

# DOES HOMEWORK REALLY MATTER FOR COLLEGE STUDENTS IN QUANTITATIVELY-BASED COURSES?

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## **ABSTRACT**

*This investigation was initiated by two students in an Advanced Computer Applications course. They sought to examine the influence of graded homework on final grades in quantitatively-based business courses. They were provided with data from three quantitatively-based core business courses over a period of five years for a total of 10 semesters of data. The results indicated that graded homework grades were highly correlated with final course grades, but the paired t-test showed significant difference between the graded homework and final course grades. The R-squared value of .463 showed that graded homework accounted for a significant portion of the final course grade. This finding is important as instructors search for pedagogy that can positively impact final grades and facilitate necessary and timely progress toward graduation.*

Keywords: homework, automaticity, practice, quantitatively-based courses, chunking

## **INTRODUCTION**

This study was initiated by two students in an Advanced Computer Applications class who decided to study the influence of graded homework on final grades as their course research project. They had observed that students who completed their homework had better grades in their classes, but they wanted to statistically support this claim. And as the instructor, I concurred that the assumption was, in all likelihood, correct and provided them with several semesters of data. By investigating the data from multiple perspectives, they exposed some interesting results. As college students are entering higher education, increasingly unprepared or under-prepared, pedagogical techniques that can positively impact their learning, need to be carefully examined. It is imperative that faculty continually explore ways to promote student learning and their progress toward graduation. Student retention and

higher education graduation rates have become an urgent issue for students, parents, politicians, employers, and instructors.

## **LITERATURE REVIEW**

### **Importance of Practice**

The importance of assigning homework as a tool for practice continues to be debated at many levels of education. Refer to the meta-analysis conducted by Cooper, Robinson, and Patall (2006) for synthesis of research on homework. However, whether it is a baby learning to walk or a professional athlete honing his or her talents, practice is essential for them to master their skills. To be an accomplished musician or athlete means hours of practice

for years. This situation is acknowledged and rarely questioned.

Although “how” an individual learns, acquires knowledge, and retrieves it are still unclear, cognitive scientists are developing frameworks to understand these processes. (Anderson & Lebiere, 1998; Bodie, Powers, & Fitch-Hauser, 2006; Buschke, 1976; Guoqi Li, 2013; Willingham 2009; & Zhang et al., 2012). Much of this research examines the importance of automaticity for acquiring increasing proficiency across disciplines and in specific courses. Rodgers (2011) investigated the role of automatization for learning language skills in college students studying Italian. He found the “...only significant difference was between the Beginner and Advanced groups for comprehension... comprehension of verbal morphology eventually becomes automatic at high levels of proficiency.” (p. 313).

Learning by strategies or learning by drill, both involved practice to produce automaticity. (Delazer et al., 2005; Lassaline & Logan, 1993; Logan & Klapp, 1991). Delazer (2005) examined neurological changes in the various areas of the brain based on fMRI study. They found that training by strategy or training by drill “lead to significant improvements in terms of speed and accuracy.” (p. 843). Logan and Klapp (1991) found that although arithmetical practice produced automatization in “alphabet arithmetic,” a single one-hour session of rote memorization produced the same level of automaticity. They suggested this finding had important implications for the practicality of achieving automaticity and significance of mastering every fact in developing specific skills. However, their contention is that in long-term development of a skill to the point of mastery, “there may be no substitute for extended practice.” (p. 194). Lassaline and Logan (1993) used a counting task involving practice for 13 sessions to determine when performance reached asymptote when examining the slope of the function of response latency to numerosity. The asymptote was reached after session three. However, significant changes in the slope were apparent in the first session “which suggests that that automatization was taking place.” (p. 565).

Burtis (1982), Buschke (1976), and Willingham (2009) attributes this automaticity to a process called chunking. They and others (Bodie, G.D., Powers, W.G., & Fitch-Hauser, M. 2006; Guoqi Li et al., 2013; Zhang, D et al., 2012) contend that significant chunking of individual pieces of information or data must be grouped together as one chunk of information that can be readily retrieved. This chunking is the result of repetitive practice. For example, learning the word “practice” as one chunk instead of eight individual items—p r a c t i c e. Individuals learn to use the word “practice” must more efficiently and effectively as one chunk instead of trying to put seven pieces

of information together. The importance of this is that working memory is freed up which some contend is fixed. (Willingham, 2009). The result is more room for higher-order operations and problem-solving. (Bodie, G.D. et al., 2006; Buschke, 1976). Guoqi Li et al. (2013) found that “chunking can increase memory capacity in an unlimited manner through training.” (p. 9). Zhang et al. (2012) found that chunking of visual information was effective in teaching students with math disabilities geometry. Other studies showed that chunking has resulted in successful learning of both verbal and quantitatively-based concepts, many times in conjunction with other strategies. (Bodie, G.D., Powers, W.G., & Fitch-Hauser, M., 2006; Zhang et al., 2012).

### Homework and the College Student

Although there are numerous articles on the impact of homework on final course grades for college students, their methodologies are quite disparate. (Alsosary, 1995; Bembenutty & White, 2012; Brender, 1996; Cartledge & Sasser, 1981; Chulkov, 2008; D’Souza & Maheshwari, 2010; Durr, 1999; Galyon, Blondin, Gorbes, & Williams, 2013; Kitsantas & Zimmerman, 2009; & Lazarova, 2015) To further complicate the role that homework plays on final grades in college courses, faculty at higher educational institutions assume that college/university students are responsible for their own learning (Brender, 1996) and should no longer have to be “spoon-fed.” And, certainly research schools have different priorities than “teaching” institutions. But with the increased democratization of higher education, students are entering colleges and universities ill-prepared to effectively complete their plan of study for graduation. A study conducted by the Educational Testing Service (Goodman, Sands, & Coley, 2015) found that of the 22 participating countries, American students scored near the bottom on every measure from literacy to problem solving to numeracy. As an example of the dismal showing of American students “nearly two-thirds (64%) failed to reach this minimum level in numeracy” (p. 12) which resulted in the United States placing last on this measure. The implications of these findings and our personal, everyday experiences in the classroom have resulted in faculty urgently exploring ways to help students successfully compete in college. The issue of the under-prepared college student is exacerbated by students not completing work outside of the classroom. Not only do students not study the recommended two hours outside of class for every hour in class, 63% spend less than 15 hours a week preparing for class. (Young, 2002) Yet, some faculty have become increasingly concerned about the impact of student mental health and stress because of assigned homework. (Kelley, 2011) An article in the Cornell Chronicle (Kelley, 2011) described how the Faculty

Senate at Cornell University passed a resolution that students should not receive extra work over breaks. The resolution strongly discouraged homework and projects that “necessitate... academic work for students” over breaks as they should be allowed to pace themselves and have rest and relaxation. (Rae, 2011) Nevertheless, there is a general assumption that homework will assist students in successfully completing coursework and lead to graduation.

Investigations of the influence of homework on final college course grades have been conducted for such courses as elementary Spanish (Brender, 1996), no course specified (Bembenutty & White, 2012), introductory physics (Lazarova, 2015), educational psychology (Galyon, Blondin, Gorbes, & Williams, 2013; Kitsantas & Zimmerman, 2009), mathematics (Cartledge & Sasser, 1981), economics (Chulkov, 2008; Durr, 1999), introductory management science (D’Souza & Maheshwari, 2010), and courses in the College of Environmental Design (Alsosary, 1995). There were no standardized measure of homework in these studies which makes comparisons of the studies difficult. Some of the studies contained self-reported information (Barkley, 2006; Kitsantas & Zimmerman, 2008), maintaining unsupervised logs (Bembenutty & White, 2013), no description (Alsosary, 1995), graded paper and online homework (Lazarova, 2015), earned extra points by just handing homework in (Brender, 1996), offered homework opportunities (Durr, 1999), and graded homework (Cartledge & Sasser, 2008; D’Souza & Maheshwari, 2010; Galyon, Blondin, Forbes, Williams, 2013). In addition, factors other than homework were included in many of the investigations.

In several of the studies, self-reported homework behavior was the method used to study the influence of homework on final grades. In the Barkley (2006) investigation, homework was self-reported and based on hours of study time. His other variables included assignment, quizzes, midterm exam and final exams. One of his findings was that “[f]inal examination grades appear to have not been influenced by assignment grades...” (p. 14) Instructors found that the average assignment grade of 83% was lower than they had expected, but higher than the mean grade for the course at 78.93. (Barkley, 2006). In the study conducted by Kitsantas and Zimmerman (2008), students in an introductory educational psychology course completed a survey of self-reported information including hours studied and study habits. They found that there were “important psychological benefits on college students’ development...and greater self-efficacy benefits” (p. 107). Nevertheless, the authors noted that over the long-term any causality between homework and other factors such as self-regulating beliefs become increasingly complex when examining the desired outcomes. The study conducted by Bembenutty and White (2013) focused on many of the same

factors as Kitsantas and Zimmerman (2008) with self-efficacy and self-regulation playing a significant role on a major project grade. Homework logs were maintained, collected weekly, and recorded after they were submitted to an instructor. If they were not filled out or filled out incorrectly, students were allowed to turn them in late. “On average, students returned four of the six logs.” (Bembenutty & White, 2013, p. 84). Their conclusion was that homework can be an important method for increasing student self-regulation and as a result improved final grades.

The investigations that included graded homework as a variable found that graded homework and final grades were positively correlated. D’Souza and Kelwyn (2010) studied the factors that influenced student performance in a management science course. Six variables, including graded homework, were identified. They ranged from student demographics to course structure to student motivation (which included homework). “All homework were collected, graded by the instructor, and returned back to the students.” (p. 7). Although much of the homework was not of high quality, it still accounted for approximately 10% of the overall grade. (D’Souza & Kelwyn, 2010). Galyon, Blondin, Forbes, and Williams (2013) examined the influence of critical thinking and accuracy as well completion of homework on final grades. Ten questions were selected from each chapter assigned in the text. Students completed the assignments and earned one point for each correct answer. Their findings were: “Overall, accurate homework completion showed promise as an intervention target for improving student performance and, at times, rivaled critical-thinking ability as the primary predictor of exam performance” (p. 96). The study conducted by Cartledge and Sasser (1981) compared pretest and posttest grades based on students having no homework versus having weekly homework assignments in a college algebra course. The homework assignments were graded and returned to the students. Pretest and posttest were given to determine if students receiving homework assignments learn more than those not receiving assignments. “The findings of the t-test for the posttest results were significant only at the .10 level ( $t = 1.744$ ,  $df = 28$ ,  $p < .10$ ) indicating that students receiving homework assignments are likely to learn more than those not receiving homework assignments” (p. 8).

### METHODOLOGY

Many of the studies included in the literature review did not provide their definition of homework as used in their investigations. The definition of homework for this study is: work assigned to be completed outside of class that provides an opportunity for students to practice and master the concepts under study. As noted in the litera-

ture review, the practice component is important to facilitate “embedding” the knowledge in working memory by becoming comfortable and familiar with it resulting in quick retrieval of chunks of information.

### Limitations and Characteristics of the Study

As with all studies, this one has limitations and specific characteristics that define it. These are identified below for the purpose of placing the investigations into a clearer context.

1. All courses comprising the data set were taught by same instructor.
2. The instructional method was similar for all the courses, e.g. problem-solving approach.
3. The homework was graded by the instructor.
4. Students repeating the course would be exposed to the same homework.
5. Students may complete homework and not submit it for a grade.
6. Students may receive assistance with homework from professor or other students.
7. Graded homework accounted for 5 – 10% of the final grade.
8. Five years of data for fall and spring semesters from three quantitatively-based courses (Bus 313 Managerial Finance, Bus 330 Quantitative Methods of Management Science, and Bus 325 Advanced Computer Applications) were collected for a total of 554 cases.
9. The attendance rate, for the courses in the study, was very high and it was unusual for students to be absent. Most of the absences are considered “excused” and include such events as athletics and college-sanctioned activities.
10. The homework assignments were paper generated versus online homework.
11. Homework was emphasized and, on occasion, students were dismissed from class if homework was incomplete.
12. Data Set and Variables

The data set consisted of 10 semesters of grades for three quantitatively-based courses from fall 2010 until spring 2014. The three courses (listed above) were taught every

semester by the same instructor. The number of cases was 554.

Dependent variable: Final course grade: scale (ratio)

Independent variable: Homework grade: scale (ratio)

### Statistical Procedures and Results

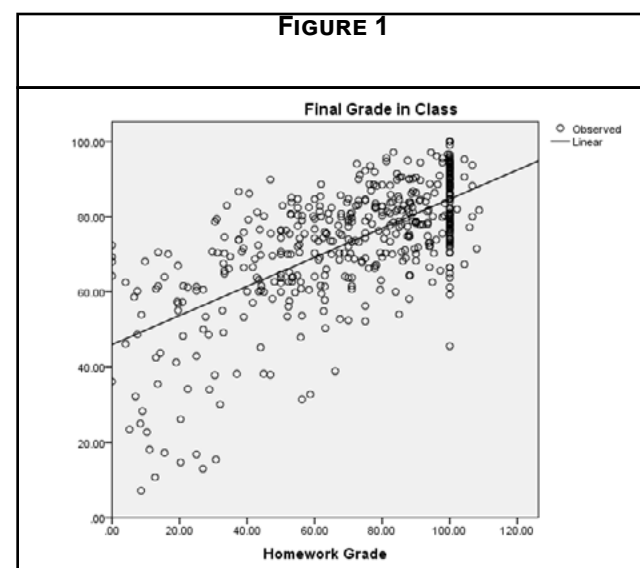
Several statistical methods were used to analyze the influence of graded homework on final course grade. The results are provided below with a brief explanation of each.

#### Pearson r

A correlation test was performed to determine if there was a significant relationship between homework grade and final course grade. With a correlation of .680, the relationship between graded homework and final course grade was significant at  $p < .000$ .

#### Scatterplot

A scatterplot visually shows the relationship between the independent variable (graded homework grade) and the dependent variable (final course grade). It can be noted there is considerable variability around the regression line. Refer to Figure 1.



#### Linear Regression

Linear regression was conducted to determine the proportion of the final course grade that is influenced by homework grade. The regression model was:  $Y = 48.289 + .370x$  where Y represented the final course grade and

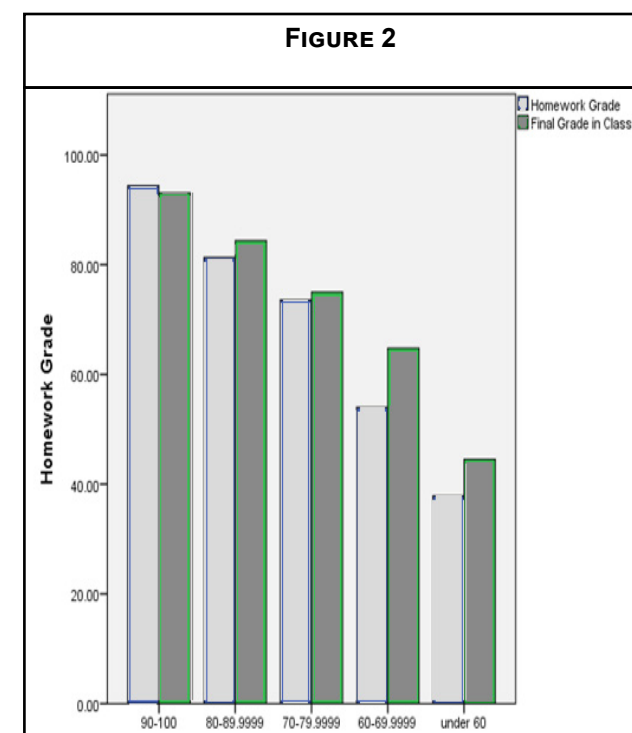
x represents the homework grade. R-squared of .463 indicated that graded homework accounts for a significant portion of the final course grade.

#### Paired t-test

A paired t-test was conducted to compare the independent variable (homework grade) and the dependent variable (final course grade). It was assumed that there would be no statistical difference. However, the mean for the homework grade was 69.4041 and for final course grade was 73.3423. With a  $t = 4.382$ , the difference between their means were significant at  $p < .000$ .

#### Bar chart

This comparison by letter grade is displayed in a bar chart. Refer to Figure 2. With the exception of a letter grade of A (final course grade between 90%–100%), the homework grade was less than the final course grade.



### DISCUSSION

Although not just one factor contributes to a student’s final course grade, this study clearly indicates that graded homework plays a significant role in a student’s final course grade with an R-squared of .463. As shown in the results, homework grade and final course grade were high-

ly correlated. This is consistent with extended practice via graded homework facilitating the chunking of new information, thereby, freeing up resources for other activities, such as critical thinking for test taking, completing a high quality, comprehensive projects, and improved decision-making. This positive impact of satisfactorily completing homework on final course grade is also shown in the scatterplot of homework grade in relation to final course grade. Refer to Table 1. However, those who did not earn a homework grade of at least 60% saw a major negative impact of their final course grade (final course grade of less than 60%). Refer to Table 2 for the bar chart that compares homework grade to final course grade. This chart shows that final course grade was higher than homework grade with the exception of the letter grade of A.

The paired t-test showed that the means of the homework grades and the final course grades were statistically significant with the final course grade being the higher of the two. The authors noted from the results of the paired t-test that not only was increased accuracy of graded homework correlated with a higher final course grade, there was a greater than a 1.058 increase in the final course grade for every point scored on the homework grade. This finding implies that completing homework at a high level of quality is an efficient and effective tool for student learning as the correlation value of .662—the higher the homework grade, higher the final course grade.

A key to graded homework having a positive impact on the final course grade is for students to understand the importance of homework. It must be stressed by the faculty or graduate assistants responsible for the course. Recommendations for emphasizing the importance of homework include such activities as:

1. grade homework and return to the students,
2. make homework a proportion of the overall final course grade,
3. check homework at the beginning of class with appropriate consequences for uncompleted homework,
4. encourage students to see instructor for assistance with homework as needed,
5. schedule office hours to maximize the time that faculty are available for student assistance,
6. place a statement in the syllabus about the importance of homework,
7. explain the impact of homework on final course grade,

8. collaborate with the academic resource center to find qualified tutors, and
9. have some type of homework assignment after every class period that corresponds to the concepts being taught.

With the democratization of higher education and the current state of inadequate, academic preparation at the elementary and secondary level, college faculty are exploring ways to facilitate the development of automaticity of skills and abilities. Research strongly suggests that this is achieved through chunking which is the result of repetition. This is where graded homework plays an important role. However, repetition should be of the sort that prompts automatic retrieval of the concepts under study by allowing working memory to be freed up for resources to be used for high-order abilities.

The completion of homework at a high level is not only an efficient tool for facilitating mastery of the concepts, but may promote confidence in students that encourages them to tackle what they view as difficult material, especially quantitatively-based subjects. For many of our students, this would be a major step in performing satisfactorily in their classes. Although grading homework does consume resources—faculty grading time—the return on this investment may result in a substantial payoff—student retention and graduation. As software continues to be developed to grade assignments, this task will consume less of the faculty's time while providing an efficient and effective tool for student learning.

### FUTURE RESEARCH

As Lehner, (2008) expressed in her study, students must have confidence to fully understand concepts of algebra. Certainly, the role of graded homework in developing confidence in students needs to be further explored. This is especially true in quantitatively-based courses. Math anxiety is real and destructive for student learning and by the time they arrive at college it has become difficult to address. A document from the Math Center at Texas A&M (n.d.) states: "Math anxiety has become so prevalent on college campus that many schools have designed special counseling programs to help math anxious students." (para. 2). Any pedagogical technique that can improve their confidence will positively impact their journey to graduation. Studying the impact of completing graded homework for specific groups needs to be considered. As more and more of students with "special needs" and inadequate math skills (Goodman, Sands, & Coley, 2015) enter in our classes, there is an obligation to them to find ways to advance their learning. Students must have a positive return on their investment (cost of college and op-

portunity costs) to continue to remain until graduation. Implementing a system of graded homework with a strong emphasis by the instructor may aid in this endeavor.

### CONCLUSION

The results of this study are consistent with Galyon, Blondin, Forbes, and Williams (2013) findings that graded homework was a significant predictor of grades. As students continue to enter higher education under-prepared in quantitatively-based skills and standards must be maintained to advance toward graduation, experimentation with the impact of graded homework on final grades provides a viable option for improvement of final course grades. This state of a lack of math proficiency with our current students relates closely with students struggling with math disabilities. (Zhang, et al., 2012). If chunking, as the result of repetitive homework, has a positive effect on students who have developed a disdain for or anxiety of math, can efficiently overcome these conflicts, the solution may be relatively simple. As was indicated from the ETS report (Goodman, Sands, & Coley, 2015), it is imperative that American regain its educational strength for continued success professionally and personally for individuals and as a collective.

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