

THE EFFICACY OF ONLINE HOMEWORK SYSTEMS IN INTRODUCTORY FINANCIAL AND MANAGERIAL ACCOUNTING COURSES

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Abstract

We examine the efficacy of online homework systems (OHS) for 421 accounting students in the introductory financial and managerial accounting courses. The purpose of the paper is to extend prior research by examining OHS efficacy differences between the two introductory accounting courses and the impact that OHS have on knowledge retention. A multivariate analysis of covariance (MANCOVA) was performed to test the research questions. The findings indicate that there is a positive performance difference on quizzes and the final exam for students using the paper/pencil method of completing homework versus an OHS. Performance differences are also greater in the managerial accounting course than in the financial accounting course. Further, our results suggest that knowledge retention is greater for students that use a paper/pencil method of completing homework than for students that use an OHS.

Introduction

Due to their presumed facilitation with advancements in technology, today's college students are often referred to as "digital natives." In a broad ranging critique of the American education system, Prensky (2001) attributes much of the system's shortcomings to educators' failure to understand the learning needs of today's students. In an effort to address this gap, institutions of higher education increasingly leverage advances in pedagogical technology. One such advancement that is increasing in popularity is online homework systems (hereafter, OHS). Prior literature indicates that students in courses as varied as Accounting, Calculus, Chemistry, Economics, and Operations Management generally have a positive reaction to the use of this type of technology (Haverty, 2012); suggesting that OHS are at least perceived as potentially compatible with the learning styles of today's "digital natives." However, though OHS provide a digital platform for students to complete homework, there is still a question as to whether or not they are as effective in promoting learning compared to the traditional paper/pencil homework.¹

¹ In addition, individuals seeking professional accounting certification (e.g., CPA, CMA, CIA, etc.) will be required to take the relevant examinations in a computer-based environment.

The importance of requiring homework in accounting courses is well established. Homework not only promotes learning, but also improves performance (Rayburn & Rayburn, 1999; Clark & Latshaw, 2012/2013). Further, students believe that homework provides motivation to learn course material (Farrelly & Hudson, 1989). Therefore, it is not surprising that accounting faculty continue to including homework as a course requirement. However, grading homework requires a significant amount of faculty time and energy. For accounting programs that provide student graders, the grading of homework can also tax dwindling departmental monetary resources.

OHS not only have the potential to relieve pressure on these scarce resources, but may also provide other conveniences and benefits to both faculty and students (Dillard-Eggers, Wooten, Childs, & Coker, 2008). For example, OHS allow for the instantaneous grading and posting of homework scores, which effectively eliminates, or at least significantly reduces, any time that faculty and/or graders have to spend grading homework and posting scores. OHS also typically allow faculty to set the number of attempts that students are allowed to successfully complete assigned homework problems. By allowing students multiple attempts, faculty may spend less one-on-one time with students answering homework related questions since students can continue submitting their assignment until they are satisfied with their grade (Peng, 2009). OHS also typically allow faculty to determine the level/type of feedback that is provided to students as they work through an assignment. This feature allows students to complete assignments on their own schedule as opposed to being constrained by faculty office hours, which may facilitate more independent learning (Gaffney, Ryan, & Wurst, 2010). Lastly, for quantitatively driven problems, OHS often include built-in algorithmic features that provide different numbers for each student, which encourages individual effort and learning. Given these potential benefits, in concert with an increasing need to align pedagogical methodologies with the learning styles of today's digital natives, it is not surprising that OHS are becoming ubiquitous in higher education (Gaffney, et al., 2010).

The purpose of this research is to extend extant literature on the use of OHS. Specifically, we examine the efficacy of OHS vis-à-vis traditional paper/pencil homework methods on multiple dimensions of course performance in both introductory financial and introductory managerial accounting courses; the latter of which receives little attention in the literature. We also examine differences in knowledge retention across homework mediums as measured by performance on a comprehensive final exam.

Our findings indicate that, in general, students perform better on homework assignments when using an OHS in comparison to a paper/pencil format. However, on average, students perform better on quizzes when using paper/pencil to complete homework relative to an OHS. Moreover, our findings indicate that knowledge retention is generally higher when students complete homework using paper/pencil vis-à-vis an OHS. The knowledge retention benefits of using the paper/pencil method of completing homework is also stronger in the introductory managerial accounting course relative to the introductory financial accounting course. These findings have important implications for instructors of introductory accounting courses that are currently using, or are considering using OHS. While the utilization of an OHS can significantly reduce or eliminate the time required to grade homework, these benefits may be outweighed by the potential adverse effects OHS have on metrics of course performance that traditionally carry greater weight than homework (e.g., quizzes and comprehensive final exams), and more importantly, knowledge retention.

The remainder of the paper is organized as follows: the next section reviews prior literature and provides motivation for the research questions, the third section discusses the research design, the fourth section discusses the results, and the final sections include a discussion of the findings and a conclusion.

Motivation and Literature Review

Prior research in non-accounting courses examines the effect of OHS on student performance, preferences, and perceptions of the effectiveness of these systems. In a meta-analysis on the use of OHS, Haverty (2012) finds that students generally have positive reactions to OHS. Specifically, in eleven of twelve studies examining OHS use in fields as varied as calculus, physics, chemistry, economics, and operations management, Haverty (2012) finds that students have positive attitudes towards the use of OHS. Research also indicates that the use of online homework

systems provide positive performance results. For example, a study involving a chemistry course found that an online system is “positively correlated with course grade” (Parker & Loudon, 2013). Studies involving the use of OHS within the accounting discipline examine student motivation and behavior (Peng, 2009), satisfaction (Dillard-Eggers et al., 2008; Haverty, 2012), and performance (Gaffney, et al., 2010; King & Mo, 2013). Peng (2009) surveyed students in a financial accounting course and found that less motivated students increase their level of effort when they believe that an OHS is interactive. This finding supports the argument that less motivated students believe that they can reduce their cognitive burden through the use of an interactive system and are, therefore, more likely to engage in homework activity. The resulting increase in engagement may impact satisfaction.

Eight of eleven accounting-specific studies reviewed by Haverty (2012) report positive student reactions to OHS use. For example, while students report that they do not spend more time completing homework using an OHS vis-à-vis paper/pencil, they believe that the use of an OHS enhances study quality, which leads to greater perceived understanding (Dillard-Eggers et al., 2008). However, educators want to know not only that OHS motivate students to engage in homework activity and that this form of engagement increases student perceived satisfaction but that OHS improve performance.

Several studies found a positive relationship between the use of an OHS and performance. Potter and Johnston (2006) reported a positive association between use of an OHS and performance on an exam in an accounting class. King and Mo (2013) found a positive relationship between a student’s overall course grade and the use of an OHS in an introductory managerial accounting course. Similarly, Massoudi, Koh, Hancock, & Fung (2017) found higher student performance on final exams in an introductory financial accounting course when students actively used WileyPlus (an OHS) to answer multiple-choice questions.

Not all studies found that the use of OHS has a positive impact on performance. The Gaffney et al. (2010) study finds mixed results. They compare the performance of students using an OHS to students using the traditional paper/pencil method of completing homework in an introductory financial accounting course. Their study was conducted in a large urban research university with a class section of over 200 students taught by one professor. They used multiple measures of performance including exams, homework, written ethics cases, quizzes, a comprehensive accounting cycle case, and students’ overall performance. They find higher levels of performance for the OHS group on written ethics cases and a comprehensive accounting cycle problem compared to the paper/pencil group. However, they find no difference in performance between the two groups on homework, take-home chapter quizzes, a single exam, or overall course grade. Also, student survey results did not indicate a difference in satisfaction between the two groups. The mixed findings in the studies cited lead us to our first research question.

RQ1: Is student performance higher when using an OHS to complete homework than when using paper/pencil?

To our knowledge, there has only been one study, conducted at a large research-oriented public institution that examines the use of OHS in introductory managerial accounting courses. In this study King and Mo (2013) found a positive relationship between performance on homework using an OHS and overall course grade. However, a significant limitation of this study is that they did not compare the performance of students using alternate methods of completing homework, and thus, the study can only speak in terms of a simple “association.” It also does not consider whether there is a difference in the efficacy of an OHS when applied to a managerial accounting course versus a financial accounting course.

Both introductory financial and managerial accounting courses require students to apply critical thinking skills when solving problems. However, some of the problems found in a managerial accounting course differ from those found in a financial accounting course. Many problems, in a managerial accounting course, are in a word-problem format and require students to clearly define the problem by organizing and determining the relevancy of available information. Homework, quiz, and exam questions in a word-problem format may require a different level of judgment and analysis than those that require the application of a skill (e.g., preparing a journal entry).

Critical thinking reflects on the reasoning and factors that go into a decision. In other words, critical thinkers evaluate the outcome of their thought process to assess how well a decision is made or how well a problem is solved (Halpern, 1996). More specifically, critical thinking, which is a higher order cognitive skill, requires judgment, analysis, and synthesis. This goes beyond the simple mechanical memorization of facts. Complex, messy, or ill-defined problems, like those that may be found in a managerial accounting class, require the judgment and analysis skills involved in critical thinking.

When using an OHS, the interactive nature of the system may reduce the need to think critically and reflect on the reasoning that went into the problem at hand because the OHS provides “hints” and an opportunity to “check my work.” Recall that Peng (2009) indicated that less-motivated students may be more motivated to engage in online homework when they can reduce their cognitive burden by using the interactive online system. Furthermore, the Meece et al. (1988) study suggests that work avoidance is positively associated with shallow learning methods such as memorization rather than deep learning methods, such as elaboration and organization. Students in a managerial accounting course work on complex, messy, or ill-defined problems that require critical-thinking skills, possibly more so than students in a financial accounting course that are learning debits and credits, preparing journal entries, etc. As a result, the “hints,” opportunities to “check my work,” and other aids available in an OHS that reduce cognitive burden and possibly result in shallow learning (as compared to a paper/pencil system) may have a greater impact on student learning in the managerial accounting course than in the financial accounting course. Therefore, we question whether students that use an OHS receive less benefit in a managerial accounting class than in a financial accounting class.

Additionally, the current study attempts to fill the gap between Gaffney et al. (2010) (that only examines the financial accounting course) and King and Mo (2013) (that fails to examine a comparison group) by looking at both managerial and financial accounting. This leads us to our second research question:

RQ2: Is student performance using OHS versus the paper/pencil method different in the managerial accounting course than in the financial accounting course?

Knowledge retention that extends beyond a short period of time requires deeper learning, of which critical thinking is an important component (Laird, Seifert, Pascarella, Mayhew, & Blach, 2014). Factors or behaviors that lead to deeper learning are comprised of a personal commitment to understanding and using multiple learning strategies including, but not limited to: reading, discussing ideas, accessing alternative sources of information, reflecting on the learning process, applying knowledge, and integrating/synthesizing information with prior knowledge (Ramsden, 2003; Tagg, 2003). Critical reading in particular is associated with reflective thinking and is a significant indicator of critical thinking (Gadberry, 1980).

A potential benefit of technology-based learning is increased student engagement. For example, in a meta-analysis, D’Mello (2013) found that the enhanced interactivity, personalized instruction, rapid feedback, and other features of technology-based learning may increase student engagement. However, real-time mediums may not encourage students to spend the requisite time to truly understand material (Greenfield, 1984), or to learn the material “deeply.” For example, OHS typically provide real-time feedback to students via links to textbook content directly related to specific homework problems, hints, and other types of feedback. While this immediate feedback is designed to assist students in completing homework assignments, it may reduce the amount of time they actually spend reading and reflecting on the concepts underlying the problem(s). This issue may be compounded when students are provided multiple attempts to complete homework problems. Studies have shown that a work avoidance approach is negatively related to the use of deep-processing strategies which in turn leads to poor performance (Meece, Blumenfeld, & Hoyle, 1988; Harackiewicz, Barron, Carter, Letho, & Elliot, 1997). Thus, some of the perceived benefits of OHS may actually have an adverse effect on critical thinking, and thus deeper learning and knowledge retention.

Students completing homework via traditional paper/pencil do not have the OHS benefits of interactivity, personalized instruction, multiple attempts, or real-time feedback. Therefore, in order to successfully complete

homework using paper/pencil, students may be more likely to employ several learning strategies typical of deeper learning. For example, students may need to spend more time critically reading the textbook and reflecting on what was read. Further, they may be more likely to discuss concepts with their peers or seek guidance from their professors. Elliot, McGregor, and Gable (1999) suggests that deep learning strategies facilitate long-term knowledge retention more than immediate performance outcomes. This discussion leads to the following research question:

RQ 3: Is student knowledge retention, as measured by performance on a comprehensive final exam, greater when using an OHS to complete homework compared to using paper/pencil?

Research Design

The study was conducted over a two-year period at a midsized, private, teaching-oriented university in the Midwest of the United States. During the first year, both the introductory financial and introductory managerial accounting courses were taught using a paper/pencil homework method (with financial being taught in the fall and managerial being taught in the spring). These same courses were taught in the same order the second year using an OHS. Two professors taught all courses involved in the study. Together they had over ten years of experience teaching both introductory financial and introductory managerial accounting prior to the beginning of this study. They also had experience using both homework methods (paper/pencil and OHS) prior to this study. The class section sizes were less than 35 students and each section met twice a week for 75 minutes per session.

In cooperation, the professors assigned the same homework problems both years to ensure that students had similar experiences with and without the use of the OHS. The same teaching assistant graded the paper/pencil homework for the two professors over the two semesters to ensure consistency. Homework assignments consisted of three to five problems. The *only* difference was that the OHS group completed their homework through the OHS. Both groups (paper/pencil and OHS) were assigned homework at the beginning of each chapter. The homework was due for both groups the class period following the coverage of each topic. The paper/pencil homework was given to the teaching assistant for grading and was generally returned to students in class one week later whereas the OHS provided immediate feedback. The policy settings for each assignment using the OHS were as follows: three attempts allowed, no penalty for taking new attempts, no time limit, and students were allowed to access the eBook, hints (without penalty) and “check my work” (one check per question without penalty).

Other than the method in which homework assignments were completed, the key difference between the paper/pencil and OHS groups was that the OHS group received instantaneous feedback via the “check my work” option and was afforded as much as two more opportunities to get the problem correct. They could also utilize the “hints” feature, which took them directly to the portion of the eBook that covered the concepts being covered in the homework problem. In contrast, that paper/pencil group could only receive feedback prior to submitting their assignment to the professor by either a) going into the professor’s office hours, b) visiting the Accounting Lab, which is a tutoring lab staffed four days per week with upper-division accounting majors, or c) emailing the professor. It is also fair to assume that both paper/pencil and OHS subjects had access to other online support materials such as YouTube videos, Wikipedia, and other similar resources.

Chapter quizzes were administered via a course management system (Blackboard) and were the same for both groups (the paper/pencil and OHS). The quizzes generally consisted of 10 multiple-choice questions and were designed to motivate students to work toward comprehending the required reading assignments and to be attentive in class. The quizzes had a 20-minute time limit, students were only allowed to take them once, and the question and answer choice orders were randomized.

Both groups (paper/pencil and OHS) took the same three midterm exams and the same comprehensive final exam. Exam content consisted of a combination of multiple-choice questions and workout problems originating from the test bank and the textbook. Midterm exams were administered in class and students were allowed 75 minutes to complete the exam. Students were allowed 110 minutes for the comprehensive final exam.

Sample

As shown in Table 1, 421 students participated in this study, including 231 (55 percent) students in the introductory financial accounting course and 190 (45 percent) students in the introductory managerial accounting course. In the financial accounting course, 113 students used an OHS and 118 students used the paper/pencil method. In the managerial accounting course, 90 students used the OHS and 100 students used the paper/pencil method.

As noted previously, two instructors taught the courses. Instructor #1 taught two sections each semester that included a total of 306 (73 percent) students (168 in the financial accounting course and 138 in the managerial accounting course) and instructor #2 taught one section each semester for a total that consisted of 115 (27 percent) students (63 in the financial accounting course and 52 in the managerial accounting course). For students using an OHS in the financial accounting course, instructor #1 taught 81 (72 percent) students and instructor #2 taught 32 (28 percent) students. Similarly, for students using the paper and pencil method in the financial accounting course, instructor #1 taught 87 (74 percent) students and instructor #2 taught 31 (26 percent) students. The composition of students taught by instructor #1 and instructor #2 was similar in the managerial accounting course. For students using an OHS in the managerial accounting course, instructor #1 taught 63 (70 percent) students and instructor #2 taught 27 (30 percent) students. For students using the paper and pencil method in the financial accounting course, instructor #1 taught 75 (75 percent) students and instructor #2 taught 25 (25 percent) students.

More students in the sample are male (241 or 57 percent) than female (180 or 43 percent). The ratios of male to female by course are very similar to the overall sample population. The sample percentage of males is 57 percent (43 percent female) in the financial accounting course and 58 percent (42 percent female) in the managerial accounting course. For students using an OHS in the financial accounting course, 54 percent are male and 48 percent are female. For students using the paper and pencil method in the financial accounting course, 61 percent are male and 39 percent are female. The gender composition of students in the managerial accounting course was similar to that of the financial accounting course. For students using an OHS in the managerial accounting course, 52 percent are male and 48 percent are female. For students using the paper and pencil method in the financial accounting course, 63 percent are male and 37 percent are female.

Sample ACT scores are fairly consistent across groups. The mean sample ACT score is 27.48 with a mean of 27.25 for the financial accounting course and 27.76 for the managerial accounting course. In the financial accounting course, students' mean ACT score is 27.5 in the OHS group and 26.9 in the paper/pencil group. In the managerial accounting course, students' mean ACT score is 28.12 in the OHS group and 27.44 in the paper/pencil group.

Results

Table 2 displays student performance scores based on homework method. Overall, homework scores are higher for students using an OHS (0.92) than the paper/pencil method (0.84 and 0.85 for financial and managerial accounting, respectively) of completing homework. Quiz scores are higher for students using the traditional paper/pencil method (0.81 and 0.82 for financial and managerial accounting, respectively) of completing homework than for students using an OHS (0.77 and 0.78 for financial and managerial accounting, respectively). The scores for the three midterm exams differ by course (the exams scores are higher in the managerial accounting course than in the financial accounting course). When comparing midterm exam scores by the homework method used, scores are very similar. The final exam scores are higher for students using the traditional paper/pencil method of completing homework (0.66 and 0.79 for financial and managerial accounting, respectively) than for students using the OHS (0.62 and 0.68 for financial and managerial accounting, respectively). The difference is larger for students in the managerial accounting course (0.11) than for students in the financial accounting course (0.04).

MANCOVA

A multivariate analysis of covariance (MANCOVA) was performed to test the research questions. The MANCOVA measures the impact of the predictor variables on all dependent variables simultaneously and tests for interaction effects. To reduce noise in the analysis, fixed factors include course, instructor, and gender. Similarly, the covariate, composite ACT score, is included in the analysis. All variable definitions are shown in Table 3. The

independent variables (fixed factors and covariate) are possible predictors of the dependent variable, student performance, and are, therefore, controlled for to reduce the magnitude of the error.

A full factorial MANCOVA is run to analyze the independent variables in association with all six dependent variables and interactions. Four control and predictor variables (homework method, course, instructor, and gender) are coded as fixed factors and one is coded as a covariate (ACT score). Table 4 provides the multivariate analysis of the full factorial model. Only the main effects and the interaction of interest are presented to conserve space and present the most relevant data analysis. Significant indicators of the dependent variables (student performance scores) are homework method, course, instructor, and ACT score. Gender and the interaction between course and homework method are marginally significant ($p < 0.10$) indicators of student performance.

Table 5 provides the univariate results of the full factorial model for each dependent variable (homework scores, quizzes scores, and exam scores). Panel A provides the results for the first dependent variable, homework scores. The model is statistically significant ($p = 0.00$; $R^2 = 0.16$; Adjusted $R^2 = 0.12$). One independent variable of interest, homework method, is a significant negative indicator of homework score ($p = 0.00$). This indicates that the traditional paper/pencil homework method results in lower homework scores. The interaction between course and homework method is not a significant indicator of homework score. Therefore, we do not find that the course (financial accounting or managerial accounting) that the student is enrolled in affects (moderates) the association between homework scores and homework method.

Panel B provides the results for the second dependent variable, quiz scores. The model is statistically significant ($p = 0.00$; $R^2 = 0.25$; Adjusted $R^2 = 0.22$). Homework method is again a significant indicator of student performance. However, rather than being a negative indicator, homework method is a positive indicator ($p = 0.00$). Quiz scores are greater for students that prepare homework using a traditional paper/pencil method than with an online homework system. The interaction between course and homework method is not a significant indicator of quiz score. Again, we did not find that course (financial accounting or managerial accounting) affects (moderates) the association between quiz scores and homework method.

Panels C, D, and E provide the results for the dependent variables, exam 1, exam 2, and exam 3 (the midterm exams). The models are statistically significant ($p = 0.00, 0.00, \text{ and } 0.00$, respectively; $R^2 = 0.43, 0.40, 0.34$, respectively; Adjusted $R^2 = 0.40, 0.38, 0.32$, respectively). However, we did not find that homework method is a statistically significant predictor of the dependent variables (midterm exams scores). Similarly, we did not find a significant interaction between course and homework method for midterm exam scores.

Panel F provides the results for the dependent variable, final exam. The model is statistically significant ($p = 0.00$; $R^2 = 0.41$; Adjusted $R^2 = 0.39$). The independent variable of interest, homework method, is a significant positive indicator of the final exam score ($p = 0.00$). This indicates that a traditional paper/pencil homework method results in higher final exam scores than the paper/pencil method. The interaction between course and homework method is also a significant indicator of final exam score ($p = 0.04$). This suggests that course (financial accounting or managerial accounting) affects (moderates) the association between final exam scores and the homework method used. As shown in Table 6, the scores of students completing the homework using paper/pencil increased more for students in the managerial accounting course (11 percent) than in the financial accounting course (4 percent).

The next section provides a discussion of the findings and a conclusion.

Discussion and Conclusion

The purpose of our analysis is to evaluate the efficacy of OHS in general. We also examine knowledge retention and homework method performance differences moderated by the type of accounting course taken (financial accounting or managerial accounting). The MANCOVA (multivariate) and ANCOVA (univariate) analysis in Tables 4 and 5, respectively, provide evidence in response to the research questions. Although prior research has

shown that in some conditions OHS result in higher student performance, the current research shows that this postulation does not hold for all measures of performance, for all courses equally, and for knowledge retention.

Homework Method (RQ1)

The dependent variable, homework method, is a negative indicator of homework score. This is not unexpected because an OHS provides feedback and multiple opportunities to find the correct solution.

Higher homework scores, however, do not always translate into increased learning, particularly if the solution comes too easy. Higher order cognitive skills, requiring judgment, analysis, and synthesis may be used more extensively to determine a solution to a homework problem when using the pencil/paper method because typically, less feedback is available to these students. The student must use more of their own resources and abilities to solve the problem.

Homework method is a positive predictor of the dependent variables, quiz score and final exam score. Students that prepare their homework using the paper/pencil method score higher on quizzes and on the final exam than students using an OHS. We did not find a statistically significant difference in the dependent variables representing midterm exams (exam 1, exam 2, and exam 3) for students using paper/pencil and for students using an OHS.

Overall, the results indicate that a paper/pencil homework method is equally or more effective than an OHS for quiz and exam measures of performance. The more specific questions examined in research RQ2 and RQ3 shed light on conditions that affect differences in performance based on the homework method employed.

Financial versus Managerial Accounting Course (RQ2)

The interaction of the independent variables, homework method and course, is a predictor of the final exam score. The analysis does not find that the interaction of homework method and course is a statistically significant predictor of the remaining dependent variables (homework, quiz, exam 1, exam 2, or exam 3). Therefore, the findings indicate that the benefits achieved from the paper/pencil method of completing homework are greater in the managerial accounting course than in the financial accounting course, but only on the final exam. This provides some evidence to answer the question of whether student performance using OHS versus the paper/pencil method is different in the managerial accounting course than in the financial accounting course. The results also seem to provide the first evidence, to our knowledge, that the specific homework platform chosen can have an effect on overall course performance based on the nature and requirements of the course.

Knowledge Retention (RQ3)

The final exam is comprehensive and, therefore, includes content from the start of the semester to the conclusion of the semester. We use the dependent variable, final exam as a proxy for knowledge retention. The analysis indicates that homework method is a positive and statistically significant predictor of the final exam score. The positive sign suggests that a paper/pencil method of completing homework results in a higher final exam score. The students that completed homework using paper/pencil did not have the convenience of interactivity, personalized instruction, and the rapid feedback that is available in an OHS. To complete the homework, the students' resource was the textbook. Spending time referring back to the textbook, reflecting on what was read, and possibly discussing the topics with other students are activities that lead to deeper learning. This can explain the lasting performance suggested by the higher final exam scores of students that prepare their homework using a paper/pencil compared to students that use an OHS.

Conclusion

This study contributes to the literature examining the advantages/disadvantages of using an OHS. This study differs from other studies in that it examines subsets of students in the financial accounting course and the managerial accounting course. Another contribution of the study is to consider the long-term (knowledge retention) effect of a homework method on student performance.

Our findings provide implications for instructors. When making a decision to use an OHS or the traditional paper/pencil format, many factors, other than time savings, must be considered. Course content and the depth of

learning are factors that have bearing on the choice to use a particular homework method. For the final exam, the benefits of using the paper/pencil method are even greater in the managerial accounting course than in the financial accounting course. Lastly, learning is deeper and, therefore, retained for a longer period of time when completing homework using the paper/pencil method.

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Table 1
Sample Summary

	<u>Introduction to Financial Accounting</u>						<u>Introduction to Managerial Accounting</u>						<u>Both Courses Overall Total</u>	
	<u>OHS</u>		<u>Paper/pencil</u>		<u>Total</u>		<u>OHS</u>		<u>Paper/pencil</u>		<u>Total</u>		<u>n</u>	<u>%</u>
	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>	<u>n</u>	<u>%</u>		
Instructor														
#1	81	72	87	74	168	73	63	70	75	75	138	73	306	73
#2	<u>32</u>	<u>28</u>	<u>31</u>	<u>26</u>	<u>63</u>	<u>27</u>	<u>27</u>	<u>30</u>	<u>25</u>	<u>25</u>	<u>52</u>	<u>27</u>	<u>115</u>	<u>27</u>
Total	113	100	118	100	231	100	90	100	100	100	190	100	421	100
Gender														
Male	59	54	72	61	131	57	47	52	63	63	110	58	241	57
Female	<u>54</u>	<u>48</u>	<u>46</u>	<u>39</u>	<u>100</u>	<u>43</u>	<u>43</u>	<u>48</u>	<u>37</u>	<u>37</u>	<u>80</u>	<u>42</u>	<u>180</u>	<u>43</u>
Total	113	100	118	100	231	100	90	100	100	100	190	100	421	100
ACT Score														
Mean	27.58		26.9		27.25		28.12		27.44		27.76		27.48	
Std. Error	3.48		3.42		3.46		3.45		3.53		3.50		3.48	

n = number of observations

Table 2

Sample Characteristics and Measurements for MANCOVA

<u>Variable</u>	<u>Category</u>	<u>Count</u>	<u>Sample %</u>	<u>Homework Score</u>		<u>Quiz Score</u>		<u>Exam 1 Score</u>		<u>Exam 2 Score</u>		<u>Exam 3 Score</u>		<u>Final Exam Score</u>	
				<u>M</u>	<u>SE</u>	<u>M</u>	<u>SE</u>	<u>M</u>	<u>SE</u>	<u>M</u>	<u>SE</u>	<u>M</u>	<u>SE</u>	<u>M</u>	<u>SE</u>
<u>Sample Characteristics</u>															
Course															
	Financial	231	55	0.88	0.12	0.79	0.18	0.70	0.16	0.73	0.14	0.72	0.17	0.64	0.18
	Managerial	190	45	0.88	0.14	0.80	0.13	0.81	0.14	0.77	0.13	0.80	0.13	0.74	0.20
Instructor															
	#1	306	73	0.89	0.12	0.82	0.11	0.73	0.18	0.72	0.13	0.73	0.16	0.64	0.20
	#2	115	27	0.87	0.15	0.74	0.14	0.80	0.12	0.83	0.12	0.83	0.12	0.81	0.11
Gender															
	Male	241	57	0.86	0.14	0.79	0.12	0.75	0.16	0.76	0.13	0.75	0.16	0.68	0.19
	Female	180	43	0.91	0.11	0.80	0.12	0.75	0.17	0.73	0.15	0.77	0.15	0.69	0.20
Homework System															
OHS															
	Financial	113	27	0.92	0.11	0.77	0.11	0.70	0.17	0.73	0.15	0.72	0.17	0.62	0.19
	Managerial	90	21	0.92	0.14	0.78	0.13	0.81	0.15	0.78	0.14	0.79	0.14	0.68	0.21
Paper/Pencil															
	Financial	118	28	0.84	0.11	0.81	0.12	0.69	0.16	0.73	0.14	0.71	0.16	0.66	0.16
	Managerial	100	24	0.85	0.14	0.82	0.12	0.81	0.14	0.76	0.12	0.81	0.11	0.79	0.18

M = mean and SE = standard error.

Variables are defined in Table 3.

Table 3
Variable Definitions

Homework Score	=	points earned on homework converted to a percent that is expressed as a decimal;
Quiz Score	=	points earned on quizzes converted to a percent that is expressed as a decimal;
Exam 1 Score	=	points earned on exam 1 converted to a percent that is expressed as a decimal;
Exam 2 Score	=	points earned on exam 2 converted to a percent that is expressed as a decimal;
Exam 3 Score	=	points earned on exam 3 converted to a percent that is expressed as a decimal;
Final Exam Score	=	points earned on the final exam converted to a percent that is expressed as a decimal;
Homework Method	=	1 if student used the paper/pencil to complete homework, 0 if student used an OHS to complete homework;
Course	=	1 if student is enrolled in the Introduction to Managerial Accounting course, 0 if student is enrolled in the Introduction to Financial Accounting course;
Instructor	=	1 if student is enrolled in instructor #2's course, 0 if student is enrolled in instructor #1's course;
Gender	=	1 if female, 0 if male; and
ACT Score	=	composite ACT score.

Table 4
Multivariate Analysis of Covariance (MANCOVA)

Effects of Homework Method, Course, Instructor, and Gender on Homework, Quiz, and Exam Scores

<u>Source</u>	<u>Wilk's λ</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Intercept	0.534	57.97	***	0.466	1.000
Homework Method	0.804	16.257	***	0.196	1.000
Course	0.934	4.681	***	0.066	0.989
Instructor	0.553	53.75	***	0.447	1.000
Gender	0.971	1.952	*	0.029	0.718
ACT Score	0.650	35.769	***	0.350	1.000
Homework Method x Course	0.970	2.065	*	0.030	0.746

*, **, ***: $p < 0.10$, $p < 0.05$, $p < 0.01$

Partial η^2 is measured on a scale of 0 to 1. The measure explains how much variance in the dependent variable is explained by the independent variable.

Variables are defined in Table 3.

N = 421

Table 5

Univariate Analysis of Covariance (ANCOVA)

Effects of Homework Method and the Interaction of Homework Method and Course

Panel A: Dependent Variable is Homework Score (n = 421, R² = 0.156; Adjusted R² = 0.122)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.068	4.663	***	0.156	1.000
Intercept	1	4.198	288.497	***	0.416	1.000
Homework Method	1	0.238	16.369	***	0.039	0.981
Course	1	0.031	2.107		0.005	0.305
Instructor	1	0.008	0.574		0.001	0.118
Gender	1	0.137	9.432	***	0.023	0.865
ACT Score	1	0.022	1.518		0.004	0.233
Homework Method x Course	1	0.039	2.698		0.007	0.374

Panel B: Dependent Variable is Quiz Score (n = 421, R² = 0.248; Adjusted R² = 0.218)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.095	8.329	***	0.248	1.000
Intercept	1	1.309	114.242	***	0.220	1.000
Homework Method	1	0.140	12.239	***	0.029	0.937
Course	1	0.040	3.513	*	0.009	0.464
Instructor	1	0.228	19.87	***	0.047	0.994
Gender	1	0.028	2.429		0.006	0.343
ACT Score	1	0.641	55.963	***	0.121	1.000
Homework Method x Course	1	0.010	0.052		0.000	0.056

Panel C: Dependent Variable is Exam 1 Score (n = 421, R² = 0.425; Adjusted R² = 0.402)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.306	18.672	***	0.425	1.000
Intercept	1	0.173	10.545	***	0.025	0.900
Homework Method	1	0.022	1.338		0.003	0.211
Course	1	0.352	21.475	***	0.050	0.996
Instructor	1	0.626	38.217	***	0.086	1.000
Gender	1	0.001	0.047		0.000	0.055
ACT Score	1	2.282	139.388	***	0.256	1.000
Homework Method x Course	1	0.005	0.301		0.001	0.085

Panel D: Dependent Variable is Exam 2 Score (n = 421, R² = 0.402; Adjusted R² = 0.378)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.205	17.004	***	0.402	1.000
Intercept	1	0.425	35.262	***	0.08	1.000
Homework Method	1	0.005	0.391		0.001	0.096
Course	1	0.191	15.872	***	0.038	0.978
Instructor	1	1.574	130.706	***	0.244	1.000
Gender	1	0.002	0.193		0.000	0.072
ACT Score	1	1.658	137.674	***	0.254	1.000
Homework Method x Course	1	0.021	1.723		0.004	0.258

Panel E: Dependent Variable is Exam 3 Score (n = 421, R² = 0.343; Adjusted R² = 0.317)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.216	13.158	***	0.343	1.000
Intercept	1	0.525	31.993	***	0.073	1.000
Homework Method	1	0.027	1.655		0.004	0.250
Course	1	0.270	16.423	***	0.039	0.981
Instructor	1	1.118	68.101	***	0.144	1.000
Gender	1	0.026	1.614		0.004	0.245
ACT Score	1	1.514	92.217	***	0.186	1.000
Homework Method x Course	1	0.008	0.498		0.001	0.108

Panel F: Dependent Variable is Final Exam Score (n = 421, R² = 0.411; Adjusted R² = 0.388)

<u>Source (Sign)</u>	<u>df</u>	<u>MS</u>	<u>F</u>		<u>Partial η^2</u>	<u>Observed Power</u>
Model	16	0.413	17.695	***	0.411	1.000
Intercept	1	0.189	8.086	***	0.020	0.810
Homework Method	1	0.552	23.614	***	0.055	0.998
Course	1	0.289	12.356	***	0.030	0.939
Instructor	1	2.675	114.545	***	0.220	1.000
Gender	1	0.026	1.127		0.003	0.185
ACT Score	1	1.888	80.843	***	0.166	1.000
Homework Method x Course	1	0.102	4.361	**	0.011	0.549

*, **, ***: p < 0.10, p < 0.05, p < 0.01

MS = mean square is the average of the square of the observations

Partial η^2 is measured on a scale of 0 to 1. The measure explains how much variance in the dependent variable is explained by the independent variable.

Observed power is measured on a scale of 0 to 1 and assesses the ability to detect an effect if there is one.

Variables are defined in Table 3.

Table 6
Mean Scores on the Final Exam

Course	OHS	Paper/Pencil	Treatment Means
Financial	0.62 n = 113	0.66 n = 118	0.64 n = 231
Managerial	0.68 n = 90	0.79 n = 100	0.74 n = 190
Treatment Means	0.64 n = 204	0.72 n = 217	Grand Mean 0.68 n = 421

Variables are defined in Table 3.