

# On Effort and Achievement of Business Undergraduate and Graduate Students under a Disastrous Event

Wai Yin Mok<sup>1</sup>, Jonathan Rex Mok<sup>2</sup> & Kit Yee Cheung<sup>1</sup>

<sup>1</sup> College of Business Administration, University of Alabama in Huntsville, Huntsville, Alabama, USA

<sup>2</sup> School of Law, University of Alabama, Tuscaloosa, Alabama, USA

Correspondence: Wai Yin Mok, College of Business Administration, University of Alabama in Huntsville, Huntsville, Alabama, 35899, USA. Tel: 1-256-824-6980. E-mail: mokw@uah.edu

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## Abstract

The 2011 tornado event in Alabama left college students with a choice to be exempt of their final examinations or participate in an attempt to improve their overall grades. This incident provided an opportunity to conduct an observational study with the goal of measuring the academic effort of business undergraduate and graduate students. The observation methodology utilized total enrollment of 3804 with an undergraduate enrollment of 3298 and a graduate enrollment of 506 for the spring term of 2011 which included 969 undergraduates and 276 graduates. A stratified random sampling was used to collect enrollment data according to 8 disciplines within the business college. Findings of this study suggest graduate students outperform undergraduate students in grade improvement. In fact, the eligibility rate and successful rate for obtaining a higher grade after taking a final examination for both undergraduates and graduates were statistically insignificant. However, the participation rate for taking the final examination between undergraduates and graduates was statistically different.

**Keywords:** disastrous event, undergraduate and graduate students

## 1. Introduction and Situation

On April 27, 2011, a tornado outbreak devastated a large section of the state of Alabama, causing widespread power outages and record-breaking damages which forced the University of Alabama in Huntsville to halt operation for weeks. This disaster interfered with the final examinations scheduled for the spring term of 2011. Given the extent of the disaster, the provost suspended the scheduled final examinations and issued a new final examination policy.

This new policy allowed students to accept their letter grades as of April 27th with no further action required on their part, or to complete the remaining coursework by taking their final examinations scheduled later in May. To assist students in their decision making process, grades were posted on the university's online notification system to allow students to make an informed decision as to whether or not to participate in any final examination and to be aware of the scores they needed to obtain the grades they desired.

This new final examination policy made this observational study of business students' academic effort and achievement possible. In this unique circumstance, the following two survey questions were conducted to measure student effort: the first evaluated the percentage of students which chose to participate in taking a final examination and the second evaluated the percentage of students which could raise their grades by doing so. Both survey questions were comparatively used to investigate student effort and achievement under a unique stressful circumstance.

## 2. Literature Review

Within the education literature, effort and achievement has been evaluated as related factors. Various studies (Pace, 1982; Natriello & McDill, 1986; Johnson, Crosnoe, & Elder, 2001; Rovin, 2012) have quantified a positive linear relationship between students' effort and achievement. Pace (25 May 1982) conducted a study based on a survey collected on 12,000 undergraduate students from 40 different colleges over a 3-year period. Pace (25 May 1982) found that quality of effort is directly correlated with achievement and concluded that the key factor for achievement is the individual student's actions, not which college they attended or what subject they studied. Further research of these studies evaluates the possibility that students' effort on learning fosters

comprehension and intelligence, which eventually leads to achievement. Carol S. Dweck and her colleagues have substantiated that quality learning effort can result in positive outcomes and foster development of intelligence over time, which will eventually lead to higher achievement. This growth mindset theory, as it has been termed, is similar to the education belief that people have the capacity to learn and change (Illovsky, 2010). The process of learning and changing can be substantiated by the functional neuroimaging of the brain (Linden, 2006; Zhao et al., 2003).

With effort being established as one of the main factors that contribute to students' achievement, the question of whether different student groups exert different levels of effort becomes important in understanding student performance. A study by R. W. Lindner and Others in 1996 examined and compared self-regulated learning related to achievement—this being degree completion—of undergraduate and graduate students. The results indicated that graduate students scored higher than undergraduate students on the five subscales of the self-regulated learning model of metacognition, learning strategies, motivation, contextual sensitivity, and environmental utilization/control with metacognition being the most distinctive area between the two groups. These results suggest that graduate students consciously decide to utilize all available means and exert much greater effort to accomplish an academic goal than undergraduate students. To echo the findings of Lindner on effort differences between undergraduate and graduate students, a study by Fish in 2013 showed that graduate students performed better on online homework than undergraduate students. In most cases, graduate students recorded a higher GPA than undergraduate students.

The understanding of the psychological aspects of undergraduate and graduate students may provide some explanations accounting for the differences in self-regulated learning in these two groups of students. A recent study by Illovsky in 2010 comparing psychological traits between undergraduate and graduate education students indicated that graduate students scored higher in the areas of achievement, harm avoidance, understanding, and desirability than undergraduate students. Due to this, there is a general consensus among educators that graduate students demonstrate a more positive view about learning and achievement than undergraduate students. In addition, a study by Menchaca-Lopez in 2014 indicated that graduate students demonstrated knowledge and the ability to respond to intervention better than undergraduate students.

Independent research has also been conducted of students' academic effort when faced with a partially completed task. Observing elementary and middle school students, these studies have evaluated the correlation between students' preference and assignment choice. The studies have shown, all else being equal, that students tend to choose tasks or assignments that require less effort (e.g., Billington et al., 2004; Friman, 1995; Hawthorn-Embree et al., 2010; Hawthorn-Embree et al., 2011; Parkhurst et al., 2011). Parkhurst et al. (2011) indicated that leisure was the most significant factor in the Multidimensional Work Ethic Profile (MWEP) when determining students' preference on assignment choice. The findings concluded that students tend to choose tasks or assignments that require the least time to finish and subsequently leave the most time to relax. Hawthorn-Embree et al. (2010) compared students' assignment choice between completing a partially completed task and undertaking a completely new task. The study showed that when the new task involves comparatively 10% less work than the partially completed task, students tend to choose the new task. However, partially completed task preference has not been evaluated among college students.

Stress has also been evaluated with regard to undergraduate and graduate students' mental health in several comparative studies. Research has shown a general rise of mental health issues in terms of prevalence and severity among university students (Gallagher, 2011) with depression and anxiety affecting 16% of undergraduate and 13% of graduate students (Eisenberg et al., 2007). According to the Fall 2009 American College Health Association-National College Health Assessment, researchers found that stress levels are higher in undergraduates than graduates (Wyatt & Oswald, 2013). Further comparisons of the two groups indicated that the number of first year college students being frequently overwhelmed was increasing (Sax, 1997, 2003). A recent study of approximately 3100 graduate students found that 44.7% reported experiencing an emotional or stress-related problem during the previous 12 months (Hyun et al., 2006). Implications of such findings include decreased academic effort and performance of those groups affected by particularly high levels of stress. Directors of the National Survey of Counseling Center reported that 37.4% of students seeking campus counseling services have serious psychological problems, with approximately 5.9% so serious that they cannot remain in school or can only do so with extensive psychological/psychiatric assistance and 31.2% experience severe problems but are able to remain on campus if utilizing available treatment methods (Gallagher, 2011). With stress already prevalent in collegiate student bodies, the addition of a unique stressful event will further exacerbate these findings, thus prompting further study of effects and possible treatments.

### 3. Observation and Method

This study used stratified random sampling to gather data through two survey questions, which were sent via emails and personal contact to the faculty of each discipline of the College of Business Administration. Each discipline was classified as a stratum and there were 8 strata in the population. A main reason for using this sampling technique is that the elements within each stratum were homogeneous; and as a whole the strata provided a close representation of the entire business student population of 1245 in the spring semester of 2011. To test whether the sample sizes of both survey questions were within the acceptable range, sample size statistical calculations were performed (see Appendix A). The result indicated that the sample sizes of both survey questions were indeed adequate.

The response rate of the first survey question was 36.75% whereas the second survey question was 13.93%, which was lower than that of the first survey question. Primarily, this is due to the fact that faculty needed to calculate three separate categories: first, the current standing of each student to determine the number of students who were eligible for moving up a letter grade if the student would take the final examination; second, the number of eligible students who took the final examination and lastly the number of students who succeeded in doing so. That required more in-depth calculation, which discouraged faculty from responding. The response rates from all strata for the first and second survey questions are respectively shown in Tables 1 and 2.

Table 1. Enrollment data for the first survey question

Discipline†	No. of classes	Population enrollment	No. of classes reported to the first survey question	Enrollment in reported classes	Percentage of enrollment in reported classes
ACC*	35	667	16	338	50.67%
BLS	4	178	1	51	28.65%
ECN	12	405	5	241	59.51%
FIN	14	307	1	28	9.12%
IS	28	509	9	289	56.78%
MGT	33	948	13	366	38.61%
MKT	16	405	2	39	9.63%
MSC	7	385	1	46	11.95%
Overall	149	3804	48	1398	36.75%

†ACC: Accounting

BLS: Business Legal Studies

ECN: Economics

FIN: Finance

IS: Information Systems

MGT: Management

MKT: Marketing

MSC: Management Science

\*The response of one of the accounting faculty members was not included because the final examinations of her classes were optional. Interestingly, her classes had the most students participated in the final examinations. Her submitted data was as follows:

Class	Enrollment	No. of students participated in the final examination
Acc 211-02	44	17
Acc 211-03	40	9
Acc 310-01	52	21

Table 2. Enrollment data for the second survey question

Discipline	No. of classes	Population enrollment	No. of classes reported to the second survey question	Enrollment in reported classes	Percentage of enrollment in reported classes
ACC	35	667	5	69	10.34%
BLS	4	178	0	0	0.00%
ECN	12	405	1	53	13.09%
FIN	14	307	1	28	9.12%
IS	28	509	6	166	32.61%
MGT	33	948	4	129	13.61%
MKT	16	405	2	39	9.63%
MSC	7	385	1	46	11.95%
Overall	149	3804	20	530	13.93%

Second, the number of business students of the 2011 spring semester was 1245, consisting of 969 undergraduate students and 276 graduate students. Gender, age, ethnicity, and GPA of the students are shown in Table 3. Although gender does not seem to be a contributing factor for the differences between undergraduates and graduates, other more significant factors appear to be such as: (1) age: the median age of the undergraduate students was early 20s and that of the graduate students was late 20s, (2) ethnicity: the percentage of White graduate students was greater than that of White undergraduate students but the opposite was true for African Americans, and (3) GPA: business graduates had higher GPA than undergraduates, as indicated in the table.

Table 3. Gender, age, ethnicity, age and GPA of business undergraduate and graduate students

	Undergraduate	Graduate
Male	495	157
Female	474	119
Median Age	22	29
White	643 (66.36%)	210 (76.09%)
African American	176 (18.16%)	24 (8.70%)
Hispanic/American Indian/Alaskan	30 (3.10%)	11 (3.99%)
Asian/Pacific Islander	34 (3.51%)	9 (3.26%)
Nonresident Alien	55 (5.68%)	17 (6.16%)
Unknown	31 (3.20%)	5 (1.81%)
GPA	3.01	3.64
Head Count	969	276

\*This category includes Hispanic, Asian/Pacific Islander, American Indian/Alaskan, Nonresident Alien and Unknown.

Third, the study used enrollment data as the basis for the survey questions, not student counts. Each incident of enrollment and final examination participation was considered as an independent count despite the fact that a single student might enroll in multiple classes and participate in multiple final examinations. The basis for this counting method is that a student's identity is protected under the 1971 Family Rights and Privacy Act and the 2008 Higher Education Opportunity Act. Hence, it is impossible to know the classes in which a student is enrolled. In addition, the score earned for each class in which a student enrolled before final examination is not likely to be exactly similar. Therefore, each examination decision reflects a unique behavior stemming from varied circumstances despite involving the same individual. As a result, the statistics based on enrollment and final examination participation incidents provide a more accurate picture of how a student responds to varied

circumstances and corresponding decisions. It also allows exploring the situation that leads to a decision rather than focusing on an individual count.

### 3.1 Findings and Statistical Analysis

This section presents the data collected for the first and the second survey questions and the findings and statistical analysis thereof. Recall that the first survey question asked for the number of students who participated in the final examinations. Table 4 shows the number of undergraduate and graduate students of each discipline who participated in the final examinations.

Table 4. Total business undergraduate and graduate students participated in final exams of various disciplines

Discipline	No. of classes	Population enrollment	No. of reported classes	Enrollment in reported classes	No. of students participated in final exams	Final exam participation rate
Undergraduate						
ACC	23	570	10	268	35	13.06%
BLS	3	165	1	51	7	13.73%
ECN	11	405	5	241	12	4.98%
FIN	8	264	1	28	5	17.86%
IS	19	450	8	277	14	5.05%
MGT	20	766	6	254	0	0.00%
MKT	10	344	2	39	0	0.00%
MSC	6	334	1	46	0	0.00%
Overall	100	3298	34	1204	73	6.06%
Graduate						
ACC	12	97	6	70	14	20.00%
BLS	1	13	0	0	0	N/A
ECN	1	0	0	0	0	N/A
FIN	6	43	0	0	0	N/A
IS	9	59	1	12	1	8.33%
MGT	13	182	7	112	3	2.68%
MKT	6	61	0	0	0	N/A
MSC	1	51	0	0	0	N/A
Overall	49	506	14	194	18	9.28%

To answer the question whether the participation rate of the business graduate students was statistically greater than that of business undergraduate students of spring 2011, we conducted a 2-proportion Z-test and the results are as follows:  $z$ -score = 1.68 and  $p$ -value = 0.046 (see Appendix B). Since the  $p$ -value is less than 5%, at the 95% confidence level the percentage of the business graduate students who participated in the final examinations was statistically greater than that of the business undergraduate students of spring 2011.

While the first survey question was concerned about the final examination participation rates of business undergraduates and graduates, it did not address the issue that not all students were eligible to improve their grades by participating in final examinations. Hence, to further investigate the relationship between effort and achievement, the second survey question was designed to gather data on the number of eligible students who were able to improve their grades by participating in the final examinations, the number of eligible participants who chose to participate in the final examinations, and the success rate of those eligible participants. Table 5 shows the collected data.

Table 5. Total undergraduate and graduate eligible students, eligible participants and successful participants

Course No./Section No.	Enrollment	No. of eligible students	Eligible student rate	No. of eligible participants in final exams	No. of successful participants for an improved grade
Undergraduate					
ACC 441	20	7	35.00%	0	0
ACC 432	8	2	25.00%	1	1
ECN 143	53	8	15.09%	3	3
FIN 461	28	15	53.57%	5	3
IS 210	37	3	8.11%	0	0
IS 310	31	5	16.13%	2	2
IS 301-01	35	1	2.86%	0	0
IS 301-02	34	1	2.94%	0	0
IS 477	17	3	17.65%	0	0
MGT 301-03	45	5	11.11%	0	0
MGT 401	44	11	25.00%	0	0
MKT 343	1	0	0.00%	0	0
MKT 480	38	8	21.05%	0	0
MSC 385-02	46	0	0.00%	0	0
Overall	437	69	15.79%	11	9
Graduate					
ACC 541	6	1	16.67%	0	0
ACC 532	4	1	25.00%	1	1
ACC 602	31	4	12.90%	3	3
IS 577	12	2	16.67%	1	1
MGT 501	13	2	15.38%	0	0
MGT 600	27	5	18.52%	3	2
Overall	93	15	16.13%	8	7
Combined Overall	530	84	15.85%	19	16

Table 5 indicates that the eligibility rates of the business undergraduate and graduate students were respectively at  $15.79\% = 69/437$  and  $16.13\% = 15/93$ . To test whether they were statistically different, a 2-proportion Z-test at the 0.05 level of significance was conducted (see Appendix C). The results are as follows:  $z$ -score = 0.0814 and  $p$ -value = 0.4676. Since the  $p$ -value is greater than 5%, at the 95% confidence level the eligibility rates of the business undergraduate and graduate students were not statistically different.

The participation rates of those eligible undergraduate and graduate students were respectively at  $15.94\% = 11/69$  and  $53.33\% = 8/15$ . A similar 2-proportion Z-test was conducted to verify whether these two percentages were statistically different. The resulting  $z$ -score is 3.137, and the  $p$ -value is 0.000853, which is less than 0.05. Hence, the participation rates of those eligible undergraduate and graduate students were shown to be statistically different.

As for the undergraduate and graduate students who successfully moved up to a next letter grade, the success rates of these two groups of students were respectively at  $81.82\% = 9/11$  and  $87.50\% = 7/8$ . A similar 2-proportion Z-test was again used to verify whether there was a statistical difference. The results are that the  $z$ -score is 0.3353 and the  $p$ -value is 0.7374, which is greater than 0.05. This means that the test did not show any statistical difference.

#### 4. Discussion and Implication

Implications of this study extend current research on student effort. Students tend to prefer assignments or partially completed assignments that require less work. This study extends the work of Hawthorn-Embree et al. (2010), Hawthorn-Embree et al. (2011), and Parkhurst et al. (2011), which involved students from elementary to middle school, by observing a more mature sample of undergraduate and graduate students. The results indicated that under a unique stressful circumstance 6.06% of business undergraduate students and 9.28% of business graduate students, which are statistically different (see Appendix B), chose to complete the course through a final examination over a reduced-to-zero effort option. These results indicate over 90% of college students remained at status quo instead of completing the final task of the course. Graduate students demonstrated significantly more effort to complete a partially completed task than undergraduates.

Various studies have shown a positive relationship between effort and achievement. This study shows that the relationship is still valid under an added stressful condition. In this study 81.82% of undergraduate final examination participants and 87.50% of graduate final examination participants succeeded in one letter grade improvement after taking the final examinations, which are not statistically different (see Appendix C). The participation rates of the eligible undergraduates and graduates showed a statistically significant difference at 15.94% and 53.33% respectively (see Appendix C). The final examination participation rate of graduate students was almost triple that of undergraduate students, but the achievement level of both groups was similar. This disparity in participation rates partially explains why the average GPA of graduate students (3.64) is higher than that of undergraduate students (3.01). Therefore, within the context of this study, the key difference between undergraduates and graduates is effort, not achievement. This finding suggests that business graduate students are more result driven and likely to exert effort for an improved reward than business undergraduate students. If both groups exerted the same level of effort, it can be expected that a similar level of achievement would be accomplished by both groups, with this being contrary to most educator's perception that graduates outperform undergraduates in assignments and examinations.

Analysis of characteristic differences between business undergraduate and graduate students showed that median age and ethnicity differences between both groups are statistically significant (see Appendix D). Median ages of undergraduates and graduates are 22 and 29, respectively, thus representing two separate generations: GEN Y and GEN X (Hansen & Leuty, 2012). Age influences the attitude of work effort to some degree among generations; but, the continued changes in technology, population and resources make it difficult for equivalent comparisons among generations (Meriac, Woehr, & Banister, 2010). However, a general trend suggests leisure increased steadily over the generations and work centrality declined (Twenge et al., 2010). Generation Y also places leisure above extrinsic and intrinsic values (Schullery, 2013). That partially explains why graduates work harder than undergraduates due to the significant age difference of the two groups.

The other characteristic distinction between these two groups is the racial profile of undergraduates and graduates. This included the ratios among White, African American, Asian, Hispanic/American Indian/Alaskan, Nonresident Alien and Unknown. Although the percentages of Asian, Hispanic/American Indian/Alaskan and Nonresident Alien between undergraduates and graduates are similar, there was a significant increase of White students and a decrease of African American students in the graduate level. While studies have shown African American and Hispanic students are still underrepresented in colleges (Kinzie et al., 2008; Walpole et al., 2002; Criddle-Straugheter & Akladios, 2011), the African American undergraduate students were well represented at 18.16% and the White undergraduate students were represented at 66.36% in this study, which is average within the general population. However, African American graduate students were underrepresented at 8.7% whereas White graduate students were overrepresented at 76.09%. Nevertheless, this discrepancy is insufficient to indicate the effort gap between undergraduates and graduates due to the fact that the identities of all final examination participants were protected by the 1971 Family Rights and Privacy Act. Therefore, the correlation between racial percentages and levels of exerted effort was inconclusive due to the lack of racial profile data of all final examination participants; even though, the percentages between White and African American undergraduates and graduates were statistically different (see Appendix D).

The acute onset of stress caused by the severe weather on April 27th, 2011, may be another link for the difference in participation of final examinations between undergraduates and graduates. Three EF4 tornadoes and around twenty EF1 tornadoes touched down within fifty miles of the university on that day and with 80% of the university's students living within thirty miles of the campus (see <http://www.uah.edu/provost/offices/oir>), a majority of students surveyed were directly or indirectly impacted by the tornadoes. This translates to a significant portion of the student population suffering from mild to severe psychological effects of a disaster; the most common of which is Post Traumatic Stress Disorder (PTSD), followed by depression and anxiety (see

National Center for PTSD). Since undergraduates are less equipped to cope with stress than graduates (Eisenbery et al., 2007; Wyatt & Oswald, 2013); it is expected that this added stress impacted undergraduates' academic performance more negatively than graduates.

This study indicated that it is the level of effort that separates undergraduate from graduate students, with graduate students more likely to exert more effort than undergraduate students. With this being the case, educators can address needs of both groups separately. Undergraduates likely represent generation Y and thus are prone to think visually, want immediate gratification, and emphasize fun and excitement (Josiam et al., 2009). They tend to utilize collaboration tools (technological devices) to solve problems and shorten the learning curve (Bradley, 2007). Faculty may design assignments with more direct applications, utilize more visual materials, and facilitate more interaction through technological devices to encourage undergraduates' participation. Also, immediate feedback and extra credit opportunities may encourage more undergraduate effort. Graduate courses need not be as much individual detail instruction, but can focus more on academic goals for students to achieve.

The above implications of exerting effort between business graduate and undergraduate students can possibly carry over in a similar trend in the workplace. Workers with graduate degrees may exhibit higher effort and self-efficacy than those with only bachelor's degrees under stressful circumstances. With this being the case, graduate students as a whole in the workforce may have a more advantageous position than undergraduate students. According to the 2009 job survey conducted by the National Association of Colleges and Employers (English et al., 2012), communication skills, both verbal and written, and a strong work ethic are the first two qualities needed for new recruits. Furthermore, the positive effort behavior of graduate students observed by this study may translate into enhanced occupational competency and increased employee productivity, even during periods of unique stressful circumstances.

Lastly, studies by Hailikari et al. (2008), Diseth et al. (2010), Hemmings and Kay (2010), and Martin et al. (2013), have indicated that prior academic achievement has a predictive value for future academic performance among grade school students and college students. This study echoes a similar hypothesis in college students. Our findings indicated that 15.79% of undergraduates and 16.13% of graduates were eligible to move up to a letter grade if final examinations were taken. The illegibility rates of undergraduates (84.21%) and graduates (83.87%) represented students who could not move up to a letter grade even if they had scored 100% correct on final examinations. It suggests that prior (or cumulative) achievement before final examinations not only has a predictive value; it is a prerequisite for students to improve their current status. In other words, prior (or cumulative) achievement restricts students' further achievement.

## 5. Limitations

This study was limited to students from the College of Business Administration of the University of Alabama in Huntsville. It would be a more comprehensive study if other colleges of the university were included, which would better represent the general population. Students from other colleges may not respond in the way that business students did. A comparison of students' responses from different colleges may enhance our understanding of students' behavior on effort and achievement under a stressful situation.

The observational study of this paper investigated business students' decision made under a unique circumstance. Although their decisions reflected academic effort, this study did not consider the intellectual and nonintellectual variables that lead to their decision preference. It would be beneficial to conduct follow-up studies to investigate the various aspects of how business undergraduate and graduate students evaluate and decide what measure of work to put forth in a unique stressful event. The use of Multidimensional Work Ethic Profile proposed by Miller, et al. (2002) and a personality measure, such as NEO-FFI five factors model proposed by Costa and McCrae, for both groups of students to complete could provide understanding on their behavior dynamic. The information of students' ACT or SAT scores can serve as a benchmark for an intellectual variable of business undergraduate and graduate students. It may yield important insights on decision making behavior. Most importantly, further findings may suggest and postulate any differences between business undergraduate and graduate students in their value of work and work performance in their career path.

The disastrous event on April 27th, 2011, posed additional stress to the students at the University of Alabama in Huntsville. We understand that undergraduates may be affected by the disastrous event somewhat more than graduates. The degree to which the additional stress and hardship influences both groups of students' decision-making preference needs to be further investigated. A similar study is being conducted by Professor James Hamilton, called the "Silver Lining Project," which is investigating the effects of the tornado outbreak of April 27, 2011, in Tuscaloosa on overall students' adjustment. The goals of the study are to identify the effects of the disaster and to pinpoint the psychological mechanisms that trigger such effects. It may widen our



understanding of how students cope with disastrous situations and continue to function to finish their academic work.

The business undergraduates of this study belong to the newest generation: generation Y or the millennial generation. The most noticeable differences of the millennial generation are their technological aptitude (Reisenwitz & Iyer, 2009) and their sense of entitlement (Schullery, 2013). Also, they exhibit more needs for counseling and more episodes of psychological distress (Sax, 1997, 2003; Gallagher, 2011). Technological aptitude and entitlement may promote counterproductive behavior and encourage a less effort approach to study that may deter them from reaching their potential. The higher level of stress experienced by this group of students may hinder their academic performance. Therefore, further research could focus on formulating and verifying a hypothesis about how technological aptitude, entitlement and stress level of the millennial generation are related to positive or negative effects of achievement.

## 6. Conclusions

Business graduate students demonstrated a higher level of work effort and stamina than undergraduate students under a disaster event with implications of a possible continuous trend in the workplace. This study also suggests that the academic achievement gap between graduates and undergraduates could be mitigated by the level of exerted effort.

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## Appendix A

To calculate the sample sizes of both survey questions, the suggested proportion of final examination participants was set at 25%, which means 75% of the students chose the reduced-to-zero effort task to complete the course. This proportion benchmark was applied according to a study of partially completed course preference (Hawthorn-Embree, et al., 2010). The study indicated that 74.55% (41/55) of 7th graders chose to finish the assignment with 10% less work than the original work required; therefore, 25.45% of students chose to complete the previous assignment. We believe the suggested proportion for final exam participants was sufficient in our study. Hence, we assume  $p = 25\%$  of business students would take the optional final examinations of spring 2011. We use the random sample formula for calculating the sample size  $n$  for the both survey questions:

$$n = (z_{(\alpha/2)})^2 p (1-p) / E^2$$

Setting the desired margin of error  $E$  to 0.04,  $n = (1.96)^2(0.25)(0.75)/(0.04)^2 = 451$ . The reported enrollments of both survey questions were 1398 and 530 respectively, which were greater than the required number of 451. A word of caveat is that with our best effort, we still had no control on the survey response rate or the number of enrollments in each class. For the first survey question, each stratum was included in the sample; however, Finance and Marketing enrollments were slightly underrepresented because of the small class size. For the second survey question, each stratum was also included in the sample except Business Legal Studies, which was peripheral to business majors and underrepresented like Finance and Marketing.

## Appendix B

Let  $n_g$  and  $n_u$  be the respective numbers of the graduate and undergraduate business students of spring 2011. Let  $x_g$  and  $x_u$  be the respective numbers of the graduate and undergraduate business students in the reported classes of the survey. Let  $p_g = x_g / n_g$  and  $p_u = x_u / n_u$  be the respective proportions of the graduate and undergraduate business students who participated in the final examinations of spring 2011. The null and alternative hypotheses are:

$$H_0: p_g - p_u \leq 0,$$

$$H_a: p_g - p_u > 0.$$

Assume  $p_g = p_u = p$ . Then, the standard error of  $p_g - p_u$  is  $\sqrt{p(1-p)(1/n_g + 1/n_u)}$ . With  $p$  unknown, the standard error of  $p_g - p_u$  is estimated as  $\sqrt{p'(1-p')(1/n_g + 1/n_u)}$  where  $p'$  is the pooled estimator of  $p$ . The test statistic  $z$  for hypothesis tests about  $p_g - p_u$  is thus  $(p_g - p_u) / \sqrt{p'(1-p')(1/n_g + 1/n_u)}$ . According to Table 4,  $p_g = 18/194 = 0.09278$ ,  $p_u = 73/1204 = 0.06063$  and  $p' = (18+73)/(194+1204) = 0.06509$ . Therefore, the standard error of  $p_g - p_u$  is 0.01908. The test statistic  $z$  is therefore 1.6847. As a result, the  $p$ -value is 0.04602 and thus  $H_0$  is rejected at the 0.05 level of significance. Hence, at the 95% confidence level the percentage of graduate students taking the final examinations was statistically greater than that of undergraduate students.

### Appendix C

Three 2-proportion Z-tests at the 0.05 level of significance were performed for the second survey question, each of which has a null and an alternative hypothesis as follows:

$$H_0 : p_1 - p_2 = 0,$$

$$H_a : p_1 - p_2 \neq 0.$$

Following a similar statistical procedure of Appendix B, the following results were obtained for the three Z-tests at the 95% confidence level:

	Undergraduates	Graduates	Statistical Results	Conclusion
Eligibility Rate	15.79% = 69/437	16.13% = 15/93	$z = 0.0814$ , $p = 0.4676$	No statistical differences
Participation Rate	15.94% = 11/69	53.33% = 8/15	$z = 3.137$ , $p = 0.000853$	Statistically different
Success Rate	81.82% = 9/11	87.50% = 7/8	$z = 0.3353$ , $p = 0.7374$	No statistical differences

### Appendix D

A standard two-sample t-test for comparing two means was conducted to verify that the average age of business graduates was statistically greater than that of business undergraduates in the spring term of 2011. The data in the following table was obtained from the Office of Institutional Research of the university.

Group	Population	Average age	Standard Deviation
Undergraduates	969	24.15	1.98
Graduates	276	32.7	1.29

The results are as follows:  $t$ -value = 85.18,  $df = 680.8$ ,  $p$ -value = 0. Therefore, at the 95% confidence level, the average age of business graduates was statistically greater than that of business undergraduates.

A Z-test similar to the one of Appendix B was conducted to verify that the proportion of White business graduates was statistically greater than that of White business undergraduates and the opposite was true for African American. For White,  $z$ -score = 3.07 and  $p$ -value = 0.001. For African American,  $z$ -score = 3.78 and  $p$ -value = 0.00008. Therefore, both assertions were statistically established.

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