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MEASURING LEARNERS' SUBJECT SPECIFIC KNOWLEDGE

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This was the second phase in a research project designed to compare student achievement in online and face-to-face classes. The aim of this phase was to determine if online and face-to-face students demonstrate different levels of knowledge in six distinct subject areas. For each of the six areas the means for 10 sections of students, collected over a five-year period, were plotted to visually review the results. Following the visual check, a two-sample t-test between proportions, assuming unequal variances, was performed to determine whether there was a significant difference between the samples with respect to the level of assessment scores earned. There was not a significant difference in the means of the online and face-to-face students. However, two subjects warrant additional research: first is production where there was a significant difference at the 0.10 critical alpha level ($p = 0.085$) and second is finance where the means were close to being significant at the 0.10 critical alpha level ($p = 0.104$).

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1 Introduction

The aim of this research was to determine if online and face-to-face students demonstrate different levels of knowledge in six distinct management subject areas. The distinct subject areas under investigation makes this research unique by building on a solid body of knowledge suggesting online and face-to-face students tend to achieve similar results (Astani, Ready, & Duplaga, 2010; Russell, 1999; McFarland & Hamilton, 2005).

This was the second phase in a research project designed to examine student achievement differences in online and face-to-face classes. The group of students under investigation remained constant for the entire research project. The researchers analyzed the student results for five semesters (10 sections) over the period 2009 to 2014. During each semester there was a single online section and a single face-to-face section of a capstone course, always taught by the same professor. The number of students in each section ranged from 12 to 24 with a mean of 16.72. In total, the results of 166 students were analyzed: 82 online and 84 face-to-face.

During the first phase of the study, the research focused on whether there was a difference in the competency of online and face-to-face students in a culminating capstone class. Given that much of the research in high impact practices has focused on the face-to-face paradigm, the researchers sought to answer the research question: Do face-to-face and online learners demonstrate the same levels of knowledge? During the first phase the question was answered by comparing the mean scores of a comprehensive, external set, final examination.

2 Literature Review

A review of literature concerning the assessment of learning outcomes in online versus traditional in-class delivery methods yields some reassuring results. Most sources reviewed indicate that the results of online versus face-to-face deliver are statistically comparable. Sussman and Dutter (2010) wrote that "essentially no difference was found for face-to-face versus fully online course delivery" when examining the indicators of a paper assessment and final course grades for an undergraduate social science course.

Herman and Banister (2007) concluded that online education has "succeeded in providing an online course that engages students in the learning process, supports strong student learning outcomes, and provides significant cost savings to the university. Maybe online education can be a win-win-win scenario, after all" (p. 326). While their work focused on the attainment of learning outcomes in relation to the cost effectiveness of the online environment, it still shows

that the online environment can deliver on the promise of comparable learning outcomes to traditional methods of instruction and student success.

In their paper *Comparing Student Achievement in Online and Face-to-Face Class Formats*, Dell, Low, and Wilker (2010) reported:

> The results of this study indicate that students in both the undergraduate and graduate sections, face-to-face and online, were able to learn the course content, actively engage with the content through analysis, observation, or experimentation, and participate in active discussion with peers regarding ideas and understandings of the content. Higher level thinking skills were required to participate in discussions of analysis, and group facilitators in the online graduate section were engaged in providing guidance to a group of students actively engaged in analysis and reflection. Instructional platforms formats differ, but evidence strongly suggests that either type can be effectively designed and taught, leading to equally strong student learning outcomes. (p.36)

One aspect that should be explored concerning online vs. face-to-face concerns the difference in subjects that are more difficult online in one of the modes. Do students have more difficulty with certain subjects if they are taught online or face-to-face? Are there classes or subjects that students perform better if they take it face-to-face compared to taking it online? Anecdotal evidence suggests some subjects are hard in themselves. By teaching the subject online, that may add to the difficulty of the class.

In a study completed by Swan and Jackman (2000) that focused on high school students taking online classes and face-to-face classes, the researchers found no significant differences in performance between online and face-to-face. However, they also found that as students advanced in grade the GPAs were lower. This could be attributed to the difficulty or complexity increase of the classes as the students moved to higher grades.

Helms (2014) found that face-to-face students perform better than online students in a lower level psychology class. For that study all possible variables were maintained constant with each group. All grading was done using online submissions. The result of that study was that online students would have a lower GPA, less class submissions and more likely to fail the class than the face-to-face students. Similar results were found by Atchley, Wingenbach, and Akers (2013) resulting in their recommendation that some subjects are not suitable for online classes.

Salcedo (2010) compared online classes of basic Spanish to face-to-face classes in basic Spanish. In her study, face-to-face students outperformed online students in three out of four semesters, though not significantly. One thing

missing out of these studies was whether best practices of teaching online were used in the online setting. That is an area that needs further study.

3 Methodology

During each semester, two sections of students (one face-to-face class and one online class) completed an external assessment during the last week of their capstone class. The first phase identified that face-to-face students scored slightly higher ($M = 0.57$) than online students ($M = 0.54$), but this difference was not significant at the 0.05 critical alpha level (Girard, Floyd & Yerby, 2014). This phase continued the examination by "drilling down" an additional level to see if a difference existed at the subject level. The students answered questions in six categories: Strategic Analysis, Accounting, Finance, Production, Marketing, and Human Resources.

Prior to accepting the assessment tool as a valid measure, the faculty reviewed the simulation and agreed it was indeed measuring student knowledge relevant to their program outcomes. To achieve this consensus, the faculty mapped their program outcomes to the external assessment plan. The mapping exercise concluded all of the program objectives were being assessed by the assessment questions. Ultimately the faculty agreed that capstone students' answers to the questions reflected a fair, accurate and objective evaluation of student knowledge.

The basic methodology used for the first phase was extended for the second phase. During the previous phase it was determined that there were not statistically differences in means of the 10 sections of students under investigation. Equally notable was the finding that there was not a statistically difference when comparing the online students to the face-to-face students. During the first phase the researchers focused on the total score achieved by the students.

For the second phase six subject specific hypotheses (H1 … H6) were derived. The purpose of the hypothesis was to test if Online Students (S_{OL}) and Face-to-Face Students (S_{F2F}) achieve significantly different scores on their final assessment. These hypotheses are important because the answer may go some way in explaining if different modes facilitate higher levels of knowledge transfer and/or retention for a particular subject area. Armed with this evidence, educators will be able to consider modifications to their pedagogy to achieve the same levels of knowledge transfer and retention. This hypothesis presupposed that there is a relationship between the dependent variable of assessment score and the independent variable of student type, specifically:

H1: Online Students achieve a significantly lower accounting score than do Face-to-Face Students.
H2: Online Students achieve a significantly lower finance scores than do Face-to-Face Students.
H3: Online Students achieve a significantly lower human resources score than do Face-to-Face Students.
H4: Online Students achieve a significantly lower marketing score than do Face-to-Face Students.
H5: Online Students achieve a significantly lower production score than do Face-to-Face Students.
H6: Online Students achieve a significantly lower strategic analysis score than do Face-to-Face Students.

In order to eliminate a major factor in student learning, all sections under examination were taught by the same professor. The professor worked diligently to ensure that before the final assessment, the same knowledge, experiences, and support were provided in both modes. Throughout the course, all students completed the same assignments and used the same simulation tools. Similarly, all sections, both face-to-face and online had access to the same learning management system (LMS). The LMS included a series of bespoke video lectures as well more traditional learning material such as class notes and links to external resources. For the online section, the LMS was the main learning resource with support by frequent asynchronous video updates provided by the professor. For the face-to-face section, professor-led lectures were the main pedagogy supported by the LMS.

4 Discussion

During phase two of this exploratory research project, each of the six subject areas were examined individually with a view to determining if there were one or more subject areas where either the online or face-to-face students outperformed the other group. For each the six areas the means for each of the 10 sections of students were plotted to visually review the results. Following the visual check a t-test was performed on the data. An overview of the statistical tests and an analysis of subject specific results follow.

For each of the six subject areas the procedure was the same and therefore is not repeated for each hypothesis. The research question was *do face-to-face and online students demonstrate the same level of [subject area] knowledge? The null hypothesis was there is no significant difference between the assessment scores between the two groups*. A two-sample t-test between proportions,

assuming unequal variances, was performed to determine whether there was a significant difference between the samples with respect to the level of assessment scores earned.

H1: Accounting

Accounting represented 20% of the total final examination score. Face-to-face students scored slightly lower ($M = 0.52$) than online students ($M = 0.54$), but this difference was not significant at the 0.05 critical alpha level; t(4)=0.76, p=0.491. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

H2: Finance

Finance represented 23% of the total final examination score. Face-to-face students scored higher ($M = 0.65$) than online students ($M = 0.57$), but this difference was not significant at the 0.05 critical alpha level; t(6)=1.92, p=0.104. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

H3: Human Resources

Human resources represented 11% of the total final examination score. Face-to-face students scored slightly higher ($M = 0.66$) than online students ($M = 0.63$), but this difference was not significant at the 0.05 critical alpha level; t(4)=0.45, p=0.674. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

H4: Marketing

Marketing represented 14% of the total final examination score. Face-to-face students scored very slightly higher ($M = 0.576$) than online students ($M = 0.575$), but this difference was not significant at the 0.05 critical alpha level; t(6)=0.02, p=0.983. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

H5: Production

Production represented 12% of the total final examination score. Face-to-face students scored higher ($M = 0.42$) than online students ($M = 0.34$), but this difference was not significant at the 0.05 critical alpha level; t(8)=1.97, p=0.08. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

Prior to conducting the data analysis, the researchers decided to test for significance at the 0.05 critical alpha level. Notwithstanding, it is worth noting that at the.10 critical alpha level there was a significant difference between the face-to-face and online students. Equally interesting is the observation that in all cases the online students' means were below the face-to-face students' means.

H6: Strategic Analysis

Strategic analysis represented 16% of the total final examination score. Face-to-face students scored slightly lower ($M = 0.54$) than online students ($M = 0.58$), but this difference was not significant at the 0.05 critical alpha level; $t(5)=1.62$, $p=0.167$. Therefore, we fail to reject the null hypothesis and conclude that the difference in online and face-to-face students was not significant.

5 Recommendation for Future Research

The results of the project are clear; there was not a significant difference in the means of the online and face-to-face students. The researchers do note that two areas seem to warrant additional research. First, is the recognition that there was a significant difference in the production area at the 0.10 critical alpha level ($p=0.085$). In addition, the finance means were close to being significant at the 0.10 critical alpha level ($p=0.104$). The first recommendation for future research is a continuation of data collection to extend this longitudinal study, perhaps to 10 years of data. The additional data might solidify the initial findings.

The two areas where the students' scores varied the most were both quantitative areas (production and finance). At the other end of the spectrum, two areas that tend to be less enumerative in nature (human resources and marketing) revealed the tightest ranges. Future research should consider the impact of quantitative-based learning in the online and face-to-face.

6 Limitations

As much as possible the project was designed to eliminate variables that could impact the results. However, as with most research project there are limitations. First, the project focused on a single school. Hopefully other researchers will replicate this research in other schools to see if similar results are obtained.

Perhaps the most important limitation is the concept of self-selection. This project examined the final class in an undergraduate program. By this point in their academic career students understand their strengths and weaknesses. They have learned, perhaps through trial and error, which modes works best for them.

As a result, the graduating seniors under examination likely had self-selected in the mode that was best for them.

Conclusion

The purpose of this research was to establish if online and face-to-face students demonstrate different levels of knowledge in six discrete management areas, specifically: strategic analysis, accounting, finance, production, marketing, and human resources. For each of the six areas the means for 10 sections of students, collected over a five-year period, were plotted to visually review the results. Following the visual check, a two-sample t-test between proportions, assuming unequal variances, was performed to determine whether there was a significant difference between the samples with respect to the level of assessment scores earned. There was not a significant difference in the means of the online and face-to-face students. However, two subjects warrant additional research: first is production where there was a significant difference at the 0.10 critical alpha level (p=0.085) and second is finance where the means were close to being significant at the 0.10 critical alpha level (p=0.104).

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