https://doi.org/10.48009/2_iis_2016_105-114

Issues in Information Systems
Volume 17, Issue II, pp. 105-114, 2016

QUANTIFYING THE OPTIMUM BLEND OF GROUP COLLABORATION EXERCISES TO PROMOTE LEARNING IN VIRTUAL GROUPS

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ABSTRACT

As businesses evolve and workers become more dispersed, students need to be better prepared to work and collaborate in virtual teams. Universities need to design courseware to build these skills within students, by using the same online tools that are used in both educational and business settings. This paper investigates through quantitative analysis the optimum blend of online group work within virtual teams. The research goal was to determine if there is an optimal number of online group assignments that will result in better group learning performance. The research questions was: To what extent do students who have worked on a variety of numbers of group assignments demonstrate group learning performance on a business case and cost risk benefit analysis, when compared to teams who have not worked on group assignments? Preliminary work indicates that students who have a high exposure (six assignments) to group assignments performed significantly better on the business case and cost risk benefit analysis than students with Low (no group assignments) exposure.

Keywords: Group Collaboration, Virtual Groups, Self-Regulated Learning, Group Performance

INTRODUCTION

Ives and Jarvenpaa (1996) and Gilbert (1996) suggested that online technologies would change business education and instructors, and predicted the widespread deployment of virtual teams in classes, with students becoming more active in their own learning and research. However, Arbaugh et al. (2009) indicated that this transition has not moved as quickly as those authors' predicted**.**

One reason for this slow adoption is that while research over the past twenty years has indicated hybrid or blended courses can result in more positive student outcomes than face-to-face and purely online courses (Arbaugh & Benbunan-Fich, 2007; Arbaugh et al., 2009; Benbunan-Fich & Arbaugh, 2006; Means et al., 2013; Zhao et al., 2005) it has not addressed the most effective blend of course elements to improve student outcomes. These elements can include face-to-face and online time; the use of technologies; level of student interaction or group work (Zhao et. al., 2005) and group goal setting (Buller & Bell, 1986).

In the past, another concern often raised by business school scholars is that research in education has not been perceived as valuable by business and education, and this research should have been more firmly positioned to address the applicability of education research to business. Educators have had little to guide them when making decisions regarding the elements of comprehensive design of classes. However, currently business schools are expected by professional organizations to be involved in learning and education research and to apply this research to their organizations (Arbaugh et al., 2009).

Online education exploded onto the university landscape fifteen years ago. Learning management systems along with Internet technologies have changed the way many courses and programs are delivered. At the same time, this proliferation of online educational tools has begun to have a dramatic effect on corporate education and training. In both cases, there is a need for teams to be able to effectively interact through online collaboration tools to learn as a group. There has been limited research in the area that addresses the effectiveness of learning through online group collaboration to enhance student performance. This research presents the results of a preliminary experiment to assess the effectiveness of online group collaboration.

The examination of element blend in hybrid classes is now overdue, and this work should be supported by business and educators. As such, the motivation for this research is to examine one of those pedagogical elements, level of

group assignments, or student interaction, as effect on student performance, as demonstrated by group-based performance on a business case and cost-risk benefit analysis. This paper will present a literature review, an experimental research proposal and hypothesis, and results of that research; implications, limitations, and conclusions; and proposals for future work.

LITERATURE REVIEW

In a review of research during the 1990s regarding online learning and collaboration, the authors offer some general conclusions: studies showed the delivery of business education using technology compared significantly better to face-to-face education; asynchronous communication stimulated group communications in online environments; and collaborative team relationships could be developed in online, virtual groups (Arbaugh et al., 2009).

Since 2000, work has centered on the development of general frameworks for effective online and blended business education, but there has been very little testing of these frameworks. Zhao et al. (2005) examined 51 studies and found that a blended approach, in which 60%–80% of learning was mediated via technology, had significantly more positive student performance effects relative to face-to face instruction and pure distance learning. In an attempt to identify specific operational elements of blended and virtual groups, the authors recommended examining courses elements of time, instructional resources, and interactions among students to determine if levels of these elements contributed to outcomes. They concluded experimental research to test designs is needed for empirical evidence to support course design practice. For example, the appropriate blend for instructor interaction is not always clear. Walker (2003) found that the instructor's role in hybrid environments moved to one of facilitator to student directed learning, and provided a path way to new technology enables virtual work environments. Brower (2003) raised awareness of the risk of level of instructor intervention in online collaborative environments, as a possible impediment to student directed learning.

Balotsky and Christensen (2004) examined traditional and information technology mediated education and proposed the need to develop teaching pedagogy that more accurately promotes the development of skills required for student success in the business environment. They argued that since the business environment is a mix of traditional, face-to-face, and distributed IT- mediated alternatives, institutions should offer this mix in their curriculum to address not only student educational options, but also as to reflect workplace demands and enabling technology. The authors pointed out those pedagogical issues, such as lectures, collaborative assignments, knowledge construction, in-class and out-of-class constructions had not been extensively examined.

There is a large body of research regarding students working in virtual teams and how this provides for collaborative activities that serve as an opportunity for learning how to perform better in virtual groups. Group collaboration tools within learning management systems such as WebCT, Blackboard and E-College have increased drastically (Kartha, 2006). This supports group work for both traditional and online classes. Students learn more when they participate in group endeavors because of the exercising of cognitive processes that require resolution of conflicts or disagreements in group discussions, assimilation of knowledge, and discussion/negotiation (Benbunan-Fich, 2006; Benbunan-Fich & Hiltz, 2003; Piccoli, Ahmad, & Ives, 2001; Webb, 1982). In a study of 40 MBA courses Arbaugh and Benbunan-Fich (2007) found that students perceived learning was higher in courses designed with group learning activities, with instructor-led content (group-based objectivism), when compared to individual oriented courses. Students achieve higher perceptions of learning in courses where knowledge is transmitted through the system, and students are engaged in collaborative assignments. The authors found that the absence of knowledge construction and group collaboration has a negative effect on student performance. The authors found a large of studies indicating that one of the most definitive research findings is that participant engagement, whether it is between participants and/or between participants and the instructor, is one of the strongest predictors of positive student performance. Arbaugh et al. (2009) reported studies of learner–learner interaction and instructor-leaner interactions both showed positive results in learner outcomes in online courses.

Two meta-analysis of a combined nearly 100 experimental or quasi-experimental studies found that student performance was better in blending learning, when compared to face-to-face instruction, but revealed that an essential mix for online elements of time, resources, and interactions in classes has not been measured. In addition to

the previously discussed study by Zhao et. al. (2005), Means et al. (2013) analyzed 45 studies to determine that students in blended, online learning out-performed students in face-to-face classes; purely online classes did not indicate an advantage over face-to-face classes. The authors concluded that research has not adequately investigated the appropriate blend of online and face-to-face delivery approach or the extent of collaborative group learning needed to affect performance.

Research also indicates that students need to prepare for changes in work environments by becoming more adept at working in virtual, online environments, and suggested that coursework that has been traditionally delivered face-to-face may be better served as delivered online (Daspit & D'Souza, 2012; McDonald, 2011). Proserpio and Gioia (2007) indicated researchers should investigate how instruction should be delivered to "new virtual generation students". In his perspective on pedagogical practices, Arbaugh (2014) indicated that the most important issue regarding management education "is the need for further work in determining optimal blends. '(O)ptimal blend'…(is) the combination of classroom based and online activities that best promotes student learning (p.784)".

Bernsteiner, Ostermann and Staudinger (2008) pointed out that a major responsibility of higher education is to train students for the requirements of their careers by designing courses to help them apply knowledge to business settings and position requirements. The authors argued that although there is a need to prepare graduates to address these issues in their professional work, there is little evidence of research designed to address this educational and professional need. Cortez, Nussbaum, Woywood, and Aravena (2009) have acknowledged that the ability to work in teams is becoming more of a need for success in business, and contended that in higher education students are not prepared to be collaborators or members of a team. In addition, more recently, Kim et al. (2015) indicated that there is little research on the blended learning on teacher preparation programs, and little research on how teachers should effectively incorporate blended learning in their course designs.

Business schools need to evaluate new methods to improve student learning (Aggarwal, 2008). These techniques must promote student-driven, self-regulated learning (Alavi & Gallupe, 2003; Arbaugh, 2008a, 2008b; Geddes, 2009), and blended techniques can be utilized to encourage this mode of learning (Garrison & Vaughan, 2008).

In terms of the research goal and question, while the advantages of hybrid online classes are acknowledged, study needs to be done to determine the most effective blend of operational elements in these classes, to affect student and potential business professionals' performance in virtual groups.

RESEARCH METHODOLOGY

Our research centered upon the following research question: Is there an optimal number of online group assignments that will result in better group learning performance? To address this, the results of a business case and cost-benefit/risk analysis were utilized.

The research hypothesis to be tested was as follows:

H_1: There will be no significant difference in student learning, as defined by group performance on a business case and cost-risk/benefit analysis, between groups with High (H) exposure, Medium exposure (M), and Low exposure (L). High exposure is defined by six group collaboration assignments; Medium exposure is defined by group collaboration on three assignments. Low exposure were the individuals with no exposure to group collaboration on assignments.

Participants

Thirty-six MBA students enrolled in an Information Systems strategy course in a major university in the northeastern United States from the Fall 2015 semester participated in this preliminary study. The course was offered in a traditional, face-to-face, 16-week semester. Each student in the course had access to the group collaboration tools in Blackboard, and was required to use this tool for assignments and collaboration.

Design

Students were randomly placed in one of three group types to be exposed to the level of blended learning. Blended learning refers to the number of online sessions/discussion groups; in this case, instances of assignments dependent on group work and collaboration. There were six assignments in this class. Two of these assignments concern a fictitious company, in which an information systems group fails to establish a business case for an e-commerce implementation.

In the experimental groups, students worked in teams of three on assignments. In the High (H) groups, students collaborated on all six assignments, and submitted each assignment as a group. Groups with a Medium (M) blend collaborated on three assignments, and submitted three assignments as a group, and three of the assignments individually. In the control or L group, students worked individually on all of the assignments. There were a total of 12 groups in this study; four each of H, M and L groups.

The dependent variable in this study was performance on the design of the business case and cost-risk/benefit analysis. This course is the study of the integration of business analysis and information systems. A major theme of this course is establishing a return on investment for information systems projects, so there is a business justification for any information systems project. The return on investment is operationalized through a Business Case analysis and cost-risk/benefit analysis. For the final requirement in the class, the students need to establish a justification for the failed e-commerce implementation that they studied from the beginning of the course.

For this final requirement all students worked in groups and submitted their results as a group, including students in the L groups. The total Business Case and Cost-Risk/Benefit score for each group was based on the combined scores of these two submissions. The business case was evaluated based on a rubric developed from Components of a Business Case. See Rubric for Business (See Appendix A). For this scale, groups can score a maximum of 50 points, based on 0-5 points for 10 business case elements, with the scale based on higher scores for quantitative return on investment formulas and measurable and observable factors in various components of the business case. These ten components are Executive Summary, Assumptions and Rationale, Program Summary, Financial Discussion and Analysis, Benefits and Business Impacts, Schedule and Milestones, Risk and Contingency, Conclusions and Recommendations, and Appendices. Two raters evaluated these categories indepdendently, and the score for this component for each group was the average of their rating. The rater inter-rater reliability on these scores was 77.5%.

The Cost-Risk/Benefit submission was evaluated based on a rubric developed from Pearlson and Saunders (2013, p. 212) (See Appendix B). This scale was open-ended, in that students supplied cost, risks, and benefits based on "Doing New Things", "Doing Things Better", and "Stop Doing Things". The rating scale was the same as was used for the Business Case. Two raters also evaluated these categories independently, and the score for this component for each group was the average of their rating. The rater inter-rater reliability on these scores was 80.0 %.

RESULTS

The result of the research indicated that there was a significant difference in the student performance on the Business Case and Cost-Risk/Benefit Analysis. The source of this variability was between the High and Low groups in the assignments, with the High Groups scoring significantly better than the Low Groups.

Table 1 shows the average scores for the students for the High, Medium, and Low Groups on the dependent variable. Each of the three students in every group received the same score as the group for the Business Case and Cost-Risk/Benefit analysis.

Table 1. Performance on Business Case/Cost-Risk/Benefit Analysis

Level of Blended Learning	N =	Mean Score for Total of Business Case/Cost Benefit/Risk Analysis
High	12	64.75
Medium	12	59.50
Low	12	52.25

Table 2 shows analysis of the student performance on the business case and cost risk benefit analysis. The overall F value shows significance for the Total Business Case/Cost-Risk/Benefit Analysis ($F=3.43$, $p < .004$) across the population.

Table 2. ANOVA for Total Business Case/ Cost-Risk/Benefit Analysis Score

Source	DF	SS	Mean Square	F Value	Pr > F
Model	2	945.500000	472.750000	3.43	.04444
Error	33	4551.000000	137.909091		
Corrected Total	35	5496.500000			

Since the F test indicated an overall effect of the only dependent variable, paired-comparison t-tests were utilized to find the source of this variability between groups. Table 3 shows the T-Test analysis on each of the three levels of groups in the business case and cost-risk/benefit analysis. The only significant difference in the Total Business Score between the Blended Groups was between the High ($M = 64.75$) and the Low Group ($M= 52.25$), ($t=2.86$, $p > .01$).

Table 3. T-Test for Total Business Case/ Cost-Risk/Benefit Analysis Score: High vs Low Groups

Group	N	Mean	Standard Deviation	t Value	Pr > F
High	12	64.7500	13.3067	2.86	.00992
Low	12	52.2500	7.2504		

CONCLUSIONS

Studies designed to assess course outcomes as a consequence and mix of process and elements of the course experience are emerging (Kock et al., 2007; Lapsley et al., 2008). As blended learning becomes more wide-spread, best practices around blends by discipline will require quantification by elements (Allen, Seaman, & Garrett, 2007; Cao et al., 2008; Webb & Poe, 2005). Researchers have called for the design of studies of effectiveness of frameworks for business education and business schools. (Arbaugh, 2008a; Arbaugh et. al, 2009; Heckman & Annabi, 2005).

The purpose of this preliminary experiment was to assess the impact of group collaboration, by using an experimental design, with an objective, not "perceived", scale. These preliminary results are encouraging in addressing the pedagogy concerning the quantification of the mix of classroom-based and online activities that best promotes student learning; in this case, the number or amount of collaborative group assignments that will affect the subsequent group performance on a critical learning task. These results indicate that the groups who had six group assignments scored significantly higher on the Total Business Case and Cost-Risk/Benefit Analysis than groups who had no collaboration experience with each other. Though group learning has long been used within MBA programs, this provides quantitative support to continue that usage. Teams that had only 3 group assignments did not perform significantly better than the groups that had no collaboration experience. This data suggests that the number of assignment collaborations needed to enhance group performance is greater than three, but less than or equal to six. This, of course, requires further examination.

Cook & Campbell as reported by Edmonds & Kennedy (2013) describe three conditions that must be present to establish cause and effect. They include: (1) covariation (the change in the cause must be related to the effect), (2) temporal precedence (the timing of the effect must be subsequent to the cause), and (3) no plausible alternative explanations. The results of our preliminary experiment meet these three conditions.

There are some limitations in this research. This research was done with a hybrid class, which is primarily face-to-face. Studies in the future should address other blends of classes, including online. This research, and planned subsequent research, will be conducted with students enrolled in one particular class. Also, 36 students is a small population from which to make generalizations. With such a small population, it is difficult to imply best practices or lessons learned from this research at this point, but as a preliminary effort to quantify the optimum blend of group collaboration exercises to promote learning in virtual groups, these results could ultimately affect the design of future hybrid or blended courses.

FUTURE WORK

We intend to expand upon the research and data collection. Additional participants will be included in this experiment. In addition, we will extend the research to perform the same study with students who are taking the course in an entirely online environment, to determine if significant differences exist based upon the delivery method of the course. These subsequent studies over the next year will provide an opportunity to better investigate and quantify the optimum blend of group collaboration to promote learning in virtual groups. In addition, we intend to explore other variables that impact group performance within information systems graduate education. This analysis will also include an examination of discussion group postings for level of knowledge construction exhibited by these groups, based on the Interaction Analysis Method, developed by Gunawardena, Lowe, and Anderson (1997), that has been used in over 400 studies.

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APPENDIX A
RUBRIC FOR BUSINESS ANALYSIS

Section or Component	Description	Points *
Executive Summary	One or two page description of the overall business case document.	0-5
Overview and Introduction	Includes a brief business background, the current business situation, a clear statement of the business problem or opportunity, and a recommended solution at a high level.	0-5
Assumptions and Rationale	Includes issues driving the proposal (could be operational, human resource, environmental, competitive, industry or market trends, financial, or otherwise).	0-5
Program Summary	Includes a high level and then detailed description of the project, well-defined scope, objectives, contacts, resource plan, key metrics (financial and otherwise), implementation plan (high level discussion and potential impacts), and key components to make this a success.	0-5
Financial Discussion and Analysis	Starts with financial summary then includes details such as projected costs/revenues/benefits, financial metrics, financial model, cash flow statement, and assumptions that went into creating financial statements. Total Cost of Ownership (TCO) calculations analysis would go in this section.	0-5
Benefits and Business Impacts	Starts with business impacts summary then includes details on all non-financial outcomes such as new business, transformation, innovations, competitive responses, organizational, supply chain, and human resource impacts.	0-5
Schedule and Milestones	Outlines the entire schedule for the project, highlights milestones and details expected metrics at each stage (what makes the go/no-go decision at each stage). If appropriate, this section can also include a marketing plan and schedule (sometimes this is a separate section).	0-5
Risk and Contingency Analysis	Includes details on risks, risk analysis, and contingencies to manage those risks. Includes sensitivity analysis on the scenario(s) proposed and contingencies to manage anticipated consequences. Includes interdependencies and the impact they will have on potential outcomes.	0-5
Conclusion and Recommendation	Reiterates primary recommendation and draws any necessary conclusions.	0-5
Appendices	Can include any backup materials that were not directly included in the body of the document such as detailed financial investment analysis, marketing materials, and competitor's literature.	0-5
	TOTAL POINTS	
	* Possible points for the category: 5 = FINANCIAL - Financial value can be calculated applying a cost/price or other valid financial benefit to a quantifiable benefit. 4 = QUANTIFIABLE - There is sufficient evidence to forecast how much improvement/benefit should result from the changes. 3 = MEASURABLE - Although this aspect of performance is currently measured, or an approximate measure could be implemented, it is not possible to estimate how much performance will improve when the changes are implemented. 2 = OBERVABLE - Some discussion, but no measurement. 1 = Section acknowledged, no discussion. 0 = No acknowledgement of Section.	

APPENDIX B
RUBRIC COST RISK BENEFIT ANALYSIS *

Objective Type	Doing New Things	Doing Things Better	Stop Doing Things
Financial (5 points each)	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each
Quantifiable (4 points each)	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each
Measurable (3 points each)	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each	State Benefit, Measure and Owner for each
INVESTMENT COSTS:			

* Students are to Complete a Cost Risk Benefit Analysis. Each entry is worth up to 5 points. There is no limit to the number of "Things" that can be identified.

Possible points for each "Thing" Identified:

5 = FINANCIAL - Financial value can be calculated applying a cost/price or other valid financial benefit to a quantifiable benefit.

4 = QUANTIFIABLE - There is sufficient evidence to forecast how much improvement/benefit should result from the changes.

3 = MEASURABLE - Although this aspect of performance is currently measured, or an approximate measure could be implemented, it is not possible to estimate how much performance will improve when the changes are imp

Total Investment Costs count for 10 points.