

Effect of Homework on Academic Achievement: On-line compared to traditional pen and paper

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Abstract

This is a longitudinal study to investigate whether there is a correlation between the methods for completion of homework and the incentive levels with academic achievement. The method adopted in this study is the t-test statistical analysis to assess the relationship between the use of compulsory homework on achievement and the influence of intervening and moderating variables. The findings are as follows - Cohort 1 which completed homework in the traditional pen and paper style (with a mean of 13.278) performed better than the Cohort 2 which completed homework online. They also performed better than Cohort 3 which completed homework online (with a mean of 11.851). Cohort 3 that had no incentive and subsequently no compulsion to do the homework (with a mean of 11.851) performed better than Cohort 2 which completed homework online (with a mean of 9.658).

Key words: *On-line homework; academic achievement; homework; incentive.*

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Introduction

The internet has had an impact upon the higher education sector with the advent of online teaching and learning (Gomory, 2001; Otte & Benkw, 2006) and according to Allen and Seaman (2008) this growing phenomenon is showing no signs of slowing. With the closure of university campuses due to COVID 19 the application of online teaching and assessment was used a significant means for maintain continuity during the crisis. The importance of on-line technology as a new approach to education has not gone unnoticed and subsequently there is a sizeable body of literature on the topic. However, the literature is dominated by research concerned with curriculum design to suit an online environment, the relevance of online teaching as a form of distance education, and the concept of blended learning (Lim, Morris, & Kupritz, 2007; Gudmundsson & Southey, 2012; Weldy, 2018).

One aspect of the online phenomena that has received less attention is the integration of homework through the internet. Research regarding web-based homework (Hodge, Richardson & York, 2009) and online homework (McKessock, Chua & Foster, 2005; Gudmundsson & Southey, 2012) has been limited to examining the application of one particular software package or simply the impact in one semester. This paper addresses the gap in the literature by providing a longitudinal study to examine the degree to which web-based or online homework, specifically for a first year accounting course, affected student performance. The longitudinal study provides comparisons between student performances (involving web-based/online homework opposed to traditional pen and paper – with and without homework being compulsory) over six years.

Literature Review

Homework has been described as a process where a student begins, continues to work on, and completes an assigned task at home or in another setting other than a formal class (Hong, Milgram & Rowell, 2004). This implies that a student is able to exercise their own preference for how and when they learn (Vucetic-Trifirò, & Laing, 2021) and this form of empowerment may be categorised as a student-centred approach (DeLong, Winter & Yackel, 2003) which effectively involves active learning. Homework in general has been found to provide a powerful effect in the learning process (Walberg, Paschal & Weinstein, 1985) and the use of on-line homework has been reported to be an additional way to enable learning (McKessock, Chua & Foster, 2005; Hirsch & Weibel, 2003).

Keeping students engaged through the use of active learning strategies is an important factor in the learning process (DeLong, Winter & Yackel, 2003; Gopalakrishnan, 2004). Whilst engagement can take many forms the most common method has been the traditional pencil and paper homework. This practice of assigning homework varies across disciplines however, the use of homework tends to be most prevalent in the business or commerce faculties of universities. The justification for this tradition can be traced to prior research that homework aided in the cognitive development of students (Walberg, Paschal & Weinstein, 1985; Cooper, 1989; Lindsay, Nye & Greathouse, 1998; Keith & Cool, 1992; Warton, 2001).

A stronger more positive effect on student learning was found to result from homework that was graded as compared to homework that gave no feedback to students (Walberg, Paschal & Weinstein, 1985). Research has identified homework as an activity that is related to motivation, mastery of course material, and achievement (Keith & Benson, 1992; Epstein & Van Voorhis, 2001). Research has found that practice can indeed lead to higher levels of skill acquisition and that as skill acquisition increases, so too does the student performance (Ericsson, Krampe & Tesch-Romer, 1993). It is

also clear from the research (Cullen, Cullen, Hayhow & Plouffe, 1975) that students who are given an incentive, such as the allocation of marks, were more likely to complete the homework task than those who had no such incentive. A causal link between incentives to complete homework and academic performance was found in a more recent study by Cooper, Robinson and Patall (2006).

The pedagogical justification for the use of homework is derived from the findings of prior research that point to improved learning (Ericsson, Krampe & Tesch-Romer, 1993). Students who actively participate in the completion of homework can therefore be expected to exhibit greater understanding and ability in applying what they have learned. These expectations lead to the following research questions. When the effects of completing homework on-line are compared to the effects of completing homework in a traditional manner (pen and paper) are there likely to be any noticeable differences?

Would there be an observable difference between the results from the final exam question of the groups? as indicated by prior research (Cooper, Lindsay, Nye & Greathouse, 1998; Cooper, Robinson & Patall, 2006) In effect was there support for the literature that such an activity would produce long term retention of knowledge.

From the research questions the following three null hypothesis were developed.

Null Hypothesis

H₀₁ *There will be no significant difference in the academic achievements of students that completed their homework in the traditional pen-and-paper method (Cohort 1) as compared to students that completed their homework online (web-based) (Cohort 2).*

H₀₂ *There will be no significant difference in the academic achievements of the students who received marks for completing their homework by the traditional pen-and-paper method (Cohort 1) as compared to the students who had no incentive to complete the homework (Cohort 3).*

H₀₃ *There will be no significant difference in the academic achievements of students who received marks for completing their homework online (web-based) (Cohort 2) as compared to the students who had no incentive to complete the homework (Cohort 3).*

Method

This paper is a longitudinal study which examines the performance of students enrolled in a first year accounting course at an Australian university. The variables in this research were the treatment groups, as the independent variables and test result as the dependent variable. The treatment groups were categorised by two further variables – firstly whether any marks had been allocated to the completion of homework, and secondly whether the homework was assessed on the traditional method of pen and paper, online or not checked at all. The dependent variable was the results from the question in the final exam. The question addressed the same specific topic from the course and were examined in a consistent manner over the six years. The topic was covered in the middle part of each semester and is therefore considered to negate and primacy versus recency effect that could otherwise have an impact on retention of information and the distort the performance evaluation of the exam question (Crano, 1977; Steiner & Rain, 1989).

Given the nature and duration of the longitudinal study the details regarding the subjects in the different years is presented in Table 1.

Table 1.
Demographics of Groups

Groups	Treatment	Gender F / M	Marks allocated	Homework
1	Treatment	88 / 52	10	Compulsory - Not Online
2	Treatment	99 / 72	10	Compulsory - Online
3	Control	84 / 83	0	Not Compulsory – set questions listed

The groups consisted of 88 (38%) females and 52 (62%) males, treatment group two consisted of 99 females (%) and 72 males (%), whilst the control group had 84 (40%) females and 83 (60%) males. To test for possible differences between the test results of female and male students a student t test was conducted and there were no significant differences ($t = 2.365$, $df = 466$, $\alpha = 0.018$ equal variances assumed Levene's test for equality of variances not significant $F = 0.078$, $\alpha = .780$). Therefore, gender was not expected to affect the results of this study (Lopus 1997; Lipe 1989) and could be ruled out as having any influence on the findings.

Prior research (Gratton-Lavoie & Stanley 2009; Jones & Fields 2001; Bieker 1996; Doran et al 1991) reported that age and GPA scores can have a positive affect on students' performance in a course. Subsequently, the age and GPA scores could act as confounding or moderating variables. To test for a possible confounding effect in academic abilities between the two groups the Grade Point Average for each student was obtained and these are presented in order for the two groups in Table 3. To gain more meaningful data, the GPA scores were collapsed into categories. Collapsing or recoding nominal data is a common approach to acquire useable data (Alreck & Settle 1985, 278). A t test was performed ($t = -1.606$, $df = 173.89$, $\alpha = 0.110$, equal variances not assumed Levene's test for equality of variances was significant $F = 4.186$, $\alpha = .042$) and this indicated that there was no significant difference in the GPA scores between the two groups.

The next step involved collapsing the ages into five age categories and the details are reported in Table 2. Comparisons of the ages of the students in the categories were made using a t test (1:2 $t = 0.022$, $df = 37$, $\alpha = 0.983$; 1:3 $t = 0.568$, $df = 39$, $\alpha = 0.573$; 2:3 $t = 0.556$, $df = 38$, $\alpha = 0.581$) and this indicated that there was no significant difference in the ages between the three groups. Subsequently, age is not considered to affect the results of this study.

Table 2:
Age Groupings of Students

Age	2006	2007	2008	2009	2010	2011
18<	18 / 28%	30 / 39%	30 / 37%	35 / 39%	20 / 24%	26 / 32%
19 - 21	17 / 27%	25 / 33%	34 / 41%	26 / 29%	28 / 33%	25 / 30%
22 - 26	8 / 13%	11 / 14%	8 / 10%	11 / 12%	22 / 26%	18 / 22%
27 - 30	6 / 9%	4 / 5%	3 / 4%	7 / 8%	7 / 8%	4 / 5%
31 >	15 / 23%	6 / 8%	7 / 9%	10 / 11%	8 / 9%	9 / 11%
Total	64	76	82	89	85	82

Results

The average of the results for the exam question for each group are presented in Table 3 for the purpose of comparative analysis.

Table 3.
Average of the Exam Question for Groups

Groups	Exam Question	Total Students	Homework
1	13.278	140	Compulsory - Not Online (pen & paper)
2	9.658	171	Compulsory - Online
3	11.851	167	Not Compulsory – set questions listed

To test the first null-hypothesis “*There will be no significant difference in the academic achievements of students that completed their homework in the traditional pen-and-paper method (Cohort 1) as compared to students that completed their homework online (web-based) (Cohort 2)*”.

Table 4.
Cohort 1 vs Cohort 2

	Cohort 1	Cohort 2
Mean	13.27857143	9.658479532
Variance	21.54054471	21.90244238
Observations	140	171
Hypothesized Mean Difference	0	
df	298	
t Stat	6.817686354	
P(T<=t) one-tail	2.57143E-11	
t Critical one-tail	1.649982976	

A *t* test was performed ($t = 6.8176$, $df = 298$, critical value = 1.6499, assuming unequal variances) as the *t* Stat is greater than the critical value this indicates that a significant difference does exist between the two sample means in their final exam question scores. *There being a significant difference between Cohort 1 and Cohort 2 the null hypothesis is rejected.* This indicates that Cohort 1 which completed homework in the traditional pen and paper style (with a mean of 13.278) performed better than Cohort 2 which completed homework online (with a mean of 9.658).

To test the second null-hypothesis “*There will be no significant difference in the academic achievements of the students who received marks for completing their homework by the traditional pen-and-paper method (Cohort 1) as compared to the students who had no incentive to complete the homework (Cohort 3)*”.

Table 5.
Cohort 1 vs Cohort 3

	<i>Cohort 1</i>	<i>Cohort 3</i>
Mean	13.27857143	11.85119048
Variance	21.54054471	27.79209438
Observations	140	168
Hypothesized Mean Difference	0	
df	305	
t Stat	2.526080144	
P(T<=t) one-tail	0.006020168	
t Critical one-tail	1.649864893	

A *t* test was performed ($t = 2.526$, $df = 305$, critical value = 1.6498, assuming unequal variances) as the *t* Stat is greater than the critical value this indicates that a significant difference does exist between the two sample means in their final exam question scores. *There being a significant difference between the two groups the null hypothesis is rejected.* This indicates that Cohort 1 which completed homework in the traditional pen and paper style (with a mean of 13.278) did perform significantly better than the Cohort 3 students who had no incentive to complete their homework (with a mean of 11.851).

To test the third null-hypothesis “*There will be no significant difference in the academic achievements of students who received marks for completing their homework online (web-based) (Cohort 2) as compared to the students who had no incentive to complete the homework (Cohort 3)*”.

Table 6.
Cohort 2 vs Cohort 3

	<i>Cohort 2</i>	<i>Cohort 3</i>
Mean	9.658479532	11.85119048
Variance	21.90244238	27.79209438
Observations	171	168
Hypothesized Mean Difference	0	
df	331	
t Stat	-4.047317509	
P(T<=t) one-tail	3.22741E-05	
t Critical one-tail	1.649470149	

A *t* test was performed ($t = 4.0473$, $df = 331$, assuming unequal variances) and as the *t* Stat is greater than the critical value this indicates that a significant difference exists between the two sample means in their final exam question scores. *There being a significant difference between the two groups the null hypothesis is rejected.* This indicates Cohort 3 that had no incentive and subsequently no compulsion to do the homework (with a mean of 11.851) did perform significantly better than Cohort 2 which completed homework online (with a mean of 9.658).

Summary

The results are surprising and certainly unexpected given the literature regarding the espoused benefits of homework in general and the growing use of online homework. The finding of a significant difference between Cohort 1 who *completed their homework in the traditional pen-and-paper method* as compared to Cohort 2 who *completed their homework online (web-based)* was contrary to the prior research. Having tested the moderating or confounding variables which are identified in the literature specifically age, gender, GPA, there being no significant differences in these variables no concerns could be directed against these being responsible for the discrepancy. Further, as the teaching was conducted by the same academic staff over the periods involved the only conclusion seems to be that online (web-based) homework may not be as strongly beneficial to learning or retention of information (knowledge) as prior research has indicated. The longitudinal nature of the study may be the difference with prior research.

Obviously further research needs to be undertaken to examine the issues concerning the method of homework completion with consideration perhaps needing to focus on the nature of feedback and the marking allocation (incentive and compulsion) to clarify retention of the information (knowledge). Future research could investigate the impact that the online only approach that occurred due to COVID19 had on the learning outcomes of students and how that compares to the findings reported in this study.

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