A Comprehensive Evaluation of the Relationship between Online Adaptive Learning Technologies, Metacognition, and Performance

Ryan Cahalan
Central Washington University

Gabriel Dickey
University of Northern Iowa

William Wilcox
University of Northern Colorado

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Ryan Cahalan, Central Washington University, Department of Accounting, Ellensburg, WA, USA;
Gabriel Dickey, University of Northern Iowa, Department of Accounting, Cedar Falls, IA, USA;
William E. Wilcox, University of Northern Colorado, Department of Accounting, Greeley, CO, USA

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ABSTRACT: This comprehensive study of students in a Principles of Financial Accounting course examines metacognition and its impact on performance. The research discovers that the Principles of Financial Accounting course has a significant influence on metacognition. The research also finds that the increase in metacognition is strongly correlated with improved performance in the course. Two mechanisms to facilitate additional metacognitive growth were examined: the incorporation of an online adaptive learning technology and the implementation of a project simulation. Although the quantitative analyses performed did not demonstrate that either had a significant incremental effect on metacognitive growth, feedback from students and observations from instructors indicate that the simulation was particularly helpful in understanding both accounting and business-related concepts, including the functioning of journal entries.

Keywords: financial accounting, metacognition; knowledge of cognition, regulation of cognition, online adaptive learning technologies; simulation

I. INTRODUCTION

There continues to be pressure on colleges and universities to prepare students not only for their first job, but to also prepare them for advancement. Businesses are looking for students who are lifelong learners and can continually adapt to a dynamic and rapidly changing business environment (Dickey & Wilcox, 2021). A potential solution to this problem is to help students develop their metacognitive skills. Activities emphasizing metacognitive skills have been shown to help students "learn about learning," resulting in improved academic performance (Jares et al. 2019, Ravenscroft et al. 2012, Schleifer and Dull 2009). Rather than focusing only on teaching skills necessary for entry-level jobs, higher education must also help students learn how to learn. Improved metacognition helps students and employees better understand their thought processes, become more self-aware about what they know and do not know, as well as the learning strategies used to develop knowledge (Schleifer and Dull 2009). This increased self-awareness allows students, as future employees, to become more agile in recognizing problems and identifying potential solutions.

Further complicating matters for the accounting profession has been the shortage of students electing the accounting career field (Bramwell, 2023). The Principles of Financial Accounting course is one of the first (if not the first) business courses offered to students. The course provides an opportunity for accounting professors to both recruit and retain potential accounting majors and an opportunity to help students develop their metacognitive skills. By helping students understand the techniques to “learn how to learn”, there are opportunities for not only developing higher caliber candidates, for the organizations who are key stakeholders for business colleges and universities, but also the potential to attract additional students into the accounting profession.

Accounting has long been considered an essential element of core business knowledge, hence the requirement for a Principles of Financial Accounting course as part of the business curriculum. Our research demonstrates the Principles of Financial Accounting course is not only important from a core content knowledge perspective, but also provides an opportunity to develop strong metacognitive skills as we find the course has a significant positive impact on the metacognitive growth of the students. In addition, metacognition is positively related to the performance of the students in the course as measured by both their final exam score and final grade.

Given the importance of metacognition as a lifelong skill and its impact on performance in the Principles of Financial Accounting course, we evaluate two potential mechanisms to foster and cultivate metacognitive growth. The first is the use of an online adaptive learning technology (OALT) and the second is the incorporation of a simulation project whereby students apply accounting principles in an active and more real-world setting. This "skin in the game" approach afforded students the opportunity to make business decisions and evaluate the consequences of these decisions.

Although the quantitative analyses performed did not find that either the OALT or simulation project had a significant impact on metacognitive growth, the direct feedback obtained from students and observations from instructors were overwhelmingly positive. In fact, it may have helped provide a solution to a decades long debate of whether facilitating journal entries is necessary for non-accountants in an introductory accounting course. The feedback and observations provide initial early evidence that journal entries are helpful in understanding how accounting works, particularly if taught after the other aspects of business decision-making and processes have been learned. This may be helpful in both recruiting and retaining students who

struggle when journal entries are taught early in the course without any concrete context provided.

Our comprehensive research design takes place in a wide variety of settings. We use two different instructors in three separate learning environments: face-to-face, virtual, and online asynchronous. A total of eighteen classes and 509 students were observed. We begin our research by reviewing the literature that addresses specific gaps in student development and the importance of metacognition in filling these gaps. We also review the literature on the design and effectiveness of OALTs. This literature review is used to formulate our research questions. Next, we discuss the methods used in evaluating the research questions and conclude with a summary of the results and a discussion of the theoretical and practical implications of the research.

II. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

Professional organizations such as the American Institute of Certified Public Accountants have long advocated that its members be lifelong learners (AICPA, 2010), as this continuing professional education is necessary for success in an ever-changing environment. Colleges and universities play an important role in preparing graduates for entry level jobs and successful careers; student success is often a core part of their missions. Survey findings by the AACU (2018) would indicate that colleges and universities need to make changes, including students not being prepared for advancement and students being even less prepared than the previous five years. These shortfalls can be explained by the changes in technology, global competition, and other environmental factors, which require businesses to respond and adapt quickly to these changes to take advantage of the opportunities through increased agility and team dynamics (Dickey et al. 2022). Lower student interest in accounting (Bramwell, 2023) further complicates

the matter, resulting in a two-fold problem: a shrinking pool of accounting applicants and a pool that is not prepared for the dynamic workplace awaiting them.

One solution is to help equip students with the tools necessary for problem-solving and analytical skills. Metacognition is self-regulated learning that focuses on how one thinks, learns, reasons, and solves problems (Ravenscroft et al. 2012). Metacognition, as measured through Schraw and Dennison's (1994) Metacognition Awareness Inventory (MAI), focuses on two distinct categories: knowledge of cognition and regulation of cognition. Knowledge of cognition has 3 components: (1) declarative knowledge, or the factual knowledge about a topic, (2) procedural knowledge, which includes learning strategies and processes, and (3) conditional knowledge, or when to apply certain skills. Regulation of cognition consists of 5 components: (1) planning or the allocation of resources prior to learning, (2) information management strategies or the processing of information sources efficiently, (3) comprehension monitoring, which is the self-assessment of one's learning activities, (4) debugging strategies or how to correct errors, and (5) evaluation, which is the analysis of effectiveness of the learning experience. All these skills are necessary to be able to learn, grow, and adapt as work conditions change, opportunities for advancement arise, and the demands for shared leadership increase.

Prior studies (Duff and McKinstry 2007, Hall et al. 2004, Lucas and Mladenovic 2004) have found a correlation between activities that are attributed to metacognition and educational performance, focusing on how activities that could enhance metacognition will help students perform better with certain classroom activities. By focusing on the development and growth of the different features of metacognition, colleges and universities can better prepare students for the workplace. In addition, improved course performance is likely to increase students' interest in the subject matter, which could lead to an expansion of accounting students.

The Introduction to Financial Accounting course introduces accounting and business terminology, a view of many of the multiple activities businesses conduct, and how these activities are summarized in reports to external parties. Many of the aspects covered in this course, as well as the techniques used in analyzing the consequences of the different activities, provide a foundation of business that will be used throughout a student's academic and professional career. It also provides an opportunity for many accounting programs to "recruit" students who are undecided or who have high potential for success in an accounting career. Therefore, it is an important course to examine when looking at the level and growth of metacognition for a student within the business curriculum. This leads to our first research question:

RQ1: What impact does the Principles of Financial Accounting course have on metacognitive growth?

Prior studies (Duff and McKinstry 2007, Hall et al. 2004, Lucas and Mladenovic 2004) have found a correlation between metacognition and course performance, but none of these studies have examined the relationship of metacognitive growth on that performance. It is unknown whether the individuals who were successful had higher levels of metacognition prior to the course, or if those higher levels were developed during the course and its activities. The AACU (2018) study highlights the importance of skills related to metacognition. Thus it is important to see if the Principles of Financial Accounting class plays an important role in that development. Therefore, our second research question is:

RQ2: What is the impact of metacognitive growth on student performance in the Principles of Financial Accounting course?

Kealey et al. 2005, Jones and Fields, 2001 have found student performance can be aided by supplemental instruction activities that target learning strategies and critical thinking skills. One of the purported benefits of online adaptive learning technologies as identified by McGraw Hill's LearnSmart (McGraw Hill 2015), is to enhance student learning and performance. Studies such as Jares et al. (2019) examined student's perceived benefits of an OALT, while studies such as Zhao and Mo (2016) examined the relationship of an OALT on course performance. Although OALT technologies have become more prevalent, it is still uncertain whether students are actually improving metacognition beyond what is normally gained through typical class activities. Therefore, it is important to examine whether the use of OALTs in a course will result in improved course performance.

RQ3: What impact do OALTs such as SmartBook have on enhancing metacognitive growth?

The AACU (2018) report noted a 43+% gap between what hiring managers deem important and what graduates demonstrate proficiently in the area of "apply knowledge and skills in a real-world setting." The ability to apply learned knowledge and skills to different situations is important to both aspects of metacognition: knowledge of cognition and regulation of cognition. While not a true "real-world setting", online simulations could provide students the opportunity to apply learned skills in a dynamic environment and enhance their metacognitive skills. This leads to our final research question:

RQ4: What impact do Online Simulations such as GoVenture Entrepreneur have on enhancing metacognitive growth?

III. METHODS

Sample Procedures and Participants

We designed a longitudinal field study using data obtained from eighteen separate Principles of Financial Accounting courses at a public university located in the Western United States taught by the two different instructors (nine classes each). Surveys were completed online via the university's learning management system at the end of the 1st and 10th weeks of classes. The students were informed that the survey responses would not be part of grade determination, nor would their instructor view them until after final grades were submitted. The second survey was given during the final week of class, just before administering a comprehensive final exam. Therefore, the students were unaware of their final exam or course grade. There were 735 total students and 509 completed both surveys at the beginning and end of the quarter for a 69% response rate. Further, to evaluate the impact metacognition has on performance, we did not include students who received a final grade of F in the class due to the unreliability of the reporting and significant survey and class-related inconsistencies (e.g., not taking the final exam, abnormally high missed classes, etc.) with the other "passing" students, thus 20 students were excluded from the final sample population.

Identical surveys were given to the students for each survey administration. Each survey included 52 questions from the Metacognitive Awareness Inventory, and each question is rated on a 100-point Likert-type scale with 1 = Strongly Disagree and 100 = Strongly Agree. The survey measures the declarative knowledge, procedural knowledge, and conditional knowledge subdimensions of knowledge of cognition as well as the planning, comprehension monitoring, information management strategies, debugging strategies, and evaluation subdimensions of regulation of cognition. We use the change in both knowledge and regulation of cognition to examine how metacognition impacts performance. The change in both knowledge and regulation of cognition was calculated using the difference in scores between the final and beginning

surveys.

In order to form a series of control and treatment groups, each instructor used the OALT for only seven of their nine quarters. Students were unaware of whether their section would be utilizing the OALT at the time of enrollment, so there was no self-selection bias. Of the eighteen total classes taught, eight were in a face-to-face learning environment, nine were in a virtual learning environment, and one was in an online asynchronous learning environment. This allowed us to evaluate the impact of the financial accounting course and OALT in a variety of different learning environments. The lack of use of an OALT took place in one face-to-face learning environment and one virtual learning environment for each instructor.

Each student's major and age was obtained from the survey and their cumulative grade point average (GPA) prior to taking the course was obtained from university records. Major, age, and prior GPA were utilized as control variables. Because there were multiple instructors and different learning environments, we also controlled for the effects of the instructor teaching the course and the face-to-face learning environment. Performance was measured using each student's comprehensive final exam score as well as the final overall grade.

Simulation Project

A simulation project was utilized in two quarters, one by each instructor. This formed the treatment groups, and the other quarters formed the control groups. The simulation project was used to determine what impact an interactive project has on metacognition and performance. For the simulation, each student created a business on the GoVenture Entrepreneuer Basic platform. This is a business simulation game where the students initially elect their type of merchandising business and make many other business set up decisions including inventory quality/quantity, purchasing, business location, sales prices, operating hours, marketing and advertising, and

hiring employees. After the business is set up, the students begin the simulation. Once the student opens business for the day they cannot make any changes during business hours, but they may make adjustments at the end of each day, before opening the following day and running the simulation again.

The students have access to a dozen business reports including Cash Flow, Products, Customers Served and Lost, Customer Feedback, and Customer Profiles. They also have access to additional detailed accounting reports including General Ledger, General Journal, Income Statement, and Balance Sheet. Throughout the class students play 60 days of the simulation. This is broken down into six different assignments ("Sim1", "Sim2" …. "Sim6"). After completion of Sim2 the instructors hid the Income Statement and Balance Sheet reports from view inside the simulation for the remainder of the assignments. For the Sim5 assignment the instructors switched the journal entry setting from automatic to manual, which required students, at the end of each simulation day, to complete and submit journal entries for all business transactions occurring during that simulation day. Then it was changed back to automatic for the last (Sim6) assignment. Thus, the Sim5 assignment is the only assignment in which students were tasked with completing journal entries. For all other assignments journal entries were automatically completed by the simulation software.

[Insert Table I about here]

Analyses

We address our four primary research questions to understand the impact of metacognition and the OALT on the learning process. For RQ1, we use a paired samples t-test to determine the significance of changes in the subdimensions of both knowledge of cognition and regulation of cognition throughout the course. This allows us to determine if there were any

significant changes in metacognition throughout the course. For RQ2, we used a hierarchal linear regression analysis to determine the effect of both the knowledge and regulation of cognition on performance. This allows us to determine whether metacognition has any impact on performance. For RQ3 and RQ4, we used a univariate analysis of covariance (ANCOVA) to test the impact that the OALT and implementation of a simulation project, respectively, had on both knowledge of cognition and regulation of cognition. RQ3 and RQ4 attempt to identify whether the OALT and simulation are tools that can lead to improved metacognition. Further, for RQ4, the instructors who taught the course obtained qualitative data via feedback from the students and personal observations. Although this did not constitute a formal action research method, there are elements of action research involved given the instructors implemented a potential solution and simultaneously investigated its effectiveness. The insights from the feedback and observations regarding the simulation project are documented in the results section below.

Table I provides the descriptive statistics and correlations among the key variables.

[Insert Table II here]

IV. RESULTS

Impact of Introduction to Accounting Course on Metacognition

Research Question 1 explored the effect that the Principles of Financial Accounting course had on metacognition. The results of the paired-samples t-test in Table II demonstrate that that the students' metacognition improved significantly ($p < .05$) in total metacognition, knowledge of cognition, regulation of cognition, and every subdimension of knowledge of cognition except for conditional knowledge and every subdimension of regulation of cognition except for debugging strategies.

[Insert Table III about here]

Conditional knowledge includes a motivational element as well as using helpful learning strategies automatically. The motivation and automatic use of learning strategies may not have necessarily improved throughout the course as motivation can be higher in the beginning for many students and the students' may have felt that their learning strategies were more a function of instructor influence than using learning strategies automatically. This may partially explain why there was not a significant increase in conditional knowledge throughout the course.

Debugging strategies include asking others for help and having the necessary discipline to reevaluate assumptions and stop and go back over information when confused. In a course such as Principles of Financial Accounting, this metacognitive element should be important. Instructors teaching the course should help foster and cultivate awareness of how to reevaluate assumptions when the information is unclear. This is a skill that is essential for the continual learning process.

Results of Metacognition on Performance

Research Question 2 explored the impact that the change in both knowledge of cognition and regulation of cognition had on performance, as measured by each student's score on the comprehensive final exam and final grade in a Principles of Financial Accounting course. To evaluate whether these factors influenced student performance, we ran four hierarchal linear regression models:

Research Question 2 Hierarchal Linear Regression Models:

(a) $\text{Performance}_{\text{(Final Grade/Final Exam score)}} = \beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{Change in Knowledge} + \varepsilon$

(b) $\text{Performance}_{\text{(Final Grade/Final Exam score)}} = \beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{Change in Regulation} + \varepsilon$

The results shown in Table III in Columns 1 and 2 demonstrate that the change in knowledge of cognition significantly impacts performance as measured by the final exam score and the overall final grade in the class (Column 1: $p < .10$, $\beta = 0.08$; Column 2: $p < .05$, $\beta = 0.09$). Columns 3 and 4 demonstrate that the change in regulation of cognition also significantly impacts performance as measured by the final exam score and the overall final grade in the class (Column 1: $p < .05$, $\beta = 0.11$; Column 2: $p < .10$, $\beta = 0.09$).

[Insert Table IV about here]

Results of Using Online Adaptive Learning Technologies on Metacognition

Research Question 3 addressed the impact of an OALT on metacognition. The classes without the OALT formed the control group and the classes with the OALT formed the treatment group. We ran a univariate analysis of covariance (ANCOVA) to control for other factors that might influence the performance outcomes, with the results shown in Table IV. Column 1 highlights the impact of the OALT on the change in knowledge of cognition and the results were not significant ($p > .10$, $F = 0.66$). Column 2 highlights the impact of the OALT on the change in regulation of cognition and the results were not significant ($p > .10$, $F = 1.03$).

Research Question 3 Linear Regression Models:

(a) $\text{Change in Knowledge of Cognition} = \beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{OALT} + \varepsilon$

(b) $\text{Change in Regulation of Cognition} = \beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{OALT} + \varepsilon$

[Insert Table V about here]

Results of a Simulation Project on Metacognition

Research Question 4 addressed the impact of using a simulation project on

metacognition. The classes without the simulation formed the control group and the classes with the simulation formed the treatment group. We ran a univariate analysis of covariance (ANCOVA) to control for other factors that might influence the performance outcomes, with the results shown in Table V. Column 1 highlights the impact of the simulation on the change in knowledge of cognition and the results were not significant ($p > .10$, $F = 0.40$). Column 2 highlights the impact of the simulation on the change in regulation of cognition and the results were not significant ($p > .10$, $F = 0.03$).

Research Question 4 Linear Regression Models:

(a) Change in Knowledge of Cognition = $\beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{Simulation} + \varepsilon$

(b) Change in Regulation of Cognition = $\beta 0 + \beta 1\text{Major} + \beta 2\text{Age} + \beta 3\text{PriorGPA} + \beta 4\text{Instructor} + \beta 5\text{F2F} + \beta 6\text{Simulation} + \varepsilon$

[Insert Table VI about here]

Although the quantitative data did not demonstrate that the simulation project had a significant impact on metacognition, the instructors gathered additional qualitative data via feedback and observation. After each simulation assignment was completed, the instructors held discussions with the students to solicit their feedback. The student feedback was almost unanimously positive with most of the comments focusing on how the simulation allowed the students to make business decisions, understand the operating cycle, see actual results (positive and negative), and adjust accordingly. The largest discussion always occurred at the end of the Sim5 assignment and focused on journal entries. This is best captured by direct quotes from the student reflections in the Sim5 assignment when asked their thoughts on having to manually complete the journal entries. The following demonstrates some direct feedback received from the

students:

> *GoVenture is a very cool game. For me, this game helps me relieve stress and reinforce knowledge at the same time. Although I don't own any stores in real life, this game gives me the experience of being a real owner. I learned to analyze the potential of each area where I wanted to open a store. Through the charts that the game provides, first, I choose areas that have a stable number of customers every day to ensure a stable income for each day. Secondly, I analyze and determine peak hours in each area to adjust the operating time of each store accordingly. This will ensure a steady flow of customers during the entire operating hours, and also maximize the productivity of every worker that I hire. The third thing, based on the chart, I can determine the customer's requirement for my product. I will then select the product quality, adjust the price, and reevaluate the workers I will have to hire for each store to achieve the highest possible business efficiency. For the journal entry added to this section, I find it very helpful. Writing the journal entry based on the transactions in the game helped me understand this week's lecture more deeply.*
>
> *I found the journal entries to be very informative because it made me more aware of how much I was spending on each aspect of my business and showing me that I was losing more inventory to spoiling than I realized and made me think about how I could lower that, by buying for each day.*
>
> *While doing the Sim5 assignment, it made me much more aware of the financial side of my business. It made me want to do all my inventory purchases in less transactions and it helped me to see the cost of everything. It also showed me the cost of all my goods that were being spoiled at each station. It has also helped me to see the cost of my advertising and my employee salaries. These have all helped me to better understand when my cash in going from my business. Before, I was just clicking a button and looking at the financials at a later time, but with this it is forcing me to look at each transaction and see where my money is going. This assignment also helped me to compare the amount of money I made to the amount of money I spend on expenses throughout the day. Overall, this assignment just made me think about my money and where it is coming from and going to.*
>
> *Playing in GoVenture hooked me up with enthusiasm, it was fun. Entrepreneurial practices were much easier when doing it in a simulation. I wanted to learn more about how to balance my books. I also wanted to learn more about hiring staff and paying them salary. I can't wait to expand my business to different areas of the city and earn more profit.*

> *I found that manually entering the journal entries helped me better understand how my business decisions affected the financial statements in real time. For instance, buying inventory both credited and debited assets. More specifically, this decision credited (decreased) cash and debited (increased) inventory. Furthermore, it showed me that the cost of goods sold (COGS) is an expense account. Therefore, as inventory items were sold to my customers, the COGS account was debited (increased expense) and inventory was credited (decreased). Lastly, manually entering the journal entries showed me that at the end of the business day, both revenue and cash increase - revenue is credited and cash is debited.*

Although the formal quantitative data analyses did not provide results that demonstrated that the simulation project had a significant impact on metacognition, the feedback from students and observations from instructors paint a different picture. Rather than simply learning the accounting equation and how debits and credits are used to record journal entries within the accounting equation, the students developed a greater sense of "why" debits and credits were being used. Although this may not have shown up the self-report of metacognition, the feedback is encouraging, and future researchers should explore the impact of similar simulation type projects.

V. DISCUSSION

Our research provides a comprehensive examination of various aspects of metacognition and performance. Two separate instructors were utilized in a variety of different learning environments, which allowed us to examine metacognition in a highly generalizable manner as well as form control and treatment groups for two proposed solutions to improve metacognitive growth. First, we find the Principles of Financial Accounting course has a significant positive impact on metacognition. This likely comes as no surprise to many involved in academic community and the profession given the dynamic nature of the topic and its novelty to many students who are experiencing the class as one of their first business-specific courses. Metacognition is particularly important when being exposed to unfamiliar content and the course

provides an excellent opportunity for business colleges to foster and cultivate metacognitive growth.

Second, we examine the impact that metacognitive growth has on performance, as measured by both the comprehensive final exam score and final grade, in the Principles of Financial Accounting course. We find the change in both knowledge and regulation of cognition have a significant impact on performance. The importance of metacognition is made even more critical when considering dynamic and novel topics such as introductory accounting courses. This is a fantastic opportunity for accounting faculty to not only teach the course content but to also facilitate metacognitive growth that will benefit the students as they progress into their collegiate and professional careers.

Given the importance of metacognition on performance, we explore two potential mechanisms that could lead to metacognitive growth: the use of an online adaptive learning technology and a simulation project. Consistent with prior research (Jares et al., 2019), we do not find that an online adaptive learning technology has a significant impact on metacognitive growth. In a self-report survey, Jares et al. (2019) found that B students believed the OALT was beneficial while A and C students did not. This non-linear finding demonstrates that the effectiveness of the OALT is likely contextual based on the type of student and perhaps instructor influence (i.e., how effectively the instructor integrates the OALT into the curriculum). Future researchers can explore the effects that the instructor has on OALT effectiveness.

The second mechanism we explored to facilitate metacognitive growth was the implementation of a simulation project. Although the quantitative data did not support the effectiveness of the simulation on metacognitive growth, the feedback from students and observations from the instructors tell a different story. It is a widely held belief that instructors in

all principles/introductory level accounting classes must impress upon their students the importance of journal entries. This is usually done through vast repetition, very early and throughout the entirety of the semester/quarter. There is a much, much smaller minority of instructors that believe accounting at the introductory level should be taught without journal entries, because the overwhelming percentage of students in these classes are non-accounting business majors who will not prepare and/or use journal entries once they are done with this class. After having students work through the simulation, we are proposing a third alternative that, based on student feedback/comments, seems to be better than both of the other options.

Instead of purely including or excluding journal entries in these classes, a better answer surfaces when the focus is on when to bring in journal entries and how to incorporate them into the class. Once the simulation was put in place, the instructors in this study did not bring journal entries into the class until after the midway point in the semester/quarter. While the vast majority of principles of financial accounting classes push journal entries on students very early in the class and focus on the sheer amount of repetition to have students understand the topic, most students drown in this sink or swim environment. This plan will likely work in a class full of accounting majors, but when 90% of the students in the class are non-accounting business majors it becomes a struggle that most never recover from. A lot of students will memorize enough to pass the exams and the class, but not ascertain and retain the knowledge to actually help in a business context. Similarly, an approach that does not show the students any journal entries neglects to provide the students with valuable insight into the inner workings of the business process and operating cycle, which those 90% of non-accounting business majors must understand if they want to be fluent in the language of business.

Based on the feedback from students obtained from this study, we believe having

students firmly grasp the concepts of the financial statements, seeing how the statements interact with each other, and teaching the students a baseline understanding of financial analysis allows them to think and make decisions like a businessperson. This lets the students see how a business measures and communicates its financial status. Much like a baseball pitcher understanding the difference between a 3-0 count or an 0-2 count, versus what is the best pitch to throw in each situation, before students can understand the tactical implications behind business transactions, they need to first understand the financial statements in which those transactions will be reported.

Throughout this study the instructors observed how students appreciated the manual journal entry process. Although many students described the journal entry process as tedious, it allowed them to more fully understand the impact their decisions were having on their business. The instructors constantly observed that students wanted a greater understanding about the interplay between transactions, journal entries, and the financial statements because they had a vested interest in wanting to see their business succeed. Journal entries were no longer an abstract concept from a textbook but rather a mechanism to better understand the implications of a business.

While there is no perfect way to teach any class, the instructors believe the demographic of students in principles of financial accounting courses would greatly benefit from incorporating journal entries later in the class after students have a more solid foundation of the financial statements and intertwining the journal entries with a business simulation the students are already invested in. Future researchers can expand on these findings to gather additional quantitative and qualitative data related to the effectiveness of the simulation.

In conclusion, the evidence is clear that metacognition is an important component to the

learning process, particularly in subjects that are dynamic and novel. The Principles of Financial Accounting course provides an opportunity for instructors to develop the metacognitive skills of the students. Although the incorporation of an OALT and implementation of a simulation project did not provide quantitative evidence of being more effective mechanisms for metacognitive growth than a more traditional course structure without an OALT or simulation, there was anecdotal evidence that demonstrated the simulation had a strong influence on the learning process for students. While the search for new mechanisms continues, the influence of the instructor should not be understated. The willingness to try new tools affords the the instructor the ability to provide a firsthand view for students to see the metacognitive learning process in action.

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APPENDIX
SURVEY INSTRUMENT USED IN RESEARCH

Metacognitive Awareness Inventory

1. I ask myself periodically if I am meeting my goals.
2. I consider several alternatives to a problem before I answer.
3. I try to use strategies that have worked in the past.
4. I pace myself while learning in order to have enough time.
5. I understand my intellectual strengths and weaknesses.
6. I think about what I really need to learn before I begin a task.
7. I know how well I did once I finish a test.
8. I set specific goals before I begin a task.
9. I slow down when I encounter important information.
10. I know what kind of information is most important to learn.
11. I ask myself if I have considered all options when solving a problem.
12. I am good at organizing information.
13. I consciously focus my attention on important information.
14. I have a specific purpose for each strategy I use.
15. I learn best when I know something about the topic.
16. I know what the teacher expects me to learn.
17. I am good at remembering information.
18. I use different learning strategies depending on the situation.
19. I ask myself if there was an easier way to do things after I finish a task.
20. I have control over how well I learn.
21. I periodically review to help me understand important relationships.
22. I ask myself questions about the material before I begin.
23. I think of several ways to solve a problem and choose the best one.
24. I summarize what I've learned after I finish.
25. I ask others for help when I don't understand something.
26. I can motivate myself to learn when I need to.
27. I am aware of what strategies I use when I study.
28. I find myself analyzing the usefulness of strategies while I study.
29. I use my intellectual strengths to compensate for my weaknesses.
30. I focus on the meaning and significance of new information.
31. I create my own examples to make information more meaningful.
32. I am a good judge of how well I understand something.
33. I find myself using helpful learning strategies automatically.
34. I find myself pausing regularly to check my comprehension.
35. I know when each strategy I use will be most effective.

36. I ask myself how well I accomplish my goals once I'm finished.
37. I draw pictures or diagrams to help me understand while learning.
38. I ask myself if I have considered all options after I solve a problem.
39. I try to translate new information into my own words.
40. I change strategies when I fail to understand.
41. I use the organizational structure of the text to help me learn.
42. I read instructions carefully before I begin a task.
43. I ask myself if what I'm reading is related to what I already know.
44. I reevaluate my assumptions when I get confused.
45. I organize my time to best accomplish my goals.
46. I learn more when I am interested in the topic.
47. I try to break studying down into smaller steps.
48. I focus on overall meaning rather than specifics.
49. I ask myself questions about how well I am doing while I am learning something new.
50. I ask myself if I learned as much as I could have once I finish a task.
51. I stop and go back over new information that is not clear.
52. I stop and reread when I get confused.

Key

Knowledge of Cognition:

Declarative Knowledge: 5, 10, 12, 16, 17, 20, 32, 46
Procedural Knowledge: 3, 14, 27, 33
Conditional Knowledge: 15, 18, 26, 29, 35

Regulation of Cognition:

Planning: 4, 6, 8, 22, 23, 42, 45
Comprehension Monitoring: 1, 2, 11, 21, 28, 34, 49
Information Management Strategies: 9, 13, 30, 31, 37, 39, 41, 43, 47, 48
Debugging Strategies: 25, 40, 44, 51, 52
Evaluation: 7, 19, 24, 36, 38, 50

TABLES

Table I. Simulation Assignments

Assignment	Description
Sim 1: 10 Days & Reflection	Play 10 simulation days and write a minimum 150-word reflection on financial performance, what went well/poor, and what they would change.
Sim 2: Excel Financial Statements	No simulation play needed. Students are given a listing of accounts and amounts for Prof IT, Co. and must create a Trial Balance, Income Statement, Statement of Retained Earnings, and Balance Sheet for Prof IT, Co. in Excel.
Sim3: 10 Days & Financial Statements	Play 10 more days (total of 20 days played). Students use accounts and amounts from their business to complete a Trial Balance, Income Statement, Statement of Retained Earnings and Balance Sheet for their company.
Sim4: 10 Days & Vertical Analysis/Ratios	Play 10 more days (total of 30 days played). Students update their financial statements with their new account details. They use that information to complete a vertical analysis for the income statement and balance sheet for both their business and the Prof IT, Co. Then they compare the ratios of the two companies to answer questions.
Sim5: 5 Days with Journal Entries & Reflection	Play 5 days (total of 35 days played). Students complete manual journal entries for their business and write a minimum 150-word reflection on how they approached their business decisions and what they thought of doing the journal entries manually.
Sim6: 25 Days & Horizontal Analysis	Play 25 days (total of 60 days played). Students update their financial statements with their new account details. They use that information to complete a horizontal analysis comparing their Balance Sheet from Sim4 assignment (after 30 days of business) to their Balance Sheet from this Sim6 assignment (after 60 days of business) and answer corresponding questions.

Table II. Correlation Matrix

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Final Exam	70.48	25.6								
2. Final Grade	2.53	1.34	0.83 **							
3. Major	0.16	0.37	0.16 **	0.21 **						
4. Age	20.64	3.29	-0.01	0.02	-0.02					
5. Prior GPA	3.04	0.69	0.46 **	0.59 **	0.11 *	-0.15 **				
6. Instructor	0.55	0.50	0.08 *	0.14 **	0.07	-0.02	0.00			
7. Face-to-Face	0.44	0.50	0.22	0.19 **	0.07	-0.14 **	0.05	0.20 **		
8. Δ Knowledge of Cognition	1.04	14.46	0.07	0.12 **	0.06	0.10	0.04	-0.06	-0.03	
9. Δ Regulation of Cognition	2.53	16.09	0.08	0.11 *	0.06	0.09	0.07	-0.10 *	0.00	0.71 **

n = 483

* p < .05, ** p < .01

Control Variables: Major (Non-Accounting = 0, Accounting = 1), Age (16-44), Prior GPA (0.79 - 4.00)
Instructor (Instructor #1 = 0, Instructor #2 = 1), Face-to-Face (Online = 0, F2F = 1)

Independent Variables: Change in (Δ) Knowledge of Cognition (-74.21 - 77.29) and Change in (Δ) Regulation of Cognition (-69.21 - 70.76)

Dependent Variables: Final Exam (0-100) and Final Grade (0 - 4.00)

Table III. Descriptive Statistics and Paired Samples t-test for Metacognition

	N	Mean	Std. Dev.	Std. Err.	t	Two-sided p
Declarative Knowledge (Beg)		74.06	13.98	0.62		
Declarative Knowledge (End)		75.54	13.96	0.62		
Difference	515	1.48			2.228	0.026
Procedural Knowledge (Beg)		72.23	17.08	0.75		
Procedural Knowledge (End)		73.91	16.79	0.74		
Difference	515	1.68			2.072	0.039
Conditional Knowledge (Beg)		76.38	15.63	0.69		
Conditional Knowledge (End)		76.28	16.13	0.71		
Difference	515	-0.10			-0.137	0.891
Knowledge of Cognition (Beg)		74.21	13.67	0.60		
Knowledge of Cognition (End)		75.25	14.09	0.62		
Difference	514	1.04			1.633	0.103
Planning (Beg)		61.56	18.05	0.80		
Planning (End)		65.53	17.73	0.78		
Difference	514	3.97			4.955	< .001
Information Mgmt Strategies (Beg)		67.98	15.38	0.68		
Information Mgmt Strategies (End)		70.18	16.17	0.71		
Difference	514	2.20			3.007	0.002
Comprehension Monitoring (Beg)		67.33	17.20	0.76		
Comprehension Monitoring (End)		69.37	17.19	0.76		
Difference	514	2.04			2.632	0.009
Debugging Strategies (Beg)		75.57	16.08	0.71		
Debugging Strategies (End)		75.76	16.35	0.72		
Difference	512	0.19			0.227	0.821
Evaluation (Beg)		62.57	17.69	0.78		
Evaluation (End)		65.63	18.00	0.79		
Difference	515	3.06			3.738	< .001
Regulation of Cognition (Beg)		67.22	14.37	0.64		
Regulation of Cognition (End)		69.35	15.00	0.67		
Difference	509	2.52			3.286	0.001
Metacogntion Total (Beg)		69.73	13.28	0.59		
Metacogntion Total (End)		71.54	14.08	0.62		
Difference	509	2.13			2.966	0.003

Table IV. Results of Linear Regression Analyses of Metacognition on Performance

	Column 1: Final Exam			Column 2: Final Grade			Column 3: Final Exam			Column 4: Final Grade		
	B	SE	β	B	SE	β	B	SE	β	B	SE	β
(Constant)	0.39	0.07		-0.19	0.37		0.39	0.07		-0.23	0.37	
1. Major	0.05	0.021	0.11 **	0.314	0.11	0.12 **	0.05	0.02	0.11 **	0.32	0.11	0.13 **
2. Age	0.00	0.00	0.06	0.018	0.01	0.07	0.00	0.00	0.06	0.02	0.01	0.07
3. Prior GPA	0.10	0.013	0.38 ***	0.793	0.07	0.52 ***	0.10	0.01	0.38 ***	0.79	0.07	0.52 ***
4. Professor	0.00	0.016	0.00	0.215	0.09	0.11 **	0.00	0.02	0.01 ***	0.23	0.09	0.12 ***
5. Face-to-Face	0.03	0.017	0.10 *	0.219	0.09	0.11 **	0.03	0.02	0.09 *	0.21	0.09	0.10 **
6. Δ Knowledge of Cognition	0.00	0.00	0.08 *	0.006	0.00	0.09 **						
7. Δ Regulation of Cognition							0.00	0.00	0.11 **	0.01	0.00	0.09 *
R^2 (model)	0.67 ***			0.71 ***			0.67 ***			0.78 ***		
Adjusted R^2 (model)	0.59 ***			0.63 ***			0.59 ***			0.72 ***		

n = 346

* p < .10, one-tailed; ** p < .05, one-tailed; *** p < .001, one-tailed

Outcome Variables: Final Exam and Final Grade

Independent Variables: Change in (Δ) Knowledge of Cognition and Change in (Δ) Regulation of Cognition

Covariates: Major, Age, Prior GPA, Professor, and Face-to-Face

Table V. Results of Univariate ANCOVA of OALT on Metacognition

	Change in Knowledge of Cognition			**Change in Regulation of Cognition**		
	TSS	df	F	TSS	df	F
Corrected Model	1406.53	6	1.13	1755.35	7	1.35
Intercept	279.27	1	1.34	116.01	1	0.53
Major	295.10	1	1.42	256.60	1	1.18
Age	670.84	1	3.22 *	501.77	1	2.31
Prior GPA	32.44	1	0.16	41.34	1	0.19
F2F	27.06	1	0.13	0.24	1	0.00
Instructor	172.68	1	0.83	725.61	1	3.34
OALT	136.35	1	0.66	223.18	1	1.03
Error	70820.86	340		74295.90	342	
Total	72822.12	347		78043.24	349	
Corrected Total	72227.40	346		76051.25	348	
R^2	0.019			0.023		
Adj. R^2	0.002			0.006		

* p < .10, ** p < .05, *** p < .001

Outcome Variables: Change in (Δ) Knowledge of Cognition and
Change in (Δ) Regulation of Cognition

Independent Variable: Online Adaptive Learning Technology (0 = not utilized, 1 = utilized) and

Covariates: Major, Age, Prior GPA, F2F (Face-to-Face), Instructor

Table VI. Results of Univariate ANCOVA of Simulation on Metacognition

	Change in Knowledge of Cognition			**Change in Regulation of Cognition**		
	TSS	df	F	TSS	df	F
Corrected Model	1352.48	6	1.08	1538.93	6	1.18
Intercept	201.21	1	0.97	116.06	1	0.53
Major	316.66	1	1.52	284.42	1	1.31
Age	523.25	1	2.51	428.95	1	1.97
Prior GPA	28.83	1	0.14	43.01	1	0.20
F2F	62.03	1	0.30	1.69	1	0.01
Instructor	122.64	1	0.59	617.82	1	2.84 *
Simulation	82.30	1	0.40	6.76	1	0.03
Error	70874.91	340		74512.32	341	
Total	72822.12	347		78043.24	349	
Corrected Total	72227.40	346		76051.25	348	
R^2	0.019			0.020		
Adj. R^2	0.001			0.002		

* p < .10, ** p < .05, *** p < .001

Outcome Variables: Change in (Δ) Knowledge of Cognition and Change in (Δ) Regulation of Cognition

Independent Variable: Simulation (0 = not utilized, 1 = utilized) and

Covariates: Major, Age, Prior GPA, F2F (Face-to-Face), Instructor