rovai and Baker (2005); and González-Gómez et. al (2012) found that girls are more comfortable in online classes than the boys.

Due to the students' negative attitudes toward the subject, Neumann et. al (2009) considered statistics as one of the most challenging subjects across any level of education. Therefore, the role of the statistics teacher is further important to create a positive mindset within students. Ramsey (1999) believed that statistics cannot be taught in the same way as other subjects are taught. When online statistics classes are considered, the instructor has a tremendous responsibility to deliver students a successful online experience in statistics. Moore (1993) identified one of the three forms of interaction for effective online courses. They are the interaction between the learner and the content, learner and the instructor, and finally leaner to learner interaction. In their research, Johnson and Kuennen (2006) found out that students' mathematical skills have a relationship with their success in an introductory statistics courses. As Ashong et. al (2012) suggested, student's success in an online course depends on demographics factors such as age, gender, and ethnicity.

Therefore, the purpose of this study was to identify the influential factors in students' success in an online statistics course at college level. Factors such as gender, prior experience in statistics, prior online experience, time gap between the last mathematics course and the current statistics course, whether the student was employed during the online course, and the number of hours that the student studied were considered in this study. As the author believes, this study is a unique one as it utilized an alternative technique (Bai and Pan, 2009) for multiple regressions to analyze the observed data.]

Description about the Data

Statistical Methods-I is an undergraduate level course taught in the University of Eastern New Mexico. In each semester, this course is offered both in face-to-face and online formats by the department of Mathematical Sciences. Students of Accounting, Biology, Communicative Disorders, Information Systems, Mathematics, Psychology and Sociology majors typically enroll for this course. This investigation was carried out in summer 2013, and in the same semester this online statistics class was taught by the author. All the class

assignments, homework, and the two exams were administered through "MyStatLab™" online system. The final examination was conducted as a face-to-face one. Students of this online class voluntarily participated to this study. Initially, there were 34 students in the class, but only 25 students agreed to take part in the study. Table 1 shows the description of the collected data.

Table 1. Description of Data (N =25)

Variable	Mean	SD	Coding System
Final	77.05	16.44	
Gender	0.38	0.49	0-Female, 1-Male
Age	29.29	9.48	
Ethnicity	0.38	0.49	1-White, 2-Hispanic, 3-Other
Online_Exp	0.75	0.10	0-No, 1-Yes
Stat_Exp	0.75	0.09	0-No, 1-Yes
Last_Math	2.52	1.53	
Employed	0.58	0.50	0-No, 1-Yes

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According to the table 1, average value of final grade (Final) was 77.05 (SD=16.44). In this class, 38% were male students and the average age of the students was about 29 (SD=9.48). The distribution of the student's ethnicity was as 44% white students, 38% Hispanic, 20% other and there were no African American students. Though 75% of the students did not have prior experience in an online course, about 25% of them had prior experience in statistics. On average, students had taken their last mathematics course about 2 and half semesters ago (SD=1.53). According to the gathered data, about 58% of the students were employed during the time that they were taking the course.

Methodology

Asymptotic statistical theories do not provide satisfactory results in small sample inferences. By considering both sample size and the number of explanatory variables, the applicability of multiple regression technique to

assess the performance of students is anecdotal. Several issues regarding the application of multiple regressions in small samples were discussed by Bai and Pan (2009) and Allison (1999). Due to these issues, an alternative method was proposed by Bai and Pan (2009). This novel approach, which was based on the kernel re-sampling technique, was applied in this study. This method can be summarized as follows.

- Let $Y_1, Y_2, \ldots, Y_n$ be a small size data set from a *d*-dimensional space, where *d* is the number of variables.
- Then a sample $Y_1^*, Y_2^*, \ldots\ldots, Y_n^*$ is generated from a Gaussian kernel, $GK_i = N_d(Y_i, H_o^2),\ i = 1, 2, \ldots, n.$

  Here, $H_o = \left[4/d+2\right]^{1/d+4} \Sigma^{1/2} n^{-1/(d+4)}$ and Σ is the covariance matrix.
- After generating the above sample, multiple regressions is applied over $Y_1^*, Y_2^*, \ldots\ldots, Y_n^*$. This generation of sample and the application of multivariate regression are repeated for *k*=200 times.
- Finally, the sampling distributions of the outcomes of the multiple regressions are evaluated.

Above procedure was implemented using a program written by the author using Matlab 7.0 ®. When investigating the impact of student's ethnicity on his or her performance in the online class, non-parametric statistic procedure (Kruskal-Wallis) was used.

Results and Discussion

As the table 2 indicates, student's performance in the statistics course has depended on the gender (β=31.51, t=4.04). Students' prior experience in statistics (β =5.81, t=2.70) also has made a positive impact on their success. In addition, the time gap (number of semesters) between summer 2013 and the semester that they took their last mathematics course, has negatively influenced their performance (β =-10.14, t=-2.59). As expected, the number of hours they studied (β =1.95, t=-5.93) during the course has significantly influenced their performance. Students' employment during the semester, in which they took the course, has shown an unexpected result. According to the results, the employment during this course has not significantly influenced on their performance. According to the figure 1, female students have performed better than their counterparts. This gender effect has not been hampered by the influence from student's ethnic group. As the Kruskal-Wallis test resulted, the performance of the students of three ethnicity groups have shown divergent performances ($p<0.05$). This dissimilar performance is displayed by the figure 1. As it shows, students of ethnic group "other", have performed better than the students of white and Hispanic ethnic groups. The performances of Hispanic students have become the lowest among all the three ethnic groups.

Table 2. Description of Data (N =25)

Independent Variable	Coefficient	SE Coefficient	T
Constant	15.39	16.76	0.92
Gender	31.51	7.80	4.04 **
Stat_Exp	5.81	2.15	2.70 *
Online_Exp	8.17	8.46	0.97
Last_Math	-10.14	3.92	-2.59 *
Employed	9.72	8.03	1.21
Hours_Studied	1.95	0.33	5.93 **

$p^{*}<0.05$, $p^{**}<0.01$

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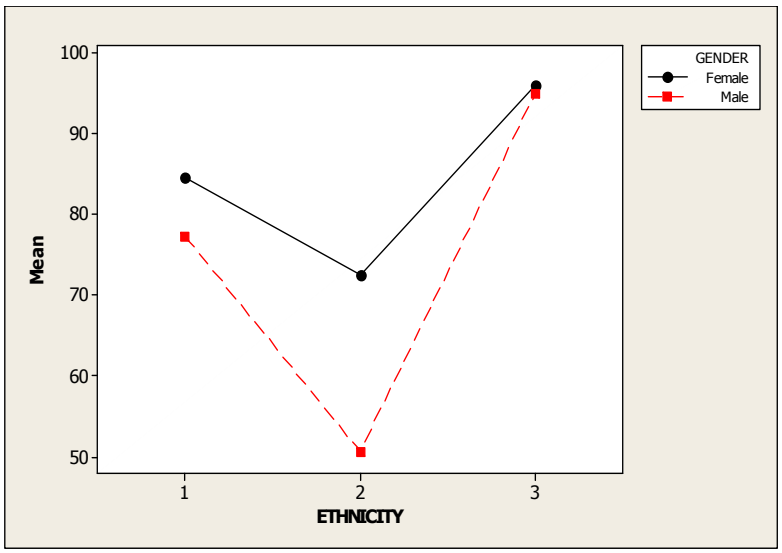
Conclusion

In this study, the performance of students in online statistics class was investigated. According to the outcomes of the study, student's gender, the prior experience in statistics, time since the students took their final mathematics course, and the number of hours they studied during the course have significantly influenced their performances in the course. When the students' gender and the ethnicity were considered, it was clear that female students have performed better than the male students regardless of their ethnicity. As far as the ethnicity was concerned, Hispanic students' performance has become the lowest.

Figure 1: Ethnicity (1-white, 2-hispanic, 3-other) and gender (solid line-female, dash line-male) on student's performance



Out of all the three ethnic groups, the best students' performance has shown by the "other" group. Surprisingly, student's performance was not affected by the fact that the student being an employee during the course. Though we expected a contradictory result with the relationship between students' employment and the students' performance, this outcome has justified the findings in the literature. Hannay & Newvine (2006) have stated that students of online classes have a wonderful opportunity to balance their other commitments so that they do not fall behind in the class unlike in face to face classes.

In the future, it would be interesting to compare these results with a face-to-face class taught by the same instructor. It is also expected to consider some additional factors such as the types of mathematics course they have taken as the last mathematics course, high school grade point average (GPA), and the relevance of statistics to their personal life in a similar prospective study.

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