TOWARDS BETTER EXAM RESULTS: COMPARING UNLIMITED VS. LIMITED ATTEMPTS AT SUPPLEMENTAL ONLINE INTERACTIVE LEARNING ACTIVITIES

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ABSTRACT
Research indicates the use of interactive online learning (IOL) instructional strategies in online courses enhances learning and results in better learning outcomes.

Purpose of the Study
The purpose of this study was to determine whether limiting the attempts by students to successfully complete formative assessments is related to improved performance on summative assessment.

Method/Design and Sample
The study included scores from 54 undergraduate students (Generation Z) from a large Midwestern university enrolled in two separate online sections of an introduction to a Principles of Marketing course, in fall semester, 2017. Twenty-eight students in one section had the opportunity to take the IOL activities as many times as they desired; fourteen students (1/2 of the section) had two or more attempts in a one or more modules. Twenty-six students in the second section were allowed a single attempt. Spearman's rank correlation coefficient was performed to measure the relationship between the total combined scores on the two exams and the total individual online interactive semester scores for both conditions sampled: unlimited attempts and limited attempts.

Results
The cohort with a singleattempt on the IOL activities did not demonstrate a statistically significant relationship to combined exam scores. The findings indicate that unlimited attempts on formative assessments correlated with exam scores while those formative assessments with a single attempt did not.

Value to Marketing Educators
It appearsfrom the study results that spending more time with chapter content through unlimited attempts (and under less pressure to get "it right the first time") translates into more frequent and deeper engagement with the material and consequently, better outcomes on midterm and final tests.

Keywords: interactive online learning (IOL) strategies, asynchronous, community of inquiry learning effectiveness, distance education, online education.

1. INTRODUCTION

The use of lectures only in college classrooms appears to be in a state of decline due to its limited value in contributing to positive learning outcomes and the shortening interest spans of college students (Schmidt, Wagener, Smeet, Keemink, & van der Molen, 2015). At the same time, even though reading compliance contributes to positive exam scores and final grades, college reading levels are also dropping dramatically (Babcock & Marks, 2011). While overall college enrollments are declining, online learning is growing and when supplemented by the use of robust and rigorous interactive online activities that embrace multimedia principles and Quality Matters (QM) standards, produces equal or better student outcomes (MacKenzie & Ballard, 2015).

In 2016, college marketing students from three different United States universities were surveyed about their attitudes toward textbook usage and relevance; findings indicate that students do not find the textbook useful to positive outcomes and prefer other study methods (Holmes, Pettijohn, & Amos, 2016).

Many textbook publishers now provide interactive online learning (IOL) activities for students on their websites. In a typical online course, professors assign chapter readings and students are then expected to complete interactive learning activities such as online quizzes, matching exercises, interactive exercises requiring calculations, video and case discussions, and video tutorials based on their understanding of the textbook material. This study examines whether limiting student access to individual online learning activities to just one attempt versus unlimited attempts can induce students to read the assigned chapters before attempting to complete the interactive online activities, thus resulting in improved learning outcomes as measured by higher exam scores when correlated with IOL scores. Unlimited attempts at an online activity provide students with the opportunity to simply search the textbook for the answers without reading the assigned chapters.

The Waning Days of Lecture
While the citation for the quote is illusionary, Mark Twain (and others) are reported to have said, "College is a place where a professor's lecture notes go straight to the students' lecture notes, without passing through the brains of either"("The professor's lecture", 2012).

An examination of any lecture-only classroom likely reveals students who are day dreaming, or looking at their cell phones, iPads or computers; research suggests that student concentration during lectures begins to decline after 10-15 minutes (Bligh, 2000). The excessive use of slides presentation by professors has effectively eliminated the need for students to even take notes. As Mark Twain and others imply, deeper and long lasting learning takes place when students are not merely passive recipients of instruction.

According to Young (2011), students consider the most valuable learning experiences to be those acquired outside of the traditional classroom such as internships, study-abroad programs, senior thesis, and capstone projects.

Model of School Learning

Some theories stand the test of time in spite of technological changes. In the 1960's Carroll developed a seminal model in which the factor of time played a central role. According to Carroll (1963), the degree of learning attained on a given task is a function of the time spent on the task divided by the time needed for task mastery. The framework was made up of five variables that contribute to the effectiveness of instruction (Carroll, 1989):

1. Aptitude: The amount of time a student needs to learn a given task to an acceptable "criterion of mastery under optimal conditions of instruction and student motivation" (Carroll, 1989, pg 26).
2. Opportunity: Amount of time available for learning both in class and within homework.
3. Ability to understand instruction: relates to learning skills, information needed to understand, and language comprehension.
4. Quality of instruction: The effectiveness with which the unit of instruction is delivered. If quality of instruction is bad, time needed will increase.
5. Perseverance: Amount of time a student is willing to spend on a given task actively participating in the learning process. It essentially measures motivation for learning.

Carroll (1963) hypothesized the shorter the time needed for learning, the higher the aptitude, with student aptitude related to time required to learn; he believed that all children would learn well but there could be a difference in time to achieve mastery.

Derived from Caroll's work, the U.S. Department of Education stated the following;

- How much time students are actively engaged in learning contributes strongly to their achievement? The amount of time available for learning is determined by the instructional and management skills of the teacher and the priorities set by the school administrator. ("What works", 1986).
- In another section, it emphasized "accomplishment in a particular activity is often more dependent upon hard work and self-discipline than on innate ability" ("What works", 1986).

Growth of Online Learning

According to Seaman, Allen & Seaman (2018), in their annual Online Learning Consortium study, distance education enrollments have increased for the fourteenth straight year; but while both distance and overall enrollments grew during the 10-year period from 2002 to 2012, overall enrollments declined for four straight years while distance enrollments steadily increased. Aslanian and Clinefelter (2014) reported that more than 80% of public universities and half of private colleges offer at least one fully online program, 5.5 million students (26 percent of all college students) took at least one online course and 13 percent (2.6 million students) studied fully online; while the percentage of students studying online continues to grow, the rate of the growth is slowing (possibly due to the growing size of the online population). As competition intensifies, students are less concerned with convenience while placement rates, prices, reputation of the institution, and credit transfer are gaining in importance (Aslanian & Clinefelter, 2014).

Growth of distance learning has continued despite lack of support by some faculty; the proportion of chief academic leaders who say online learning is critical to their long-term strategy rose to 66 percent in 2013 but dropped to 63.3 percent in 2014 (Seaman et al., 2018). That number was less than 50 percent in 2002 (Seaman et al., 2018).

One factor in the acceptance of online learning is the suggestion that there was no significant difference in learning outcomes between face-to-face and online instruction (Larson & Sung, 2009). In a 2010 U. S. Dept. of Education report, a meta-analysis and review of 50 studies conducted between 1994 and 2006 comparing online to face-to-face, found online students performed modestly better than those receiving the traditional face-to-face instruction ("Evaluation of evidenced-based", 2010).

Nguyen (2015) conducted meta-analysis on the effectiveness of online learning by using studies found at Nosignificantdifference.org, and organized the findings into categories of positive, negative, mixed, and null. The results indicated that 92% of all distance and online studies were as effective as traditional education, three percent show that traditional face-to-face is more effective, and four percent showed mixed findings (Nguyen, 2015). While much has been learned about the effectiveness of online learning, and there is strong evidence to suggest it can be as effective, or even more, as traditional, face-to-face instruction, there is still more examination that needs to take place.

Strategies Used in Online Learning

Not all online learning activities are equally valuable and many do not result in greater student engagement. An online survey of 417 undergraduate college students taking an online course at a state university revealed that students found connections to themselves, others, and course material in both online discussions and in interactive assignments, resulting in more engagement (Buelow, Barry, & Rich, 2018). However, the students indicated the discussions needed to be authentic, challenging and respectful; for greatest engagement, the interactive assignments needed to be well-planned, make use of nontraditional materials and media, and include hands-on exercises (Buelow et al., 2018)

Strategies to promote online interactions can include a wide array of activities to help students apply or demonstrate what they are learning. These activities can be done in or out of a class, as individuals or in groups, with or without technology.According to Crawford (2001), integration of productive interactive activities can develop higher-level thinking skills and can motivate students to complete the online course. Textbook publishers are investing in the enhancement of online education by providing interactive, online activities to accompany their texts. Many have online versions of textbooks, e-books, and website access bundling options for students. These websites typically provide video tutorials, multiple-choice, "drag and drop," and interactive exercises for students, video and traditional case discussions, and instructor resources. The role these interactive, online resources play in improving learning outcomes is beginning to be studied.

Recently, a textbook publisher hosting a site of online resources provided the results from 20 different case studies completed by instructors who used the online resources in their courses

("The impact of Connect," 2016). The aggregated case study data indicated a 20-point improvement in student retention, from 70.1% to 89.9%, a 13-point improvement in pass rates, from 72.5% to 85.2%, and an average grade increase of more than five points ("The impact of Connect," 2016).

In their seminal article, (Swan, Shea, Fredericksen, Pickett, Pelz& Maher, 2000) determined that well-designed online courses can support the development of a Community of Inquiry (CoI) which provides multiple types of interactions for students. In a CoI:

- students interact with the content and ideas presented in the course materials such as the text (Student-Content interaction),
- student interactions with instructors through formative feedback on assignments and in discussion forums (Student-Instructor interaction), and
- student interact with their peers (Student-Student interaction) through debate, discussion, and collaboration on assignments and projects (Swan, 2003).

In an effort to gain a better understanding of the current state of CoI research, 73 articles from Google Scholar were identified and examined (Befus, Cleveland-Innes, Garrison, Koole & Vaughan 2014). The researchers concluded that the "CoI model is likely to continue to be popular although technologies, research forms and educational practices are also likely to change" (Remesal & Friesen, 2014).

In 2015, a research study investigated whether the inclusion of individual online interactive activities from a publisher's website was related to improved student learning outcomes; Pearson's Product Moment Correlation Analysis was conducted to measure the relationship between the total combined scores on two exams and the total individual online interactive semester scores of 133 undergraduate students at a large Midwestern university who were enrolled in five sections of a Principles of Marketing undergraduate course (MacKenzie & Ballard, 2015).

Pearson's product moment correlation analysis was used to measure the relationship between exam scores and IOL activities overall and then by section, and the results demonstrated that overall there was a positive and significant correlation between total exam scores and IOL activities scores for all sections combined (r=.585) (MacKenzie & Ballard, 2015). Thus, the more students engaged with the supplemental publisher online activities, the better their overall exam performance was for the semester. When analyzing this relationship in individual sections, similar significant results were noted. In each of the five sections, a significant and positive correlation emerged between total exam scores and scores for the IOL activities (MacKenzie & Ballard, 2015). The findings that emerged from this study support the research cited by one textbook publisher that suggests that online interactive tools used as an adjunct to a course can enhance student performance ("Evaluating the all," 2014). Not only are the correlations consistently significant overall and by section, but also a review of the means and standard deviation, suggests that these types of online supplements hold promise for students who are not performing well in the course.

Knight and Wood (2005) sought to determine whether student-learning gains in a large, upper-division Biology lecture course, could be increased by partially changing to an interactive class.

For one semester, a traditional lecture format was used; for a successive semester, using the same syllabus, student participation and cooperative problem-solving during class time replaced some of the lecture time (Knight and Wood, 2005). Using pretest and posttests to estimate student learning gains, they found higher learning gains and increased conceptual understanding with in-class activities and group collaboration and discussions.

Demand for Online Education in anEra of Covid 19

Due to the worldwide pandemic, universities and colleges in the United States, and across the globe, have been abruptly tossed into the world of online education; many schools have yet to decide if they will be opening their doors to face-to-face instruction in the fall.

In the early spring of 2020, due to the widespread of Coronavirus disease (COVID-19) in China, most Chinese universities started online education (Bao, 2020). As of March 13, 61 countries in Africa, Asia, Europe, the Middle East, North America, and South America had announced or implemented school and university closures (Unesco, 2020).

According to Ubel (2020), many schools in the United States had only a few weeks to move courses online:
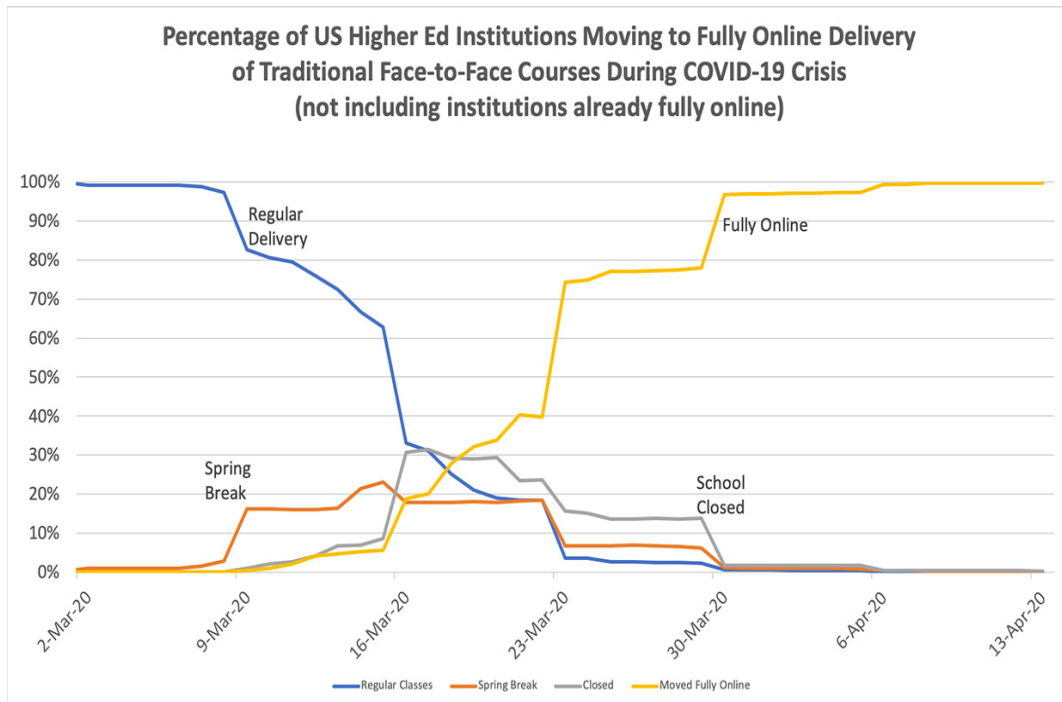
A case study focused on Peking University's experience provides the following principles for others at universities in similar circumstances:

1. Appropriate relevance - The quantity, difficulty, and length of teaching content should match with the academic readiness and online learning behavior characteristics of students.
2. Effective delivery - due to students' characteristics of low concentration in online learning, it is essential to adjust the teaching speed in order to ensure the effective delivery of teaching information.
3. Sufficient support - faculty and teaching assistants need to provide students with timely feedback, including online video tutoring and email guidance after class.
4. High-quality participation - it is necessary to adopt some measures to improve the degree and depth of students' class participation.
5. Contingency plan preparation - in view of the extraordinarily large scale of online education, it is necessary to make contingency plans in advance for addressing possible problems such as students' anxiety needs. (Bao, 2020).

Southern New Hampshire University had a large online learning presence even before COVID - 19; it's President offers the following guiding rules:

1) Do whatever it takes to get through this phase by adhering to a Minimum Viable Product (MVP) – the minimal functioning version that gets the basic functions done
2) Students matter most – understand that anxiety and depression reduces student's ability to learn but regular one-on-one interaction, making students feel like they matter to you beyond deadlines, outcomes, grades, etc., is important
3) Plan for the long haul including high-quality, student-centered online programs because it is possible that campuses will not reopen in the fall
4) Mine your own resources quickly by finding those people who are closest to the problem, and subsequently, the solution, and who can move quickly, defying slow-moving bureaucracy. (LeBlanc, 2020).

IOL Activities for This Study

While IOL activities are becoming ever more popular, the quality is not consistent. The IOL activities for the present research study embraced multimedia principles, QM standards, and the seven principles of Chickering and Gamson seminal article published in 1987.

Multimedia principles. According to Mayer and Moreno (2002), people learn more deeply from verbal (on-screen text or narration) and pictorial form (photos, illustrations, videos, animation) because they are able to mentally construct knowledge. The underlying theory is that humans have separate channels for processing visual and auditory representations, limited capacity assumption (limited processing of information), and active processing (meaningful learning takes place when a learner selects material, organizes it and integrates it with existing knowledge).

Seventeen to twenty-nine experiments conducted by Mayer (2009), resulted in the following multimedia principles:
- Multimedia principle - students learn more deeply from animation and narration than narration alone.
- Spatial contiguity - deeper learning occurs when text and animation are presented nearrather than far from each other on the screen.

- Temporal contiguity - deeper learning occurs when corresponding narration and animation are presented simultaneously rather than successively.
- Coherence principle - deeper learning occurs when extraneous narration, sounds and video are excluded.
- Modality - deeper learning occurs from animation and narration rather than animation and online text.
- Redundancy - deeper learning occurs from animation and narration, than from animation, narration, and on-screen text.
- Personalization - deeper learning occurs when narration or on-screen text is conversational rather than formal.

In addition, Mayer (2009) posits that deeper learning occurs by 1) segmenting learner-paced units rather than presenting one continuous unit, and 2) engaging learners in pre-training, that is, learning the names, characteristics, etc. of the main concepts. The IOL's for the research embraced multimedia principles, QM standards, and the seven principles of their seminal article Chickering and Gamson (1987).

QM standards. The QM Rubric reflects current research finding and national standards of best practice in online learning. The rubric consists of a set of eight general standards with four specific standards used to evaluate the design of online and blended courses. (https://teaching.uncc.edu/sites/teaching.uncc.edu/files/media/QM/qm-rubirc-5th-edition.png)

The IOL activities used by this research project followed the following QM Standards:

- Instructional Materials Standard: The instructional materials are current; a variety of instructional materials are used in the course
- Course Activities: the learning activities promote opportunities for interaction that support active learning. The learning activities promote the achievement of the stated learning objectives or competencies. The requirements for learner interaction are clearly stated
- Course Technology: The tools used in the course support the learning objectives and competencies; course tools promote learner engagement and active learning; technologies required in the course are readily obtainable; the course technologies are current.

Chickering & Gamson. In their seminal article, Chickering & Gamson (1987) articulated seven principles to help "improve undergraduate education". Of the seven, four of them are adhered to by the IOL activities used in the research for this paper, namely, 1) the use of active learning techniques that use structured exercises and opportunity for independent study, 2) giving prompt feedback, 3) computer-assisted instruction approaches which require time on task, and 4) showing respect for diverse ways of learning.

Formative Assessments
Formative assessments monitor student by providing ongoing feedback while summative assessments evaluate student learning at the end of an instructional unit ("What is the difference", n.d.).

For nearly ten years, a large group of first year, undergraduate, biology students were provided with both offline (paper-based) and online assessment resources; both qualitative and quantitative research methods were used to gauge whether the offline and online assessment resources were used by students, and if used, whether they contribute to final performance (Peat & Franklin, 2002). Most of the students who had attempted or completed the various assessment resources found them to be at least useful, if not extremely useful; students responded less positively to summative responses (weekly quiz, report and poster presentation) than to formative resources (mid-course exam, self-assessment modules and weekly self-text quiz) (Peat and Franklin, 2002).

The IOL activities which form the basis for this research study would be considered formative assessments.

Participants in the Study

The study included scores from 54 undergraduate students (Generation Z) from a large Midwestern university enrolled in two separate online sections of an introduction to a Principles of Marketing course, in fall semester, 2017. In addition to case discussions and a team marketing plan, the students were required to complete the weekly individual online interactive learning (IOL) activities over a total of 12 weeks and to take two exams (the multiple choice questions came from the publisher's test bank). Twenty-eight students in one section had the opportunity to take the IOL activities as many times as they desired; fourteen students (1/2 of the section) had two or more attempts in a one or more modules (one student had five attempts in one module, four attempts in another module, and three attempts in another module). The theory behind the study was that with limited attempts, students would more likely read the book rather than simply looking up answers to the IOL, resulting in better exam scores.

Students did not collaborate with one another in performing the publisher's website activities. All activities presented and completed on the publisher's website were individual. One section of students was allowed unlimited tries at completing the activities in order to improve their scores while the other section was allowed one attempt. The total possible IOL score for the semester was 60 points. The two exams required for the course, a midterm and a final, covered core Marketing topics and were worth 100 points each for a total possible exam score for each student of 200 points. The midterm exam covered content presented in the first half of the semester and the final exam covered content presented in the second half of the semester. Both exams used multiple choice questions from the publisher's test bank.

2. METHOD OF ANALYSIS

The purpose of this study was to determine whether limiting the attempts by students to successfully complete formative assessments (IOL activities from the publisher's website) is related to improved performance on summative assessment (exams). In order to investigate this, Spearman's rank correlation coefficient was performed to measure the relationship between the total combined scores on the two exams and the total individual online interactive semester scores for both conditions sampled: unlimited attempts and limited attempts.

3. DATA ANALYSIS AND RESULTS

The cohort with unlimited attempts (n = 28) and the cohort with limited attempts (n = 26)were analyzed separately with the R statistical software package (R Core Team, 2018). Prior to performing the analysis, data cleansing operations were performed and the data reviewed for fitness. As an initial step, a single student record was excluded from the data set of the cohort with a limited number of attempts because the student did not register for the IOL activities in the learning management system. A visual inspection of the histograms for the variables under review suggested that the variables should not be assumed to be normally distributed. The Shapiro-Wilk test was performed to verify that the data were normally distributed (Ghasemi & Zahediasi, 2012). The Shapiro-Wilk test results, summarized in Table 1, confirmed that the data is not normally distributed: the tests rejected the null hypothesis (the data are normally distributed) for the combined exam scores and the combined IOL scores for both cohorts. In other words, a reliable assumption could not be made that the variables in question met the assumptions required for parametric correlation tests such as the Pearson Product Moment Correlation Coefficient. Therefore, Spearman's Rank Correlation Coefficient was used to measure the relationship between the combined exam scores and the combined IOL scores.

Table 1: Shapiro-Wilk Test of Normality

Cohort	Total IOL (P-value)	Total Exams (P-value)
Limited Attempts	1.398e-06	1.318e-05
Unlimited Attempts	5.669e-06	0.001476

Table 2 summarizes the results of Spearman's Rank Correlation Coefficient for both cohorts. Surprisingly, the cohort with limited attempts at the IOL activities did not demonstrate a statistically significant relationship to the combined exam scores. In other words, random variation is the best explanation of the observed correlation coefficient for the cohort with limited attempts. On the other hand, the cohort with unlimited attempts provided evidence of a statistically significant positive relationship between the IOL activities and the exam scores. In fact, the proportion of shared variance between the IOL activities and the combined exam for the cohort with unlimited attempts is over 50% (Coefficient of determination: 0.534). In short, judging purely from the results of this experiment, the conclusion is made that providing students with unlimited attempts to complete IOL activities offers significant improvements in the quality of feedback on these formative assessments. With that being said, these results are offered with caution due to a number of limiting factors to be discussed below.

Table 2: Spearman's Rank Correlation Coefficient

Cohort	rho	P-value
Limited Attempts	0.2535618	0.2213
Unlimited Attempts	0.7304872	1.018e-05

4. DISCUSSION AND FUTURE RESEARCH

The findings that emerged from this study suggest that limiting the number of attempts for IOL activities (formative assessments) will not necessarily correlate with better student performance on exams (summative assessments). Since formative assessments should in some way prepare

students for the more formal and consequential summative assessments, instructors would want to fine tune the delivery of formative assessments so that they provide as much feedback to students and teachers regarding their progress as possible. The study results suggest that offering students unlimited attempts at formative assessments may provide a better signal of progress to students seeking to improve their learning.

It might be construed from the study results that spending more time with chapter content through unlimited attempts (and under less pressure to get "it right the first time") translates into more frequent and deeper engagement with the material and consequently, better outcomes on midterm and final tests. This would reinforce Carroll's (1963) contention that the degree of learning effectiveness is a function of the time needed for learning and the time actually spent for learning.

Acknowledging the limitation of the small sample size, the author of this study plans to replicate the research the next time she teaches Principles of Marketing using the same textbook and IOL's, albeit at another university (she no longer teaches at the Midwestern university).

A future study could compare results when students are limited to a single attempt and a limited time of 20 minutes to complete the IOL activities. In addition, student performance comparisons could be made between those sections of the course, both online and face-to-face, that include IOL activities and those that do not.

Understanding student reading habit is another challenge to interpreting IOL results. Studies have found that many college students are non-compliant when it comes to reading course material (Starcher and Proffitt, 2011). As such, many of the students completing IOL activities may be doing so as a substitute to reading the material. Capturing this information may help researchersto better understand the effectiveness of IOL. Students' lack of preparedness also may account for poor formative (IOL) and summative (final grade) results.

In addition, college students could be surveyed to gather anecdotal information on their perceptions of learning outcomes as a result of performing IOL activities.

5. LIMITATIONS

While the authors are encouraged by the results of this study, the results are bound by important limitations due to sample size, data fitness, technique limitations and narrowness of scope. The sample sizes limited the ability to apply the results beyond this specific sample. In other words, the results are not representative for all students based on this limited sample size. Since the study relies on correlation, no claims can be made regarding causation because the technique cannot control for the many variables involved in online learning. Moreover, the use of a non-parametric technique like Spearman's Rank Correlation Coefficient means that the analysis sacrifices any knowledge regarding the magnitude of the correlation. With rank correlations only the direction of the relationship is known, but no inference can be made about the magnitude of the changes involved in the relationship. Finally, the scope of the study is extremely narrow including the analysis of two sections of one course design and one set of IOLs on a singular publisher's website. The differences in course design cannot be accounted for in the results. As with other scientific studies, replication offers the best path to discovering the truth. Colleagues are encouraged to replicate the experiments for themselves

to verify the results of the study.

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