Teaching effectiveness and digital learning platforms: A focus on mediated outcomes

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Abstract

Teaching approaches and effectiveness have become more closely aligned with technology in establishing curriculums and disseminating course instructions. To the extent that Cengage MindTap and other digital learning tools are utilized offers a platform for measuring learning effectiveness through grade outcomes. This analysis considers university business classes within the core curriculum and as part of a finance major elective to measure if the use of such tool is statistically associated with higher grades. Independent variables analyzed are homework (HW), quizzes, and exams. Mixed results conclude that each independent variable in a simple regression produces stronger coefficients of determination with higher beta values in classes where MindTap is used but the association is less robust in a multivariate analysis. Mean grades collectively for all courses where MindTap was used were 80.49 compared to 79.42 for courses taught without MindTap.

Keywords: Digital learning, MindTap, teaching effectiveness, learning outcomes, student engagement

INTRODUCTION

The process of teaching has a long and varied evolution over the last few decades (Loewus & Molnar, 2017), to the extent that how one teaches has transcended from teacher centered to student centered. As a matter of personal preference this issue may be debated and analyzed across a variety of approaches. Technology has increasingly been employed to mediate learning initiatives and open areas where students are afforded more hands-on opportunities to learn (TG, 2011). Consistent with the burgeoning trend toward active student involvement in the learning process, technology solidly occupies an important role. Such that a positive relationship between using technology and not using technology may be measured, a focus on learning outcomes is important in determining its effectiveness as a teaching tool.

Previous research has primarily considered online versus traditional classroom instruction in measuring outcomes (Bennett, McCarty, & Carter, 2011).

This analysis approaches learning outcomes not from the perspective of differences observed in traditional or online instruction, but rather how developing technologies have transformed the educational landscape through feedback and interactive mediation that allows students an opportunity to function in a more dynamic environment. Our research analyzes learning outcomes for students who took business finance and / or personal financial planning classes with the same two instructors at Jacksonville State University, a university with a student-centered mission. MindTap by Cengage Publishing – an interactive digital learning platform which combines all of one's learning tools such as readings, multimedia, activities, and assessments into a singular learning path for each curriculum - was used in this analysis. Learning outcomes for students in sections of those classes where MindTap was used was compared with sections where MindTap was not used. The research question that this analysis seeks to explain is whether this online digital platform fosters learning as measured through higher grades or if an inverse or absence of relationship otherwise exists.

LITERATURE REVIEW

The use of digital learning platforms is in its infancy in most college and university curriculums (Dede & Richards, 2012). Several noted benefits, however, have been documented – higher student performance, student satisfaction, and dropout prevention – but there is generally limited formal use and implementation of such platforms even though accessibility is widespread (Selwyn, 2007). Lee, Courtney, and Balassi (2010) analyzed the effects of Aplia, an online homework tool by Cengage Publishing, and found that pre and post-test measures of performance on an undergraduate and graduate economics standardized test were not explained by type of homework method.

Fairweather (2000) points toward organizational characteristics of respective institutions in identifying the relevance and role of digital learning tools' use depending on whether focused on a teaching discipline like business or various sciences or to emphasize a goal, such as funded research. Roca, Chiu, and Martinez (2006) surmise that computer literacy is a factor in platform use, finding that a higher degree of literacy is positively related to greater use and success. This research presents an interesting contrast with Oppenheimer (2003) who finds an inverse relationship between classroom technology and interaction between students and teacher.

Instructor status is in part a function of which of these two approaches is emphasized when digital tools are used. Tenure track faculty experiences are positively related to conducting research and teaching fewer first year courses (Naveh, Tubin, & Pliskin, 2010), while adjunct and non-tenure track faculty disproportionately embrace these platforms for teaching (Braxton, Eimers, & Bayer, 1996; Bland, Center, Finstad, Risbey, & Staples, 2006; Fairweather, 2005; Mayhew & Grunwald, 2006). This relationship extends in part to the size of class taught, where larger classes are frequently encountered by freshman and sophomore undergraduates but small, more defined, classes are encountered as students proceed through major courses. Trow (1998) surmised that classroom technology is a motivator for faculty to better deliver information and structure for larger classes, while Hong (2002) followed that the learning is cumulative to the extent that technology becomes an increasingly integral part of a student's curriculum over time.

Perhaps an important consideration of most students and an issue emphasized in marketing various disciplines to prospective students, both introductory and advanced classroom experiences offer simulation opportunity for students to embrace emerging technologies (Alavi, Wheeler, & Valacich, 1995; Hildebrand, 1995) that firms employ in developing core employees in a competitive work arena (Leidner & Jarvenpaa, 1993). Depending on local company mores and presence of recruiters within the university community, cross cultural applications allow the effectiveness of a well-trained student with distance learning experience to not only represent underdeveloped areas of the world (Utsumi, Boston, Klemm, & Miller, 1997) but to equally deliver training and similar application to stakeholders who support the institution (Latchem, Mitchell, & Atkinson, 1994; Walsh & Reese, 1995).

This may or may not make the course more interesting to students, as research shows expected enjoyment is higher than actual enjoyment (Cleveland and Bailey, 1994), although attitudes play a role (Davis, Bagozzi, & Warshaw, 1989) and self-responsibility is a contributing factor (Wang & Stiles, 1976). Evidence exists that instructor attitudes are a causal factor in media effectiveness (Dillon and Gunawardena, 1995) that Webster and Hackley (1997) observed in technology-mediated distance learning.

Regardless, learning is best accomplished in an active, engaging environment where course design facilitates and encourages learning (Adelson, 1992; Hsi & Agogino, 1993), to the extent that interaction from multimedia exposure (Collis, 1995) or via distance learning (Borbely, 1994; Latchem et al, 1994) should be considerations in the design of distance learning environment (Ellis, 1992) . Concentration is a universal attribute required of distance education students relative to face to face, classroom engagement (Kydd & Ferry, 1994) that must be fostered to avoid distractions and establish a foundation for positive learning outcomes (Gowan & Downs, 1994; Isaacs, Morris, Rodriquez, & Tang, 1995; Nahl, 1993; and Schwartz, 1995) in transforming from teacher based to learner based curriculums (Tapscott, 1999).

Evidence suggests that clear distinctions exist between online and traditional learning. Bennett, McCarty, and Carter (2011) found a significant grade difference between stronger and weaker students in online versus traditional classes, suggesting that online instruction perhaps requires more defined student skillsets, abilities, or motivation. Students are less likely to recall and retain information accessed via a computer as opposed to a print format (Jones, Pentecost, & Requena, 2005), become less focused in their approach to gathering and learning facts (Mangen, 2008), and exhibit less accuracy over a longer period required in accessing information (Dillon, 1992). Hernandez-Julian and Peters (2012), conversely, found seven percent higher completion rates of homework assignments submitted electronically than for students who otherwise submit via paper, leading to higher homework scores even though final exam performance was unaffected. Thus, the realized benefit in this sample points to higher completion rates and accompanying points earned, as opposed to affecting quality of learning from an observable medium.

Webster and Hackley (1997) explain that research in the area of student engagement through media technology vis-à-vis instructor presentation and delivery has not been adequately explored, although individual interaction with the technology (Bruce, Peyton, & Batson, 1993; Jacques, Preece, & Carey, 1995) has formed a basis for such research that can be applied across a learning spectrum of individual instruction. Student perceptions of the usefulness of various forms of technology in supplementing teaching delivery (Moore & Benbasat, 1991; Boozer & Simon, 2019) is a significant consideration when developing curricula to engage the student to maximize course outcomes, especially to the extent that students are encouraged to become autonomous learners (Cotterall, 1995; Leatherwood, 2006) in larger classes with less availability of faculty, a disproportionate trend toward more online and blended options, and more independence in a changing world requiring multifarious skills.

MODEL

The model for this analysis tests if the use of the online learning-based platform produces higher student final grades as a positive course outcome. The model borrows from Jensen and Barron (2014) in measuring the relative impact of the sequence of exams in predicting final grades. The Jensen and Barron research analyzed first exam and midterm exam scores in myriad biology courses and found that grades remained relatively stable throughout a semester, where early grades on exams were strongly correlated to final averages. Student expectations are often unrealistic and misguided and develop from higher grades in high school that don’t extend to college coursework Jensen and Moore (2008a and 2008b). The model measures learning outcome as a grade that is a function of the following sources of measurement: homework (HW), quizzes, and exams. Other factors such as age, level of effort, and ability are not quantitively identified.

With the purpose of our research to test the effectiveness of Cengage MindTap as a Learning Management System technology in improving student grades, a pattern of assignments throughout the semester for each class is considered and measured with and without the use of such technology. Classes analyzed in the research ranged from Fall 2011 to Fall 2017 and included FIN 301 (Business Finance - a required core class for all business majors) and FIN 311 (Personal Financial Planning - an elective for business majors and requirement for all Family and Consumer Science majors). For classes with the use of MindTap and classes without the use of MindTap mean grades were tallied, standard deviation around the mean expressed, and the level of skewness as a measure of probability distribution asymmetry defined.

The model is structured as follows:

1. Exam 1, midterm exam and final exam was each used as a predictor (independent) variable in a simple regression analysis predicting effect or amount of variance on final grade average as the dependent variable. Coefficient of determination (Adjusted R-squared) indicates how closely the distribution fits a regression line. Beta values express how strongly the predictor (independent) variables influence the dependent variable.

2. A multiple regression analysis of an assignment (HW / Quiz) and the accompanying exam to that assignment (Exam 1, midterm exam, and final exam) predicts the effect of these impacts on final grade average. Both FIN 301 and FIN 311 classes were considered relative to using or not using MindTap within the courses. An adjusted R-squared for the model is indicated and beta value effects of each predictor provided.

ANAYSIS

There were 196 total observations without MindTap and 301 total observations when using MindTap. Mean grades were overall higher for all classes when using MindTap – mean grade of 80.49 versus 79.42 – but with a higher observed standard deviation between higher or lower around the mean, as indicated in the descriptive statistics of Table 1 (Appendix).

Model analysis includes a simple regression of the effect of three separate independent variables – Exam 1, Mid Term, and Final Exam – on final course grades. For each independent variable a coefficient of determination as adjusted R squared reports the variance of the independent variable from the regression line. With a simple regression either R squared, or adjusted R squared may be used. A beta coefficient is reported for each variable that reflects slope of regression line of the sensitivity of changes in the variable to final course grade.

With and without the use of MindTap the model includes analysis for the following: All Classes; HW / Quiz and Exam 1; HW / Quiz and Exam 2 (Midterm); and HW / Quiz and Exam 4 (Final). A strong effect was anticipated and confirmed through the level of significance of each independent variable at $p < .001$ as indicated in Table 2 (Appendix).

For all classes the use of MindTap produced a more pronounced relationship between the application of each independent variable and final course grade, as evidenced through a higher beta. To the extent that each independent variable explained the regression line through adjusted R2, MindTap also produced higher results. Again, this is indicated in Table 2 (Appendix).

Tables 3, 4, and 5 present multiple regression output by measuring effects of HW / Quiz average scores and exam scores on final course grade. The model considers both FIN 301 and FIN 311 classes separately with and without the use of MindTap. Beta values are expressed with coefficient of determination for each iteration.

Referring to Table 3 (Appendix) model results for the effect of MindTap on final course grade are mixed when considering HW / Quiz and Exam 1 as a predictor. Using beta values, FIN 301 HW / Quiz is a better predictor for classes supplemented with MindTap, but Exam 1 without MindTap produces a stronger relationship with final course grades. These independent variables for FIN 311 produce a stronger relationship without MindTap as measured through beta and coefficient of determination.

Table 4 (Appendix) substitutes Exam 2 or midterm exam for Exam 1 in the multiple regression equation with HW / Quiz average scores. For FIN 301 HW / Quiz features of MindTap again offer a stronger relationship with final course grades through higher beta values, but for FIN 311 Exam 2 has a stronger relationship when tested in classes using MindTap. For both classes a higher coefficient of determination indicates a data fit for the use of MindTap.

The effects of MindTap are similarly observed when measuring Exam 4 in the model. In Table 5 (Appendix) in FIN 301 classes, the HW / Quiz features of the online digital platform have a more positive relationship with how well students perform in class based on final course grades, but this effect does not extend to exams. In FIN 311 classes MindTap appears to have less impact in producing higher course grades through each of the independent variables measured.

CONCLUSIONS AND FUTURE RESEARCH

The results of this analysis of course grades were less robust than what was anticipated by student perceptions analyzed by Boozer and Simon (2019). Inconsistencies in results across classes and independent variable categories do not definitely support the use of MindTap in increasing student performance through higher grades. This is not to say that this digital learning platform is not effective; rather, its use may be more specifically applied in the classroom to enhance teaching approaches, which prior research maintains. Jensen and Barron (2014) conclude that students perform similarly across a course from beginning to end, which this research supports, but does not lend directly to actual or perceived benefits of MindTap. Given the similar beta values for each independent variable in Table 5 model analysis an argument can be made that not only is student performance maintained throughout the course, but there is also a closer relationship between HW / quiz and exams at the end of the course and final course grade.

Each independent variable was found to be statistically significant at $p < .001$ for each regression output in the model. This level of significance is not unexpected in that each measured assignment disproportionately was a high percentage of total points available and would, thus, be expected to closely align with earned grades. Our intent with this model was to use beta values as a measure of effect and coefficient of determination to approximate data fit.

This research offers opportunities to further explore behavioral areas of pedagogy to more specifically identify positive traits of a tool in a learning centered environment. Conclusions from this analysis that benefit teaching and offer a foundation for extended research include the following areas: student perceptions and grade performance; online versus in-class application of digital learning management tools; and electronic versus paper submission of assignments.

As the trend from student-based to learner-based education intensifies, ample evidence supports the importance of expected and actual enjoyment in a course (Cleveland and Bailey, 1994) and the attitude of both students and faculty to achieving desired outcomes (Davis et al., 1989). While student perceptions of MindTap as a learning tool were overwhelmingly positive (Boozer and Simon, 2019), inconsistent results do not preclude the use of this tool, but rather offer support to better encourage positive attitudes about its capabilities to foster more student enjoyment in class. This could be accomplished by narrowing broad criteria such as HW, quizzes, and exams to perhaps how specific features of the learning tool are embraced by students and affect learning in general or isolated assignment questions specifically.

With most of the classes analyzed for this research consisting of online delivery, to what extent the medium supports various course deliveries provides important insight into other curriculum features such as the use of technology by faculty and students, and structure and size of classes (Trow, 1998; Hong, 2002) at either undergraduate or graduate levels (Bennett et al, 2011). Findings from this research suggest that similar regressions with appropriate control variables could isolate online versus in-class, as one suggested example. Biases may exist between students who may not embrace technology and how well they integrate MindTap within a curriculum (Roca, Chiu, and Martinez, 2006), a condition that Oppenheimer (2003) identified in finding less interaction with students as the use of technology increases.

Finally, with classroom engagement closely aligned with learner-based education how students gather facts (Mangen, 2008), study and learn the material, and submit assignments is a function of technology use. Although to a casual observer these attributes may seem unimportant, in reality there appears to be a dichotomy between students who use a computer to recall and retain information and assignment completion and submission (Hernandez-Julian and Peters, 2012).

As MindTap espouses its homework features of engagement and interactive learning, the premise of higher completion rates for students who are more technologically savvy bridges the need for such features and points toward the positive relationship between HW / Quizzes and course grades.

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APPENDIX

Table 1 Descriptive Statistics

Without MindTap						
	N	Min	Max	Mean	Stand dev	Skewness
All classes	196	0	96.00	79.42	13.78	-2.34
FIN 301	111	0	95.96	76.37	14.69	-2.38
FIN 311	85	29.61	96.00	83.40	11.39	-2.31
With MindTap						
	N	Min	Max	Mean	Stand dev	Skewness
All classes	301	0	101.47	80.49	17.98	-2.69
FIN 301	95	0	101.47	75.05	23.75	-2.11
FIN 311	206	5.73	98.9	82.99	13.95	-2.70

Table 2 Model Analysis – All Classes

Without MindTap		
Independent Variable	Adjusted R2	Beta
Exam 1	.470	.687
Mid Term	.623	.790
Final Exam	.600	.776
With MindTap		
Independent Variable	Adjusted R2	Beta
Exam 1	.574	.759
Mid Term	.699	.836
Final Exam	.769	.877

Dependent variable is Final Course Grade; each independent variable significant at $p < .001$

Table 3 Model Analysis – HW / Quiz and Exam 1

FIN 301 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.631	.810
Exam 1	.402	
FIN 301 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.792	.927
Exam 1	.200	
FIN 311 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.721	.804
Exam 1	.480	
FIN 311 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.663	.757
Exam 1	.383	

Dependent variable is Final Course Grade; each independent variable significant at $p < .001$

Table 4 Model Analysis – HW / Quiz and Exam 2

FIN 301 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.450	.890
Exam 2	.588	
FIN 301 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.606	.954
Exam 2	.404	
FIN 311 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.718	.781
Exam 2	.457	
FIN 311 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.595	.851
Exam 2	.512	

Dependent variable is Final Course Grade; each independent variable significant at $p < .001$

Table 5 Model Analysis – HW / Quiz and Exam 4

FIN 301 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.562	.850
Exam 4	.484	
FIN 301 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.572	.953
Exam 4	.433	
FIN 311 - Without MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.639	.898
Exam 4	.579	
FIN 311 - With MindTap		
Independent Variables	Beta	Adjusted R2
HW / Quiz	.542	.876
Exam 4	.558	

Dependent variable is Final Course Grade; each independent variable significant at $p < .001$