The Effects of Intrinsic Cognitive Load on Student Learning in Managerial Accounting

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Abstract: This study investigates whether reducing students' Intrinsic Cognitive Loads (ICL) improves student performance in Managerial Accounting, a core introductory accounting course. The purpose of the study is not to compare accounting and non-accounting majors' learning. The goal of the study is to determine whether overall student learning improves by only focusing on instructional material that is needed by non-accounting majors in the course. Intrinsic Cognitive Load refers to the innate level of difficulty associated with an instructional topic. Cognitive Load Theory (CLT) posits that high levels of ICL negatively affect learning. To date, empirical research supports this premise for novice students enrolled in introductory accounting courses. The present study reduces students' ICL in Managerial Accounting by removing instructional material not deemed to be essential to non-accounting majors in an effort to improve overall student learning in the course. The course was presented in three modules, with three exams administered after each module to assess students' learning. Instructional material was removed for the second and third modules only (the independent variable manipulations), since material covered in the first module is critical to all students' success. The main finding of the study is that the instructional material manipulation significantly explains the improvement in students' overall learning in the course. A sensitivity analysis reveals non-accounting majors' performance did not drive these results, despite the fact that the instructional material manipulation was chiefly employed to improve their performance in the course. These results are of importance to professors seeking to improve student learning in courses that include both major and non-major students.

Keywords: Cognitive Load Theory; Intrinsic Cognitive Load, Introductory Accounting Course, Managerial Accounting

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Introduction

Managerial Accounting is a core introductory business course for accounting majors, non-accounting majors, and a number of non-business majors. Student attrition and poor performance persist in this course, where excellent performance is the exception, not the rule. Prior literature has proposed a number of prominent learning theories to identify factors that are critical to students' success. These theories include behaviorist, constructivist and cognitivist theories.

The current study employs Cognitive Load Theory (CLT), a cognitivist theory, to investigate whether student learning in Managerial Accounting improves after reducing students' intrinsic cognitive loads (ICL). This study is motivated by both academic and professional factors. From an academic perspective, this study is motivated by Mostyn (2012, p. 241), who suggests that a paucity exists in the literature regarding the relationship between CLT and accounting education research.[1] Mostyn's (2012, p. 234) research indicates that optimizing a learner's total cognitive load improves learning efficiency. The present study reduces students' ICL by removing instructional material associated with certain learning objectives covered during the course.[2] From a professional standpoint, research reports that entry-level professionals are not prepared for public accounting (Kingry et al., 2015, p. 54). This may be due to the vast amount of information covered in introductory accounting courses, which leaves less time for students to firmly grasp fundamental knowledge, resulting in students who memorize information as opposed to learning the material. This line of reasoning is consistent with Lawson

[1] Mostyn (2012, p. 242) finds that only four of 92 research papers addressed course content modifications in prior cognitive load research. Of these four, one was related to Managerial Accounting, the course to which we apply CLT.
[2] The learning objectives to which we are referring are the learning objectives set forth by the textbook (Appendix A provides a description of these learning objectives.

et al. (2014), who assert that students do not understand basic competencies in the accounting curriculum. Reducing students' ICL by focusing on critical learning objectives not only improves students' learning in this course, but may also improve students' retention of the foundational principles that is critical to the success of entry-level professionals during the initial phases of their professional careers.

A pre- post- experimental methodology is employed to examine the following research question: Does *overall* student learning in managerial accounting improve when learning objectives that are non-essential to the current course (Managerial Accounting) are removed in order to reduce students' ICL? Data was collected for students for six semesters, from 2012 to 2016. Three modules were taught during the course, with subsequent exams administered after each module. The independent variable of interest is the instructional material manipulation, which was created by varying the instructional material presented to students in a Managerial Accounting course. For three consecutive semesters, the course was taught using all of the instructional material in the textbook (the full-objective group). In the three following semesters, the professor removed instructional material that was not deemed to be important to non-accounting majors in an effort to improve learning of the material.[3]

The main finding of the study is that reducing students' ICL improves the performance of students in the course, even after controlling for student gender and student major. The purpose of the study was not to compare the performance of accounting and non-accounting majors. However, an analysis of both subgroups reveals that the overall improvement in student performance is not driven by the non-accounting majors, regardless of the fact that the instructional material manipulation was designed to improve their learning. Although these

[3] Note: The professor teaching the course was also an author of the textbook.

results run contrary to expectations, the results are consistent with studies in other majors that question the theory that majors and non-majors are different with respect to their learning (Sundberg and Dini, 1993). The improved student learning was primarily driven by accounting majors that completed their second exam following Module 2, the first module in which the instructional material was manipulated. Overall, these findings contribute to the literature by demonstrating that the strategic placement for improving overall learning should occur prior to the end of the course, not near the end of the course.[4] Future experimental research is needed to determine the impact of factors such as student motivation, study time and expert-level beliefs on their learning. Future research may also manipulate instructional material at the beginning of the semester to understand the impact of ICL on student learning.

The remainder of the paper is organized as follows. The next section contains the literature review and develops the research questions. The following section discusses the methodology. The subsequent section discusses the results of the study. The final section concludes the paper and provides areas for future research.

Literature Review

Overview

Prominent learning theorists have presented a number of schools of thought which target the enhancement of accounting students' learning success. Despite the application of CLT in numerous undergraduate courses,[5] Mostyn (2012) reports that this theory has not been

[4] While this may be due to a number of reasons, it is worth noting that the university at which this study was conducted observes a "dead week" in which no extracurricular activities occur the last week of the semester. The university's reduction in students' cognitive load could potentially impact their learning in a positive way. Thus, future research may replicate this study at universities that do not observe "dead week." These results provide context to research question one, by indicating that reduced ICL may improve student learning, but only if it is strategically placed in the semester.

[5] Some of these courses include Introductory C programming classes (Impelluso, 2009), Calculus (Miller, 2010), and Bookkeeping courses (Stark, 2004).

extensively applied to the accounting discipline. Mostyn (2012, p. 227) highlights the need to understand the tenets of CLT, which may be applied to introductory accounting classes in order to develop introductory-level instructional design to meet the needs of the diverse students who enroll in introductory accounting courses. The present study relies on Mostyn's (2012, p. 234) guidelines for applying CLT to a specific introductory accounting course (Managerial Accounting), which suggests optimizing students' intrinsic loads to improve student performance. We rely on Mostyn's (2012) qualitative work on CLT and student performance in introductory accounting courses – along with his suggestions for future research – to motivate this study. The remainder of the literature review (1) discusses CLT, (2) discusses CLT and introductory accounting courses, and (3) develops the research questions examined in this study.

Cognitive Load Theory

Cognitive Load Theory, which is derived from cognitivist learning theories, suggests that learners who hold multiple, complex information in their working memory exert an effort that is referred to as a "cognitive load" (Mostyn, 2012, p. 232). Three types of cognitive load that affect human processing have been distinguished in the literature (Blayney et al., 2016; Kingry et al., 2015; Mostyn, 2012). Germane load is a necessary load that is intentionally placed on learners in order to develop their schema (Sweller et al., 1998). Extraneous load is an unnecessary load that impairs learners' schema development when instructional materials are poorly designed (Mostyn, 2012, p. 232). Finally, intrinsic load is a value-added necessary load which consists of the inherent complexity of the subject matter, the learner's given level of schema, and the learner's natural working memory ability (Kingry et al., 2015; Mostyn, 2012). It is this intrinsic load that is the focus of this study.

Cognitive Load Theory posits that high levels of intrinsic and/or extraneous loads may negatively affect learning. Sithole et al. (2017, p. 221) indicate that cognitive load research may be divided into two categories: (1) the impact of learners' application of CLT's design principles to improve their outcomes, and (2) the influence of educators' instructional design on student outcomes. The present study is positioned in the latter literature stream. Research in this stream has explored the relationship between elements of CLT and introductory accounting performance with respect to the impact of prior knowledge and task efficiency (Halabi, 2006), isolated-interactive elements and learner expertise (Blayney et al., 2010), the learning of transaction analysis (Johnson and Slayter, 2012), instructional fading and learners' performance (Kingry et al., 2015), tailored instructions based on learners' level of expertise (Blayney et al., 2015), task complexity and learner expertise (Blayney et al., 2016), and learners' self-management of instructional material as a way to improve student outcomes (Sithole et al., 2017).

Cognitive Load Theory and Introductory Accounting Performance

The present study contributes to the literature by investigating whether a reduction of ICL improves students' learning in Managerial Accounting. Kingry et al. (2015, p. 56) indicate that the number of elements that a learner can process at once determines a learner's cognitive load. Van Merrienboer et al. (2006) find that a reduction in the level of intrinsic load for novice learners may improve students' learning. Mostyn (2012) suggests that the optimization of the complexity of the content provided to learners is the only facet of ICL which instructors may control. The study proposes that this may be accomplished by reducing the content to be covered by primarily focusing on content that is considered to be foundational to accounting.

Research Question Development

Cognitive Load Theory states that cognitive loads limit the ability to learn and retain information in the long-term memory. Critical to the optimization of a learner's ICL is that non-foundational learning objectives should be removed from the course. This is consistent with Mostyn (2012, p. 235), who implies that the removal of non-foundational accounting learning objectives improves students' learning in Managerial Accounting.

For students, cognitive load may limit and hinder learning in an academic environment. Instructors can do little to control the external cognitive load on students; however, instructors may manipulate either the classroom setting or the instructional material covered in the course in an attempt to limit the impact of cognitive load on the learning environment and the long-term retention of material covered.

This study attempts to reduce students' cognitive load in Managerial Accounting by reducing the instructional material that was identified as non-essential for non-accounting students. Managerial Accounting is a course which includes the identification, the analysis, and the communication of financial information to internal managers to help them achieve the corporation's goals. This course is the second in a series of introductory accounting classes for students in the university's college of business. Whereas the first course focuses on the needs of external financial statement users (Introduction to Financial Accounting), Managerial Accounting is concerned with the needs of internal stakeholders. Since the first course is a prerequisite to Managerial Accounting, all students enrolled in this course have been exposed to accounting at the college level. This exposure removes some of the diversity that would exist if students had no prior knowledge of accounting, which would have contributed to higher levels of cognitive load for students.

Anecdotally, Mostyn (2012, p. 235) suggests that students' learning in Managerial Accounting may be improved by removing non-foundational accounting learning objectives. However, no research has confirmed this assertion. The present study fills this void in the study. The following research questions are proposed in this study:

RQ1: Does students' overall learning in Managerial Accounting improve when professors remove instructional material that is non-essential to non-accounting majors?

RQ2: When ICL is reduced by the removal of instructional material that is non-essential to non-accounting majors, are the results from research question one primarily driven by (1) non-accounting majors or (2) accounting majors?

Methodology

Data Collection

A total of 133 archived records were used in the study, which spanned calendar years 2012 through 2016. Twelve records that did not record a score for each exam were removed. This resulted in 121 usable student records for the study.

Table 1 summarizes the participants' demographic data. A total of 73 students completed the course *prior to* the reduction of ICL. Forty-eight students were in the treatment group *after* the reduction of ICL. A higher percentage of female students (61.2%) than males (38.8%) were involved in the study. The records indicate that a higher percentage of students were non-accounting majors (71.9%).[6] Students were classified as traditional or non-traditional according to the National Center for Education Statistics (NCES, 2002). Students age 24 and below were classified as traditional students (43.0%). Non-traditional students were categorized by two

[6] This was verified by checking students' upper-level classes. Students who had completed the second portion of an Intermediate Accounting class were classified as accounting majors. All others were identified as non-accounting majors. Students were designated as either traditional or non-traditional students based on the number of hours in which they were enrolled during semester in which they completed the Managerial Accounting course.

levels: ages 25 through 34 (38.0%) and ages 35 and above (19.0%). Students were classified as full-time students (22.3%) or part-time students (77.7%) based on whether they were enrolled in twelve or more hours during the semester. No significant differences were noted due to the demographics of the students included in the study.

---Insert Table 1---

Research Design

Data were collected over six semesters in Managerial Accounting during the calendar years 2012 through 2016. All lectures for all classes were taught by the same instructor, who used the same pedagogy, quizzes, homework and Managerial Accounting textbook for each of the classes. The book was written by Sawyers, Jackson and Jenkins (Sawyers et al., 2013). Students in both groups were presented with three objective-answer format exams each semester. Twenty-five questions were randomly selected for each test from the test bank which accompanied the textbook for only the topics covered.

Treatment Groups

The independent variable is created by varying the content and the related instructional material covered in each **treatment group** for module two and module three.[7] The 'full-objective treatment group' consists of students who completed the course during the three semesters preceding the removal of the instructional material for module two and module three. The group in which instructional material was removed is referred to as the 'reduced-objective treatment group' and consists of students who completed the course during the three semesters

[7] Since the first exam covered basics that are instrumental to both accounting and non-accounting students, ICL was not reduced for module one (i.e. no instructional material was removed). Only the instructional material in Chapter 8 (Long-Term Investment Decisions) was excluded for **both** treatment groups.

after the manipulated instructional material was removed in module two and module three. No additional modifications were made for either treatment group.

The total class time devoted to students in both treatment groups was not manipulated. However, the reduction of content allowed the instructor to focus more on the remaining instructional material in the 'reduced-objective' group during the time that students were in the classroom. Appendix A details the content covered in both treatment groups.

Results

Manipulation Testing and Correlation Analysis

Table 2 presents the preliminary analysis. As expected, students' overall grades improved significantly after reducing students' intrinsic loads ($p = 0.000$). These results suggest that the manipulation is effective: student learning appears to have increased significantly following the removal of instructional material covered in class prior to Exam 2 ($p = 0.001$) and Exam 3 ($p = 0.049$). The correlation analysis in Table 3 confirms a significant correlation between overall grades and the treatment variable ($p = 0.000$), and suggests that the following may be suitable covariates: student gender ($p = 0.081$) and student major ($p = 0.000$). Although student type (i.e. traditional versus either category of non-traditional students) is not significant, the impact of this factor and the significant demographic factors is explored in the multivariate analysis of the research questions.

---Insert Table 2---

---Insert Table 3---

Research Question One Analysis

Research question one explores whether the reduction of ICL improves student learning in Managerial Accounting, irrespective of students' major. The mean performance for both

treatment groups is recorded in Table 2 (reduced-objective mean = 78.0 and full-objective mean = 69.3). The multivariate ANCOVA results in Table 4 suggest that ICL reduction is significant in explaining students' overall mean performance in the course, even after controlling for student gender and student major ($F = 10.962$, $p = 0.001$; Table 4, Panel A).

---Insert Table 4---

The study also evaluated the impact of the ICL reduction on the performance of each individual exam. Analysis of variance tests were performed on the results for Exam 2 and Exam 3. Regarding Exam 2, students in the reduced-objective treatment group produced an average score of 78.8% (Table 2), while the mean score for students in the full-objective group was 68.7% (Table 2). The ANOVA results in Table 4 (Panel B) indicate that increase in scores for students in the reduced objective group is significantly higher ($F = 9.153$, $p = 0.003$), even after controlling for gender ($p = 0.061$) and student major ($p = 0.000$). The analysis for Exam 3 (Table 4, Panel C) reveals that the reduction of instructional material was also significant ($F = 3.759$; $p = 0.055$) in explaining student learning; even after controlling for student gender ($p = 0.070$).[8] Taken together, the results suggest that there while there is merit to the reducing the instructional material during the course, the timing of this tactic must be considered to receive the greatest benefits from reducing ICL.

[8] Compared to ANOVA results for student performance on Exam 2, the absence of a more stringent significant difference may suggest that the reduction of instructional material covered late in the semester may not be as effective in improving student outcome compared to earlier in the year. One plausible explanation lies in a practice observed both at this university and several other universities in the United States, which places a moratorium on school-sponsored activities late in the semester. This practice inherently reduces students' extrinsic cognitive loads near the end of the term. If this is the case, the practical implications of these findings is that the reduction of instructional material covered during the class is most beneficial to improving performance during the middle of the semester.

Research Question Two Analysis

Research question two specifically investigates whether reducing the ICL of non-accounting and accounting students improves their performance. Table 5 provides the descriptive statistics for students' overall grades *by major*. The purpose of this table is not to compare the performance of non-accounting majors to accounting majors. The purpose of the table (and research question two) is to understand which sub-group of students drives the results from research question one.

---Insert Table 5---

An inspection of the data in Table 5 reveals a greater increase in the performance of accounting majors (approximately thirteen percent) compared to that of non-accounting majors (approximately four percent). These results suggest that accounting majors' learning in the course drives the improvement from the results in research question one, despite the instructional material manipulation being implemented to improve non-majors' performance.

The multivariate results that measure the impact of cognitive load on non-accounting students' overall grade and Exam 2 and Exam 3 are presented in Table 6 (Panel A). The instructional material manipulation approached marginal significance in explaining non-accounting students' overall learning ($p = 0.105$), but not for any of the individual exams.

---Insert Table 6---

Additional analyses find that the ICL manipulation continues to approach marginal significance, even after controlling for traditional students under the age of 25 ($p = 0.106$; Table 7, Panel A). Another analysis examined whether the results were influenced by the interaction between the manipulation and the student type (Table 7, Panel B). Although none of the interaction terms were significant, the ICL manipulation approached marginal significance ($p =$

0.070) in the presence of an interaction with non-traditional students age thirty-five and older. Collectively, these results indicate that reducing ICL among non-accounting majors does not significantly improve their learning during the course.

---Insert Table 7---

Table 8 presents the analysis for the impact of ICL reduction on accounting students' performance. The removal of learning objectives resulted in a significant improvement ($p = 0.000$) for both their overall grade and their Exam 2 grade (Table 8, Panel A). These results indicate that accounting students' performance in the course drives the overall results from research question one.

---Insert Table 8---

Discussion

Recent literature has raised awareness that students' cognitive loads are adversely associated with poor academic performance. However, empirical evidence regarding the impact of reduced cognitive loads on novice students' learning in introductory business classes in the literature is scant, at best. In an effort to better understand this theoretical premise, a study was conducted to investigate whether the removal of instructional material that is non-essential to non-accounting majors from a Managerial Accounting course would improve the learning of non-accounting majors in the course. In the experimental design, the following factors were held constant in order to reduce noise from the data: the textbook, the instructor and the test bank from which questions were randomly selected for exams for only the topics covered. Regarding the manipulation, learning objectives that were regarded as non-essential to accounting majors were removed, as they will cover those objectives in their Cost Accounting course. However,

these objectives are of lesser importance to non-accounting majors; the performance of these students is expected to improve by reducing ICL in this manner.

Consistent with expectations, students' overall exam performance increased when less instructional material was presented in the class. These results persist after controlling for students' gender and their major. The additional analysis of the results reveal that strategically reducing students' ICL in the middle of the semester results in improved learning more so than at the end of the semester.

The generalization of these results is restricted by at least two limitations that allow for future research. First, the study did not address students' overall cognitive loads. Future research may focus on whether intrinsic or extrinsic cognitive loads have a stronger impact on student learning in introductory business courses, which would make for a richer study. A second limitation is that students in the study were selected from one university in the United States, which would also impact the generalizability of the results. Future research may include students from more than one university in order to create a larger sample size, which will improve the strength of the findings in this study. Due to the large number of non-traditional students who completed the course (i.e. older students, working students, students of varying loads, etc.), a larger sample size would allow for more subgroup analyses.

These results provide a number of fruitful opportunities for future research. For example, further research to capture sources of extrinsic loads to explain student performance would assist in the interpretation of the results from this study. Future research may also examine why this proposed phenomenon may be true. In addition, future studies may also focus on the impact of cognitive load reduction on accounting students, since they appear to benefit more from this treatment and have a vested interest in the subject due to the choice of their major.

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TABLE 1
Demographics

Demographic Overview	**Statistics**	**Percent**
Treatment		
Full-Objective Group	73	60.3%
Reduced-Objective Group	48	39.7%
Gender		
Male	47	38.8%
Female	74	61.2%
Major		
Accounting	34	28.1%
Non-Accounting	87	71.9%
Student Type		
Traditional (Age 24 and Below)	52	43.0%
Non-Traditional (Age 25 - 34)	46	38.0%
Non-Traditional (Age 35 and Above)	23	19.0%
Student Status		
Full-time	27	22.3%
Part-time	94	77.7%

TABLE 2
Analysis of Variance: Analysis of Student Learning for All Majors

Measure	Full-Objective	Reduced-Objective	F-statistic	p-value
Exam 1	73.6%	77.6%	2.236	0.137
Exam 2	68.7%	78.8%	12.583	*0.001
Exam 3	71.4%	77.5%	3.972	**0.049
Overall Grade	69.3%	78.0%	14.462	*0.000

*Significant at p < 0.01
**Significant at p < 0.05

TABLE 3
Correlation Analysis
(All Majors)

	Overall Grade	Treatment	Gender	Major	Traditional Below Age 25	Nontraditional Age 25-Age 34	Nontraditional Age 35 and Above
Overall Grade	1.000						
Treatment	-0.329						
	*0.000						
Gender	-0.159	0.040					
	***0.081	0.667					
Student Major	0.454	-0.154	-0.030				
	*0.000	***0.091	0.745				
Below Age 25	-0.049	0.026	-0.233	-0.171			
	0.593	0.774	*0.010	**0.060			
Age 25 to Age 34	0.087	-0.053	0.135	0.041	-0.680		
	0.342	0.563	0.140	0.658	*0.000		
Age 35 or Above	-0.046	0.032	0.127	0.166	-0.421	-0.379	
	0.618	0.725	0.166	**0.069	*0.000	*0.000	

*Significant at p < 0.01
**Significant at p < 0.05
***Significant at p < 0.10

TABLE 4
The Impact of the Instructional Material Manipulation on Student Learning (All Majors)

PANEL A: Dependent Variable (Overall Grade)

Source	Sum of Squares	df	Mean Square	F	p-value
Corrected Model	0.588	3	0.196	16.178	0.000
Intercept	53.841	1	53.841	4441.427	0.000
Treatment	0.133	1	0.133	10.962	*0.001
Gender	0.037	1	0.037	3.085	***0.082
Major	0.328	1	0.328	27.052	*0.000
Error	1.418	117	0.012		
Total	65.746	121			
Corrected Total	2.007	120			

PANEL B: Dependent Variable (Exam 2)

Source	Sum of Squares	df	Mean Square	F	p-value
Corrected Model	0.983	3	0.328	18.479	0.000
Intercept	55.466	1	55.466	3128.591	0.000
Treatment	0.162	1	0.162	9.153	*0.003
Gender	0.063	1	0.063	3.579	***0.061
Major	0.617	1	0.617	34.808	*0.000
Error	2.074	117	0.018		
Total	66.761	121			
Corrected Total	3.057	120			

PANEL C: Dependent Variable (Exam 3)

Source	Sum of Squares	df	Mean Square	F	p-value
Corrected Model	0.193	2	0.097	3.691	0.028
Intercept	61.497	1	61.497	2348.130	0.000
Treatment	0.098	1	0.098	3.759	***0.055
Gender	0.087	1	0.087	3.333	***0.070
Error	3.090	118	0.026		
Total	69.110	121			
Corrected Total	3.284	120			

*Significant at p < 0.01
**Significant at p < 0.05
***Significant at p < 0.10

TABLE 5
Descriptive Statistics for Course Performance by Major
To Determine Whether the Overall Results are Driven by the Performance of Non-Accounting Majors, Accounting Majors, or Both

Dependent Variable: Overall Grade

	Non-Accounting Major			Accounting Major		
	Reduced Objective Group	**Full Objective Group**	**Total**	**Reduced Objective Group**	**Full Objective Group**	**Total**
Mean	71.6%	67.5%	68.9%	88.6%	75.2%	81.9%
Std. Deviation	11.2%	11.5%	11.5%	9.6%	10.0%	11.8%
n	29	58	87	17	17	34

Note: Table 5 does *not* compare the statistics of each group, as this is outside the scope of our research project.

TABLE 6
Analysis for the Impact of Cognitive Load Reduction on Non-Accounting Majors

Panel A: The Impact of Cognitive Load Reduction for Overall Grade and All Exams

Dependent Variable		Sum of Squares	df	Mean Square	F	p-value
Overall Grade	Between Groups	0.035	1	0.035	2.692	0.105
	Within Groups	1.099	85	0.013		
	Total	1.133	86			
Exam 1	Between Groups	0.007	1	0.007	0.381	0.539
	Within Groups	1.603	85	0.019		
	Total	1.610	86			
Exam 2	Between Groups	0.040	1	0.040	2.009	0.160
	Within Groups	1.688	85	0.020		
	Total	1.727	86			
Exam 3	Between Groups	0.019	1	0.019	0.775	0.381
	Within Groups	2.110	85	0.025		
	Total	2.129	86			

*Significant at p < 0.01
**Significant at p < 0.05
***Significant at p < 0.10

TABLE 7
Non-Accounting Majors: The Effects of Internal Cognitive Load and Student Type on Managerial Accounting Performance

Panel A: Dependent Variable
Grade ICL Manipulation and Student Type: No Interaction

Source	Sum of Squares	df	Mean Square	F	p-value
Corrected Model	0.038	2	0.019	1.443	0.242
Intercept	37.480	1	37.480	2873.182	0.000
Treatment	0.035	1	0.035	2.668	0.106
Students Below 25 Years	0.003	1	0.003	.218	0.642
Error	1.096	84	0.013		
Total	42.467	87			
Corrected Total	1.133	86			

Panel B: Dependent Variable
Impact of Treatment and Students 35 years or Older on Overall Grade Performance

Source	Sum of Squares	df	Mean Square	F	p-value
Corrected Model	0.101	3	0.034	2.718	0.050
Intercept	11.729	1	11.729	943.258	0.000
Treatment	0.042	1	0.042	3.361	***0.070
Students Age 35 and Above	0.004	1	0.004	.361	0.550
Treatment x Students Age 35 and Above	0.021	1	0.021	1.681	0.198
Error	1.032	83	0.012		
Total	42.467	87			
Corrected Total	1.133	86			

*Significant at p < 0.01
**Significant at p < 0.05
***Significant at p < 0.10

TABLE 8
Analysis for the Impact of Cognitive Load Reduction on Accounting Majors

Panel A: The Impact of Cognitive Load Reduction for Overall Grade and All Exams

		Sum of Squares	df	Mean Square	F	p-value
Grade	Between Groups	0.153	1	0.153	15.921	0.000
	Within Groups	0.307	32	0.010		
	Total	0.460	33			
Exam 1	Between Groups	0.011	1	0.011	0.691	0.412
	Within Groups	0.519	32	0.016		
	Total	0.530	33			
Exam 2	Between Groups	0.197	1	0.197	16.517	*0.000
	Within Groups	0.383	32	0.012		
	Total	0.580	33			
Exam 3	Between Groups	0.026	1	0.026	1.698	0.202
	Within Groups	0.483	32	0.015		
	Total	0.508	33			

*Significant at p < 0.01
**Significant at p < 0.05
***Significant at p < 0.10

APPENDIX A

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(Bold, Italics, Underlined indicates reduced instructional material)

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