

# **A NEUROEDUCATION AND COGNITIVE LEARNING-BASED STRATEGY TO DEVELOP ACTIVE LEARNING PEDAGOGIES FOR ACCOUNTING EDUCATION**

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## **Abstract**

This study combines educational neuroscience research with cognitive load theory to form the foundation of a prescribed seven-step strategy useful in creating in-class activities. The purpose of this study is to provide the lecture-focused professor a tool to easily create in-class activities. The activities supplement lectures and in turn, help to trigger students' "aha" moments of learning. The method includes elements to optimize cognitive load in working memory, a prelude to long-term memory storage and for future retrieval during subsequent learning activities. Utilizing the prescribed seven-step strategy, three in-class activities were created and used to introduce inventory costing, accrual accounting, and depreciation concepts in a financial accounting principles course. The pedagogy was tested with the one-group pretest-posttest quasi-experimental design. Combining the activity with group work and professor-led discussion during class time proved beneficial with significantly higher posttest results. The prescribed seven-step strategy was also implemented by a different instructor at a different institution in the first intermediate accounting course. The original inventory activity was implemented and extended, resulting in two additional in-class activities related to advanced inventory topics. The strategy again proved beneficial with significant results between pretests and posttests after implementing each of the three learning activities.

## **Introduction**

Accounting concepts such as accrual accounting, valuation, and recognition, crucial to understanding the language of business, seem abstract and complex to many students. Such intimidating theories are critical to accounting, and yet the approach of many students is to temporarily memorize (Bonwell, & Eison, 1991, McKeachie, Pintrich, Lin, & Smith, 1986) definitions and formulas for summative assessment and then move on to the next topic. This strategy is not only potentially detrimental to success in the course, but it may also be detrimental for long-term survival as an accounting major.

The introductory financial accounting course contains challenging concepts that confuse and frustrate students, while at the same time serves as the first student exposure to accounting. In addition, this course potentially leads students into (or away from) the accounting major. Learning the material beyond short-term memory increases the chances of successfully completing the course and subsequent courses of the accounting major.

Temporary memorization fails to develop higher-order thinking skills, a requirement as the course progresses and as accounting majors move into more difficult, upper-division accounting courses. In addition, the failure to move above the knowledge (memorization) level on Bloom's taxonomy (Bloom, Englehart, Furst, Hill, & Krathwohl,

1956) fails to develop a solid foundation in the study of accounting. Without a foundation to build upon, difficult topics cause challenges for students, as revealed in the dropout rates for these fast-paced, content-heavy introductory accounting courses (Etter, Burmeister, & Elder, 2000; Fortin, Sauv , Viger, & Landry, 2016). Implementation of active learning in the financial accounting principles course serves to reduce these dropout rates as well as increase the average GPA of the course (Huber, Law, & Khallaf, 2017).

Findings in neuroscience reveal that individuals learn (beyond memorization) by connecting prior knowledge to new knowledge. Functional magnetic resonance imaging (fMRIs) within the brain shows actual neurological connections to validate this theory (Koch, Timmerman, Peiffer, & Laurienti, 2013). These findings serve as the foundation for the purpose of this study; that is, to present a seven-step strategy for the development of an in-class, active learning pedagogy.

The strategy makes a conscientious effort to start new topics in financial accounting principles with information that is generally known by most students. The strategy emphasizes learning as revealed in the neuroeducation, cognitive psychology and active-learning literature. The final result of the seven-steps strategy combines the in-class activity with group work and professor-led discussions.

This study contributes to the accounting education literature by first highlighting the calls for change in accounting education by various professional groups over the past several decades. Based on the foundations of neuroscience and cognitive psychology concepts, the study further contributes to accounting education by providing faculty a prescribed seven-step strategy for integrating active learning into the classroom. The seven-step strategy to develop in-class activities includes: (1) identify the topic, (2) identify a known business entity, (3) create an accounting scenario based on the topic and known business (steps #1 and #2), (4) add a related illustration, (5) select an active learning method, (6) pose relevant and focused questions, and (7) conduct in-class group and professor-led discussions. The seven-step strategy was developed for financial accounting principles and subsequently extended to the first intermediate accounting course.

The strategy includes relatable and understandable examples that resonate with students' experiences. The instructional strategy adopted in the financial principles course resulted in in-class activities that actively engage students in connecting prior experience and learning to new concepts and theories. The development of the active learning activities through the seven-step strategy provides an effective and efficient method for accounting faculty to create and integrate their own active-learning strategies to benefit student learning.

Students connect prior knowledge to new accounting content and begin building the foundational accounting base. This new foundational accounting base becomes the student's "new knowledge" base from which to subsequently build more difficult accounting topics for the course, and potentially the major. The inventory activity implemented in the financial principles course was also implemented in the intermediate course. The inventory activity was then extended to create two additional activities for more advanced inventory topics.

The remainder of this study includes first a literature review with the development of the hypothesis. The literature review contains the various calls on accounting educators to change accounting education, and relevant neuroscience, cognitive psychology and active learning literature. Next, with the literature as the foundation, the seven-step strategy is presented. The methodology section follows with specifics related to the sample, the research design and methods, and the in-class implementation. The subsequent sections contain the results and discussion, faculty and student feedback, and limitations of the study. Finally, the conclusion and future research section is presented.

## **Literature Review**

The challenges of the introductory accounting course are well documented. In the 1990s, the Accounting Education Change Commission (AECC) and the resulting AECC Position Statements called for colleges and universities to submit proposals that address issues in accounting education in exchange for grant funds. Reports of success appear for grant-receiving institutions such as Brigham Young University (Albrecht, Clark, Smith, Stocks, & Woodfield,

1994) and Kansas State University (Ainsworth, 1994). Reports to the AECC from the grant-institutions describe their pre-grant programs as technical accounting-skills focused, rules-based, lectures, and little if any teamwork (Flaherty, 1998: North Carolina A&T State University Chapter 6, University of Massachusetts at Amherst Chapter 10). Similar to findings in the accounting education research, these grant-institutions aligned with the AECC's suggestions for the first course in accounting (AECC, 1992) and identified the need to move from a pure lecture-based approach to the integration of team/group work, group discussions (faculty-student and student-student), and active learning techniques (Flaherty, 1998: University of North Texas, Chapter 11; University of Virginia, Chapter 13). The subsequent plethora of accounting education research reveals the benefits of active learning pedagogies (Riley & Ward, 2017) and teamwork (Opdecam & Everaert, 2012) relative to passive learning associated with pure lecture.

Nearly two decades after the AECC was established, The Pathways Commission (2012) continued with recommendations to project the first accounting course in a light that reflects the true nature of the accounting profession (Pathway Commission, 2012). The Commission mentioned the positive results from the AECC changes but highlight the failure to sustain the model due to the lack of funding and a supporting structure to propel recommendations forward. In this light, the Commission highlighted the need to “develop curriculum models, engaging learning resources, and mechanisms for easily sharing them ...” (Recommendation 4, p. 67).

In addition to the accounting education research that resulted from the AECC calls for change, textbook authors made innovative changes in their textbooks to enhance learning in the financial accounting principles course. Some of these changes include the addition of learning objectives, end-of-chapter materials specifically aligned to the learning objectives, and the beginning of the chapter vignettes.

Evidence from the literature related to students' use of textbooks reveals the importance of in-class pedagogy when introducing new material. While textbooks provide interesting stories about real companies to facilitate connections, research shows that an average of only 17 percent of introductory accounting principles students read the text prior to the lecture (Phillips & Phillips, 2007). Over one-half of students do not read the text until after classroom coverage of the material (Phillips & Phillips, 2007). The underlying implication is that students' initial exposure to new topics occurs in the classroom. It appears critical to facilitate the connection of the new material with students' prior experiences and knowledge during class time. This “critical” need to facilitate connections is highlighted by neuroscience research.

### ***Neuroscience and Neuroeducation***

“The single most important factor in learning is the existing networks of neurons in the learner's brain. Ascertain what they are and teach accordingly” (Zull, 2002, p. 91). Recent theories on learning developed in the fields of neuroscience and cognitive psychology provide guidance on how to enhance learning through the use of crucial associations as a foundation to connect existing and new knowledge (Schreiner, Rothenberger, & Sholtz, 2013; Findlay, 2012).

Neuroscience focuses on “how the nervous system develops, its structure, and what it does” while “neuroscientists focus on the brain and its impact on behavior and cognitive functions” (About Neuroscience, n.d.). Alternatively, neuroscience is “the study of the nervous system, which includes the brain, spinal cord, and nerves” and largely in relation to behavior (Neuroscience, n.d.). Multiple branches of neuroscience evolved and include, but are not limited to, affective neuroscience, behavioral neuroscience, and cognitive neuroscience (Neuroscience, n.d.). Another branch, neuroeconomics, also evolved and combines economics, psychology, and neuroscience in the study of “how and where decisions are made in the brain” and the impact on public policy (Glimcher and Fehr, 2014). Dickhaut, Basu, McCabe, & Waymire (2010) used the term neuroaccounting to describe the linkage of neuroscience and accounting principles (e.g. revenue realization) and proposed neuroaccounting as the foundation “to produce a theory of accounting principles rooted in the science of the human brain” (p. 250) with potential effects on accounting policy.

Neuroscience is also slowly infiltrating higher education (Morris & Sah, 2016). Groundbreaking research on the “new science of learning” suggests that curriculum innovations based on neuroscience and developmental psychology provide opportunities for increased student learning (Meltzoff, Kuhl, Movellan, & Sejnowski, 2009; Ruiter, van Kesteren, & Fernandez, 2012). The research reveals that if learning is to occur, prior knowledge is a necessary foundation to create and develop new knowledge (Zull, 2002; Ambrose, Bridges, Lovett, DiPietro, & Norman, 2010; Ruiter et al., 2012; De Jong et al., 2008). When applied to education, these best practices designed to enhance the learning experience are known as educational neuroscience or neuroeducation (Zadina, 2014, Zhang, 2019).

The study of learning and the brain involves neurons, axons, synapses, and dendrites –familiar terminology for those in the study of biology and anatomy (Zull, 2002; Owens & Tanner, 2017). When a student suddenly understands a new concept and has that “aha” moment, learning occurs through neural communication, whereby prior knowledge found in one neuron links to the new knowledge in another neuron by changing the gap or synapse that separates neurons in the brain (Zull, 2002). Science has revealed, through functioning resonance magnetic imaging (fMRI), that in order for learning to occur, neuronal networks must change (Zull, 2002, Zadina, 2014; Schreiner et al., 2013; Envision Experience, 2015).

### *Cognitive Psychology*

Cognitive psychology bridges neuroscience with concepts of behaviorist and constructivists. Cognitive psychology builds on behaviorist’s pedagogy concepts of stimulus and response, and input data constraints. In addition, cognitive psychology includes the constructivist’s learning concepts of personal and social interactions. Cognitive psychology adds to the behaviorists and constructivists with the study of “mental activities involved in learning” including the brain structure and brain processing (Mostyn, 2012, p. 231).

Cognitive psychology considers Cognitive Load Theory (CLT), which is a hypothesized mental process whereby the amount and complexity of effort required of working memory affects learning efficiency (Mostyn, 2012). Working (short-term or temporary) memory might be likened to the central processing unit (CPU) of a computer. Like a CPU that pulls instructions from the main memory of the computer, working memory pulls information from long-term memory schema (see Figure 1). Working memory takes in sensory input and performs the processing, pulling previously learned information from long-term memory (in the form of schema) as needed. Learning occurs when working memory changes long-term memory by either (1) creating new knowledge or (2) adjusting existing long-term schema; where schema are mental constructs such as facts, relationships, etc. (Mostyn, 2012)

Cognitive load is the effort placed on working memory to complete the mental process. The three types of cognitive load include intrinsic load, extraneous load, and germane load (Mostyn, 2012). Intrinsic load is the load created because of the complexity of the material being learned, the level of schema already developed, and the learner’s natural working memory ability (affected by social, emotional, and physical considerations) (Mostyn, 2012).

Extraneous load is the effort created by the instructional method (Mostyn, 2012). An example provided by Mostyn (2012) is the verbal descriptions of converting accrual account balances to the statement of cash flows without a visual, stating that combined visual and text typically reduces load. Visuals reduce extraneous load, and thus reduce cognitive load and maximize working memory (Mostyn, 2012). Illustrations (decorational) placed in textbooks prior to (as opposed to after) the text increase learning (Phillips, Alford, & Guina, 2012). Illustrations facilitate the connection of “old” known information to the “new” concepts introduced.

Germane load is the effort required of working memory to comprehend material and develop schema. Simple illustrations often serve to increase students’ potential to exert effort and comprehend the day’s lesson and thus, reduce germane load.

In summary, CLT suggests the design of pedagogical techniques should consider the load placed on working memory. Pedagogical techniques should be structured to optimize cognitive load, or the effort required of working memory to process new material in order to maximize learning efficiency. The current project taps into the “already

developed” schema by building on what is believed known to students (e.g. type of business used in the written scenarios). In addition, the strategy facilitates breaking down new material to minimize complexity by posing relevant, focused questions. Both of these efforts serve to minimize intrinsic load on working memory and thus enhance learning. The proposed method also seeks to minimize extraneous load with an instructional method that includes a visual.

### *Active Learning Strategies*

The accounting education literature reveals statistically higher performance for students involved in active learning over students in pure lecture classrooms (Riley & Ward, 2017). However, research indicates that a majority of instruction in accounting and other disciplines is lecture (Blankley, Kerr, & Wiggins, 2017; Duchac & Amoruso, 2012; Lammers & Murphy, 2002). Despite continual research showing the positive impact of active learning techniques, accounting instructors spend only a little more than one-third of their class time using active learning strategies (Blankley et al., 2017).

A meta-analysis of teaching and learning in college classrooms reveals that although lecture has benefits for obtaining knowledge, discussion is superior to lecture when the desire is retention, transfer of knowledge to new settings, increased problem-solving, and motivation to learn (McKeachie et al., 1986). The desire for accounting students to move beyond knowledge acquisition makes a strong case for the integration of active learning into primarily lecture-based classrooms.

Variations of the lecture-only approach that integrate active learning strategies reveal improved student learning. These variations include, but are not limited to, pausing throughout the lecture for students to discuss their notes and/or concepts (without teacher interaction) and a concentrated in-class study session sandwiched between two mini-lectures (Bachhel & Thaman, 2014; Bonwell & Eison, 1991; Chowdhury, 2016). Additional active learning strategies that are beneficial include writing in class, problem-solving, case studies, peer teaching, cooperative learning, debates, role plays, games, and simulations (Bonwell & Eison, 1991). A miniature version of case studies has also proved successful in student learning (Carloye, 2017; Friedman, 2002; McLaughlin & Peterson, 2018).

Combining validated learning theories and neuroeducation with active student engagement and experiential learning research provides an opportunity for enhanced student instruction. Kolb’s (1984) work on experiential learning requires a “process whereby knowledge is created through the transformation of experience” (p. 38). Bonwell & Eison’s (1991) active learning requires students doing, and then thinking about what they are doing. These theories are time-tested in educational literature and provide the groundwork for the development of new instructional strategies when blended with knowledge of how the brain learns (neuroscience) and cognitive psychology.

Active learning involves students engaging their higher order intellectual skills (analysis, synthesis, etc.) (Bloom et al., 1956). Many of these active learning strategies have been successfully implemented in accounting courses (Blankley et al., 2017). A meta-analysis of collaborative learning studies reveals the successful use of collaborative learning to develop various skills in accounting majors, including problem-solving and decision-making (Strauss-Keevy, 2015). Collaborative learning and simulation active learning techniques were successfully combined in a managerial accounting course to promote confidence in students’ managerial accounting skills (Ugrin, Odom, Honn, & Rose, 2021). Peer instruction produced significantly higher performance results in financial accounting principles over a pure lecture group of students (Marshall & Varnon, 2012; Taiwo, Ige, & Ugwoke, 2020). Several studies report of flipping the classroom, whereby the majority of class time includes problem-solving and discussion (Downen & Hyde, 2016; Duxbury, Gainor, & Trifts, 2016). A hands-on conceptual model also proved beneficial over pure lecture to enhance problem-solving skills in an introductory accounting course (Kern, 2002). Nwaukwa and Okolocha (2020) report significantly higher performance and self-efficacy for students in a financial accounting principles course that integrated the think-pair-share activity in class over students in a traditional lecture course.

Implementation of short-descriptive scenarios and mini-cases with groups of students includes elements of Kolb’s (1984) experiential learning and Bonwell & Eison’s (1991) learn by doing. Using shorter cases addresses declining student attention spans, transformed by the digital age, which require instructors to ensure they optimize learning to

address what many consider to be changes in the typical college student's brain (Battle & Tyson, 2018; Conard, Barbour, & Marsh, 2017; Richtel, 2010). Short scenario, mini-cases about real-life frauds were successfully used in an introductory accounting course to teach transaction analysis and analytical thinking (Marshall & Bolt-Lee, 2016). Other mini-cases are found in intermediate financial accounting (Gunderson, 2013), AIS (Lehmann & Heagy, 2014), the AICPA Core Competencies Framework skills (Brenner, Jeancola, & Watkins, 2015), and ethics (Larres & Mulgrew, 2009).

The classroom environment is significantly related to effort, motivation, and performance in the introductory accounting principles course (Wooten, 1998) indicating the benefit of creating a positive classroom experience. Studies integrating active learning strategies in accounting courses reveal that students perceive they learn more (Handy & Polimeni, 2015; Marshall & Varnon, 2012; Riley & Ward, 2017) and the methods increased their competencies, are helpful, improved their content knowledge, and/or were enjoyable (Edmonds & Edmonds, 2010; Handy & Polimeni, 2015; Huber et al., 2017; Marshall & Bolt-Lee, 2016; Matherly & Burney, 2013). Some students believe their flipped classroom active learning strategy made the course easier (Duxbury et al., 2016). Lento (2016) found the flipped classroom that integrated case analysis, comprehensive problem-solving, small class discussion, and mini-lectures in an introductory financial accounting course served to improve student performance.

### **Hypothesis**

While short-term memorization often appears to be successful for other courses, the cumulative nature of the financial accounting principles course requires long-term memory storage of accounting concepts for subsequent use. It is quite possible, if not probable, that the short-term memorization for exams early in the financial principles course produces lower than expected results as the semester progresses and as accounting majors move into their major courses. The lack of shifting the knowledge from short-term (working) memory into long-term memory hinders subsequent learning that requires retention of earlier materials, or at best, makes it more difficult to "re-learn." Students begin to drop the course and label the course as one of "dread" that they do not like and complete only as a prerequisite for non-accounting majors.

The connection of new and old knowledge in the neuroscience literature appears to describe the retrieval of developed schema from long-term memory of cognitivists' ideas. Both ideas point to the necessity of making connections between students' existing knowledge (stored in long-term memory) and new material for learning to occur. The active learning literature indicates active participation via experiential learning and learning by doing are also critical elements that facilitate learning.

In an effort to increase student learning in accounting principles courses and possibly the accounting major, this study draws on the educational neuroscience literature and learning theories that suggests it is incumbent upon faculty to facilitate students' connections between "prior knowledge" and "new knowledge" in an active-learning environment. Extending the research results to an accounting education context suggests that facilitating the connection between students' existing knowledge and new accounting topics results in a better than likely chance that the neurons will communicate, and subsequent learning will occur. Theoretically, moving higher up on Bloom's (1956) taxonomy vis-à-vis deeper levels of learning should minimize pure memorization and increase student performance.

H<sub>1</sub>: Students in financial accounting principles will increase their knowledge when introduced to new accounting topics in an active-learning environment through a strategy that connects "known" information with new accounting topics, where the "connection" is facilitated via the proposed seven-step strategy.

It should be noted that the purpose of this research is to provide an easy-to-implement strategy for the development of in-class activities that extends the lecture-delivery mode of instruction. The literature unequivocally reveals the strength of active learning methods over pure lecture. It is not the purpose to suggest one active-learning strategy over another.

### **Seven-Step Strategy Design**

The proposed strategy (see Table 1) is simple, easy to implement and builds on educational neuroscience (neuroeducation), cognitive psychology, and learning theories. The strategy includes elements of the neuroeducation research that reveals the importance of using existing neural networks (known knowledge) as a foundation for learning new knowledge (Zull, 2002). This study extends the neuroscience and learning theory research to financial accounting principles with a focus on building a foundation in the study of accounting. Implementation of the in-class activities addresses active learning and the learning theories of Bonwell & Eison (1991) and Kolb (1984) by providing students the opportunity to learn by doing or through the experience.

The suggested strategy addresses The Pathways Commission's (2012) recommendation for easily sharable resources (Recommendation 4, p 67) and the AECC's recommended student-to-student and faculty-student interactions (AECC, 1992). Additional considerations include initial exposure to course topics in the classroom (versus textbooks) and introductions of new accounting topics in an active learning environment with a focus on students' existing knowledge.

This study evaluates the efficacy of the proposed seven-step strategy in accounting principles by applying the strategy to create in-class activities. The proposed seven-step strategy includes: (1) identify topic or subtopic, (2) identify a business known to or familiar to most (if not all) students, (3) write a scenario that combines the selected topics (#1) and the known business (#2), (4) add an illustration, (5) select an active learning method, (6) write at least one relevant and focused question, and (7) conduct group and professor-led discussions (see Table 1).

The strategy also includes the integration of cognitive load reduction methods (cognitive psychology) and cognitive load theory (CLT). The design focuses on methods to optimize working memory (see Figure 2). Intrinsic load is optimized by using simple and understandable language with everyday real-life businesses (step 3). The one to two paragraph scenarios (step 3) are intentionally short and are combined with a decorative illustration to minimize extraneous load (step 4). Germane load is minimized by providing in-class demonstrations and practice during the discussion of the in-class activity.

The activities were designed to develop students' accounting knowledge by connecting prior general knowledge (step 2) to more challenging accounting topics (step 1). The activities were developed with a mindfulness on the literature related to the inclusion of a foundation that begins with a "known" knowledge base (step 2). The "known" knowledge base in financial accounting principles is a business in which most, if not all, students should be able to relate (e.g. convenience store, construction company, and lawn care service). Combining the "known" with the "unknown" (new accounting concepts) emphasizes a basic tenet of neuroscience and learning; that is, moving toward that "aha" moment when the neurons connect.

#### ***Step 1: Identify the Topic***

The identification of the topic or subtopic, in general, follows the textbook chapter titles. The textbook chapter name provides a good starting point for developing the related in-class activity. An example includes the chapter title, Cash and Cash Equivalents. However, the topic may lead to subtopics for in-class activities. For example, the chapter on cash might include the subtopics of accrual accounting, internal control over cash, and/or items considered in cash and cash equivalents. Receivables might include subtopics of bad debts on accounts receivable and interest on notes receivables. The current study includes in-class activities for accrual accounting, inventory, and depreciation (see Table 2)

#### ***Step 2: Identify a Business Entity Familiar to Students***

The second step requires the identification of a business known to most, if not all, students. The particular business will vary, depending on the topic. In general, big-box stores, convenience stores, social media platforms, and fast-food restaurants are probably known to most accounting principles students. The known business serves as the stimulus of behaviorists and prior knowledge of neuroeducation and creates the foundation for subsequent

learning. The three in-class activities of this study included a lawn care service, a gas station/convenience store, and a construction company.

### ***Step 3: Write a Scenario***

The third step requires combining the first two steps and writing a relevant scenario in simple and easy-to-understand language. For example, the first case presented in this research project was accrual accounting (see Appendix A). The only accounting “jargon” contained in the scenario is “financial statements.” The scenario was implemented early in the semester and after the financial statements were superficially introduced (for most textbooks, this appears in the first chapter). The current study utilized short, one-half paragraph scenarios; however, the accrual accounting activity also included an income statement, statement of retained earnings, and a balance sheet.

### ***Step 4: Add an Illustration***

The fourth step requires the identification of an illustration to accompany the text. Illustrations are easily obtained with a Google (or other search engine) search of the type of business and “pic.” Clicking on images in the search results further narrows the search for fun and relevant illustrations.

### ***Step 5: Select activity***

The specific format of the in-class activity should be selected, such that it engages students while maintaining the comfort level of the faculty. The strategy may be as simple as posing the question on the board and asking the students to discuss among themselves, prior to discussion with the teacher. Another strategy might pose the question(s) in an overhead, ask students to think about their responses and then share with their neighbor(s) (think-pair-share (TPS)), prior to class discussion with the teacher. If the question is a problem-solving question, the TPS strategy might be most appropriate, where students explain the theory behind each step of the problem-solving process.

### ***Step 6: Write a Relevant and Focused Question(s)***

The next step of the proposed strategy requires the creation of one or more questions for students to discuss in groups. These questions provide the experiential learning by doing benefits (Kolb, 1984, Bonwell & Eison, 1991) as well as the positive effects on the classroom environment (Wooten, 1998). These positive effects may also serve to reduce cognitive load and optimize working memory for subsequent storage in and retrieval from long-term memory.

Question(s) might be relatively open-ended with the ability for students to offer various “opinions” with justifications or problem-solving questions with specific answers. For example, the question for the inventory scenario requests that students explain why the owner of a convenience store (gas station) is having difficulty determining gross margin on each gallon of gas (see Appendix A: Inventory). In addition, students are asked how to calculate gross margin.

### ***Step 7 Discussion***

The strategy culminates in first student-to-student interactions and then students-faculty interactions. Instead of passively listening to lectures, watching the professor demonstrate problem-solving, and/or hearing rhetorical questions posed by the instructor, students actively engage in the learning experience. In addition, a benefit of the questions during class is the immediate feedback obtained by students.

Implementation of the in-class activities require students to become active participants in their learning and with classmates. Blank space for students to write responses and reflections during the group and/or instructor-led class discussions (step 7) should appear after each question. Reflection and adaptation are facilitated during the instructor-led portion of discussion, as students reflect on what they thought and adapt (adjust schema) to correct responses.

The non-threatening (non-graded) method of reflection and self-reflection promote learning as students identify their weaknesses and build on their strengths (Bisman, 2011).

Students discuss questions posed for each learning activity, within their group, and write potential solutions for subsequent class discussion and studying. The use of books, notes and computers could be encouraged. Students should be allowed to retain any written work created during the discussions as formative self-assessments; however, the work could be collected for summative assessment and subsequently returned to the students.

After about five to 10 minutes of group discussion, depending on the topic and the activity, the professor calls for the entire class to discuss the results. The professor-led discussion period could easily serve as a springboard for subsequent class discussion as well as reinforcing previously learned accounting knowledge.

### **Methodology**

The seven-step strategy was implemented to create three activities for financial principles. Subsequently, the strategy was implemented to create three inventory activities for intermediate financial accounting students. In addition, the effect on student performance was evaluated with pretest and posttests, administered before and after the classroom implementation of the activity. The following section contains descriptions of the sample, methods, financial accounting principles in-class implementation, and subsequent implementation in a section of intermediate financial accounting.

### ***Sample***

Students in one of two financial accounting principles sections offered during the fall of 2018 at a small, regional, military, AACSB-accredited institution received instruction based on the seven-step strategy. One faculty member taught both sections of the three-credit hour accounting principles course. Both sections were offered in the face-to-face environment during a 15-week semester and used the Warren, Reeve, and Duchac (2018) textbook. There were 34 and 18 students in the two sections of the course, for a possible total sample of 52 students. Most students were males (98%) and of traditional college age. The students were predominantly business majors with a small percentage of accounting majors and a few non-business majors.

The sample consists of those that completed each segment in which an in-class group activity was used to introduce the topic and that completed both the pretest and posttest. The sample sizes vary by the number of attending students on the days the pedagogical method was implemented and the pretests and posttests were administered.

### ***Research Design and Methods***

A one-group pretest-posttest quasi-experimental design is used to test the effects of the seven-step strategy, for each topic, in the financial accounting principles course (see Figure 3). Results of the pretests provide evidence to the level of existing accounting knowledge prior to coverage of the related topic. Posttest scores measure accounting knowledge after completing the activity. Matched paired t-tests consider the change from the pretest to the posttest scores and test for statistical difference between the two measures. The matched paired t-tests of the pretest-posttest design controls for variations that result from the individual student. Each of the three activities serves as a quasi-experiment which mitigates internal validity issues.

### ***In-Class Activity Implementation***

The three topics selected and used to implement the proposed strategy include accrual accounting, inventory, and depreciation. Students completed a pretest for the respective material prior to, but on the same day as, the in-class introduction of the topic (see Appendix B). Each activity has a separate set of true-false or multiple-choice questions that serve as both the pretest and the posttest. Students added their name on the pretests for subsequent matching to the posttests. The pretests were collected but were not discussed at any point during the semester.

After the collection of the pretests, students were asked to assemble into groups of three or four. Students were allowed to self-select into groups because student-selected groups provide for a more harmonious environment than instructor-selected groups (Hilton & Phillips, 2010).

Then, the scenario was presented, either on the overhead projector or a paper copy. The topic was not discussed prior to the in-class activity. All students received a paper copy of the discussion questions. Students collaborated by sharing insight, ideas, and experiences in a team of students, as they responded to the discussion questions.

Students were given about 5-10 minutes for discussion. The intent of the discussions is to facilitate the connection of the narrative and students' personal experiences (prior and new knowledge) as they work toward a solution. Students completed the group activity prior to the instructor calling the class together for professor-led class discussion.

Professor-led class discussion provides the opportunity for the professor to interact with students and share ideas, as well as correct misunderstandings. It is during this time the professor presents the material using the scenario content to discuss and demonstrate concepts and processes. The discussion focused on the content and requirements of the scenario, *without* reference to the pretest or additional materials.

A follow-up posttest was administered after the professor-led discussion, on the same day the activity occurred in class. Only on one occasion was the posttest administered at the beginning of the class period following the implementation of the activity. The purpose of the posttest was to identify the effects of the pedagogical strategy. Students completed the posttest during class. The responses were not provided to the students nor at any point were the pre/posttest questions used for class discussion or explanation of the material. After the posttests were collected, the faculty easily transitioned into a more in-depth conversation about the related accounting topic.

### ***Intermediate Financial Accounting***

A second sample of 36 students in a first intermediate accounting course at a different institution taught by a different instructor applied the seven-step strategy to the inventory chapters. The strategy served to "test" the seven-step strategy, add additional internal validity to the financial principles results, and address generalizability issues. The institution is a medium-sized, AACSB-accredited, regional institution in the Midwest United States. The class met twice a week over a 15-week period for 75 minutes per class period. The Kieso, Weygandt, & Warfield (2019) *Intermediate Accounting* textbook was used.

The strategy was implemented in the intermediate accounting course during the fall of 2019 to students that were predominantly accounting majors (72%). The remaining students were either finance majors (14%) or students that completed the course as a part of their accounting minor (14%). The majority of students were traditional college age.

Three validation experiments of the seven-step strategy were implemented in the intermediate accounting class. Similar to the financial principles sample, pretests and posttests were administered for each activity. The administration of the financial principles inventory activity (pretest, scenario, and posttest) was duplicated for the intermediate accounting students. Two additional inventory scenarios were created (see Appendix C) from the seven-step strategy. The first additional scenario introduced dollar value LIFO inventory costing. The second additional scenario introduced inventory valuation. A set of multiple-choice questions for each additional case was created and used as the pretest and posttest (see Appendix D). Matched paired t-tests were used to test for differences between the pretests and posttests for each activity.

### **Results and Discussion**

The matched-paired t-tests produced significant results for each of the three topics introduced with the in-class activity in the financial principles course (see Table 3). Posttest scores for each topic (accrual accounting, depreciation, and inventory costing) are significantly higher ( $p$ -values=0.00) than the pretest scores. The results

support the hypothesis that the use of the in-class activities, created with the seven-step strategy described in this article, increases learning ( $H_1$ ).

Support for the results obtained in the financial accounting principles course occurs with the results from the intermediate financial accounting course (see Table 4). The pretest score of 74 percent earned by the intermediate students on the first inventory in-class activity, compared to the pretest results from the financial principles course (38%), was as expected. A higher pretest score is expected for the intermediate students, as the intermediate students most likely learned the material in their introductory financial course. The higher pretest scores also indicate a certain knowledge base (prior knowledge) of the topic prior to the in-class activity. The intermediate accounting students' posttest average score of approximately 87 percent is significantly higher than their pretest average score ( $p$ -value  $< 0.05$ ).

The follow-up inventory in-class activities created from the seven-step strategy for the intermediate students also produced significantly higher scores. The inventory costing in-class activity extended the basic accounting knowledge of the first inventory activity to teach dollar-value LIFO. The pretest scores (38%) indicate limited knowledge of the material prior to the in-class discussions. The third inventory in-class activity extended the inventory costing concepts to teach inventory valuation, more specifically lower-of-cost-or-market and lower-of-cost-or-net realizable value. Again, the pretest scores (25%) reveal the limited knowledge with respect to inventory valuation. The posttest scores reveal an increase in knowledge related to dollar-value LIFO and inventory valuation (71% and 80%, respectively). Implementation of the in-class activities constructed with the seven-step strategy, including the focus on previously known knowledge with group and class discussions, resulted in significantly higher posttest scores.

The results indicate the pedagogical strategy, in totality, significantly and positively impacts student performance. The mindful attention given to help create students' connections between existing knowledge and new accounting knowledge, while simultaneously including the structure to help minimize cognitive load in an active learning classroom environment produces positive results on student performance.

The strategy presented in this study includes the creation of in-class activities, more specifically, the use of short scenarios. However, it is noted that other in-class activities might prove equally beneficial. Several keys to successful activities include (1) start with the known, (2) pose thought-provoking questions, (3) allow time for processing, preferably with other students in the course, (4) include a visual, and (5) provide instructor-led discussion after the group discussions.

The results of this study clearly reveal the benefit of the proposed pedagogical strategy. The extra time required for student group discussion allows students to connect their existing knowledge with new knowledge. It is quite possible that the extra time used for in-class activities and making connections might reduce the time required to learn subsequent but related topics. The ability to process information and move the information into long-term storage (building their schema) should minimize class time when introducing additional new but related topics. As the new knowledge is retained in long-term memory, it serves as the "existing" accounting knowledge by which to trigger the learning of "new" accounting knowledge. The theory is that "new knowledge" is moved into long-term memory (schema) and reduces cognitive load when this new knowledge is accessible (has been learned) from long-term memory.

### **Faculty and Student Feedback**

Two separate faculty applied the seven-step strategy to create in-class learning activities. Similar to many lecture-faculty, both instructors routinely asked rhetorical questions as they presented and "taught" their respective courses. Both faculty reported increased student participation over what they had previously witnessed in their combined 60 years of experience. As a result of this study, one faculty member created and provided guided lecture notes to accompany in-class activities. The guided lecture notes afforded the in-class activity experience. The notes were made available to students through the learning management system prior to the class discussion.

Students in the intermediate financial accounting course disagreed with the statement that the methods used to present the materials was “not helpful to me in learning the material.” In addition, a majority (86%) of the intermediate financial accounting students view the in-class activities as a positive learning experience. Responding to an additional posttest statement, students indicated they “learned more today, working the case and working with others.”

One faculty noted that the increase in learning and the positive classroom environment more than offsets the loss of class time to lecture. With that said, the faculty member created lecture, problem-solving demonstration videos to cover additional material.

### **Limitations**

One limitation of this study relates to the study environments and generalizability to all institutions. This study was conducted at a southeastern, military institution and a midwestern, regional institution, both in the United States. Although both institutions are AACSB-accredited, the results may not be generalizable to institutions that are substantially different from the two in the study, or institutions from different regions of the United States or from different countries.

The one-group pretest-posttest quasi-experimental research design could compromise internal validity; that is, identifying the teaching method as the cause for the increase in posttest scores when the teaching method has no effect. The threat specifically is whether credible alternative explanations exist for the increased performance (Harris et al., 2006). The causality risk is mitigated with repeated experiments or the use of control groups. This study implemented repeated experiments by administering the in-class activity (result of the seven-step strategy) over the three different topics in financial principles. Additional support occurs with the three repeated experiments in the intermediate financial accounting course.

The results of this study are limited to face-to-face and small classroom environments. The results may not necessarily transfer to the online environment or to large classrooms.

### **Conclusions and Future Research**

This study presents a teaching strategy based on neuroscience, cognitive psychology, and the active learning literature. The strategy responds to The Pathways suggestion of easily sharable and sustainable classroom pedagogies that require no funding. This study contributes to accounting education by highlighting the usefulness of neuroscience and cognitive psychology concepts when developing learning activities for accounting classrooms.

Accounting educators could capitalize on the findings of brain-based research that reveals the importance of prior knowledge to generate new knowledge. Successful accounting education depends on students having learned (beyond short-term memorization) material of prior courses, as well as material learned earlier in any given course. The results of this study contribute to the development of accounting education pedagogy by highlighting the scientifically revealed connections between “prior” and “new” knowledge. The results of this study heighten accounting educators’ awareness of the necessity to identify and build upon previously learned knowledge (whether obtained via life experience, within a course, and/or in prerequisite courses).

This study presents accounting faculty with an easy-to-implement active learning pedagogical strategy to enhance teaching and learning of basic accounting concepts. The strategy involves the creation of in-class active learning and includes seven basic steps: (1) identify a topic, (2) identify a business known to students, (3) combine the topic and business into a one or two paragraph scenario, (4) add an illustration, (5) select an in-class active learning method, (6) pose one or more questions, and (7) student-groups followed by professor-led class discussion. The strategy is based on basic neuroscience and cognitive psychology concepts and answers the call by Koch et al. (2013) to “apply brain-based, fMRI research findings to improve teaching and learning” (pg 586). This study builds on the “aha” moment of neuroeducation and the minimization of cognitive load to provide room in working memory for the connection of neurons to occur. The results reveal that introducing new accounting topics with written scenarios,

using easy-to-understand language, based on everyday situations, and accompanied with a visual using in-class groups increases students' knowledge of accounting.

Future research might evaluate other forms of active learning that include the elements of this study (start with the known, thought-provoking questions, group work, etc.). Future studies might also extend the neuroscience and cognitive psychology concepts utilized to measure the effects of pedagogical strategies on long-term schema and the use of classroom time. Follow-up studies might also focus on minimizing other aspects of intrinsic cognitive load (e.g. social, emotional, etc.) not considered in this study. It would be beneficial to test the efficacy of the "in-class" strategy presented in this paper in the online environment. Application of the study in large classrooms could also prove to be beneficial.

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## Appendix A: Scenarios and Discussion Questions

### *Accrual Accounting*



Adam wants to start his own summer lawn care company and his dad gives him the money for the equipment. With \$500 in the bank, Adam buys a used riding mower, weed eater, and blower. His neighbors like his work, trusting him to maintain their yards when they are on vacation. As his customer base grows, he hires a friend to help him part time. At the end of the summer, Adam shows his dad the financial statements for his company, revealing a \$4,000 profit. He explains that a large part of his customer base is individuals from a wealthy neighborhood where homeowners travel abroad all summer and that he will get

paid when they return. He's very proud that he kept track of the accounting based on the class he took the year before.

Seeing the success on the financial statements, dad asks to see the bank statement. With only \$400 currently in cash, he gets very angry.

**Discussion:** How should Adam explain the difference in the cash in his bank account showing a balance of \$400 in cash and the financial statements (below) showing \$4,000 in net income to his dad?

**Adam's Landscaping Company  
Income Statement  
Three Months Ending 08/31/xx**

<b>Revenue:</b>	\$ 7,000
<b>Expenses:</b>	
Supplies expense	1,000
Wage expense	<u>2,000</u>
Total expenses	<u>(3,000)</u>
<b>Net Income</b>	<b><u>\$ 4,000</u></b>

**Adam's Landscaping Company  
Statement of Retained Earnings  
Three Months Ending 08/31/xx**

Adam Smith, Capital June 1, 20XX	\$ 500
Plus net income	4,000
Less Owner's Withdrawals	<u>2,000</u>
<i>Adam Smith Capital August 31, 20XX</i>	<b><u>\$2,500</u></b>

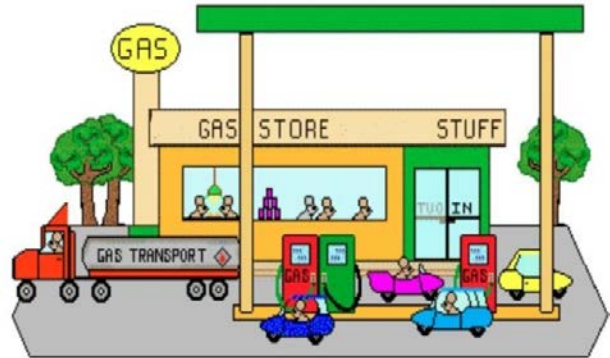
**Adam's Landscaping Company  
Balance Sheet  
08/31/XX**

<b><u>Assets</u></b>	
Cash	\$ 400
Accounts Receivable	3,100
Lawn Mower Equipment	<u>500</u>
<b>Total Assets</b>	<b><u>\$ 4,000</u></b>
 <b><u>Liabilities</u></b>	
<i>Accounts Payable- Supplies</i>	\$1,000
<i>Wages Payable</i>	<u>500</u>
<b>Total Liabilities</b>	<b><u>1,500</u></b>
<b><u>Owner's Equity</u></b> <i>Adam Smith Capital 8/31/XX</i>	<b><u>\$ 2,500</u></b>
 <b>Total Liabilities &amp; Owner's Equity</b>	 <b><u>\$4,000</u></b>

### Appendix A (cont.): Inventory Cost Flow

Janice owns two convenience stores in a small town. In addition to gas, the convenience stores sell snacks and a variety of locally-made crafts like pottery, jewelry and small paintings. Janice wants to calculate her gross margin per gallon of gas. She can determine her margin off of each sale of locally-made crafts because they are all one-of-a-kind. But how does she determine the margin on a gallon of gas?

The gas tanker trucks fill her tanks weekly and the price is always different, varying from a fraction of a penny to several cents each time. The tank holds 20,000 gallons and she sells about 1,000 gallons of gas a day. There is no way to specifically identify the gas that a particular customer has purchased, although she uses this exact process with her crafts to match up revenue and sales.



See the scenario below for one month:

<u>DATA FOR INVENTORY</u>	<u>Gallons</u>		<u>Per Gallon Cost</u> <u>of Each Fill</u>		<u>Total Cost</u>
Beginning Inventory	10,000	@	\$2.25	=	\$22,500
Purchase 1	5,000	@	\$2.30	=	\$11,500
Purchase 2	8,000	@	\$2.35	=	\$18,800
<u>Purchase 4</u>	<u>10,000</u>	<u>@</u>	<u>\$2.40</u>	<u>=</u>	<u>\$24,000</u>
Total Goods Available	33,000				\$76,800
Gallons of Gas Sold	20,000				???
Gallons of Gas Remaining (Ending Inventory)	13,000				???

### Discussion: How would you answer her questions below?

1. Why is Janice having difficulty determining the gross margin on each gallon of gas sold?
2. How should she calculate the gross margin on the 20,000 gallons sold during the month for her income statement?
3. What is the total cost of the 13,000 gallons remaining in ending inventory at the end of the month?
4. What is an example of a product sold by Janice where goods flow and cost flow might be the same and this might be an easier problem to solve?

**Appendix A (cont.): Depreciation**



**Depreciation and  
Accumulated Depreciation**

The Bulldog Construction Company is in its second year of business. You've been hired as the accountant and the owner wants to know what will happen to the "bottom line" after a \$75,000 equipment purchase is recorded. Management understands the basic concepts of an income statement (they call it a P&L), but without a basic understanding of accounting they need help understanding the effect of this transaction on the financial statements.

**Discussion:**

1. What effect does the \$75,000 equipment purchase have on the financial statements?
2. What accounts are affected and how do you determine the value on the books (known as book value) of the equipment from year to year?

**Appendix B: Pre- and Post-Tests****Accrual Accounting** (Ray's Lawn Service)

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Please respond on the scantron.

**A=TRUE B= FALSE**

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1. Oscar Company performs yardwork for a customer on Friday morning. The customer isn't home so a bill for \$300 is left in the customer's mailbox. Oscar Company should include the \$300 as revenue earned when they prepare their financial statements on Friday afternoon.
2. Delta Company buys supplies for \$500 at the local store and asks the owner to charge it to their account to be paid later. The supplies are taken to the Delta Company supply room. Delta Company does not include these supplies in their accounting records until they have paid for them.
3. Beta Company received a cash payment in August for \$250 for a job they will not perform until October. Beta's accounting records will record the \$250 as revenue in August.
4. On July 31, Kilo Company is preparing their monthly financial statements. July ends on a Wednesday. Kilo Company pays their employees every Friday. Wage expense should be calculated and recorded for Monday through Wednesday as an expense on the July financial statements, even though employees aren't being paid yet..
5. Lee Company pays \$1,200 cash for an insurance policy for their truck on January 1. This pays the entire year's insurance in advance. This transaction should be recorded as insurance expense on January 1.

**Appendix B (cont.): Pre- and Post-Tests****Inventory** (Janice's Convenience Store)

Please respond on the scantron.

**A=TRUE B= FALSE**

- The Fruit Company sells bananas for \$1.00 each. The cost of each banana varies between 25¢ and 40¢. The Fruit Company has to keep track of the cost of each banana individually to ensure their cost of goods sold is accurate on their income statement.
- Excel Jewelry Company sells unique one-of-a-kind necklaces. Each necklace costs a different amount. The Excel Jewelry Company will reduce inventory by a different price each time a necklace is sold.
- The Flop Company sells identical flip flops for \$5.00 each. The vendor who sells them the flip flops charges a different price, depending on how many flip flops the Flop Company orders. Their information is below:

	<b>Number purchased</b>	<b>Cost per unit</b>
<b>Beginning Inventory</b>	100 pairs	\$3.50
<b>Purchases</b>	50 pairs	\$3.75
<b>Total Units Available to Sell</b>	150 pairs	

When Flop Company sells one pair of flip flops, the gross margin will be different depending on which cost they use for cost of goods sold.

- The Water Company sells water bottles to tourists for \$1.00 each. Their information is below:

	<b>Number purchased</b>	<b>Cost per unit</b>
<b>Beginning Inventory</b>	50 bottles	40¢
<b>Purchases</b>	75 bottles	45¢
<b>Total Units Available to Sell</b>	125 bottles	

The first water bottle sold came from the 50 bottles batch (beginning inventory). The gross margin on this sale should be 60¢ because the water bottle came from the inventory that cost 40¢ per unit.

- A used car dealership will always have the same gross margin on each car sold.

**Appendix B (cont.): Pre- and Post-Tests****Depreciation and Accumulated Depreciation** (Bulldog Construction Company)

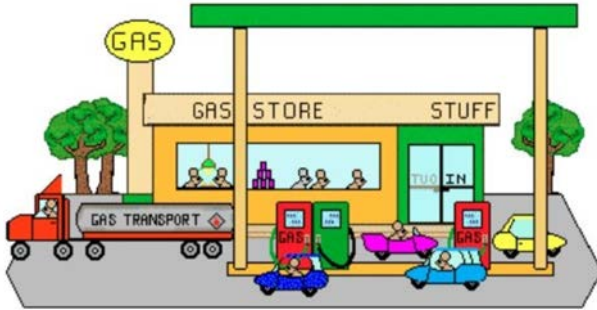
1. A company pays cash for a \$75,000 piece of equipment. What type of account is increased for the equipment purchase?
  - a. An asset
  - b. An expense
  - c. A liability
  - d. Revenue
  
2. Depreciation expense recorded in financial statements shows:
  - a. the decline in resale value of an asset from one accounting period to the next.
  - b. the division/allocation of an asset's cost over its estimated useful life.
  - c. the amount paid on the asset's loan each month.
  - d. the total purchase price of an asset.
  
3. All of the following statements are true about the Accumulated Depreciation account except:
  - a. Accumulated depreciation is a liability account.
  - b. Accumulated depreciation is a contra-asset account.
  - c. Accumulated depreciation is increased by depreciation expense.
  - d. The balance of Accumulated Depreciation contains the total of all depreciation expense recorded on the related asset.
  
4. The definition of an asset's book value is
  - a. The amount the asset is worth if the company wants to sell the asset.
  - b. Cost less the total depreciation expense taken/recorded on the asset
  - c. Cost less current year's depreciation expense
  - d. An asset's fair market value.
  
5. Which of the following statements correctly describes depreciation expense and accumulated depreciation after closing entries are prepared?
  - a. At the end of the accounting period, Depreciation Expense and Accumulated Depreciation are both closed to Retained Earnings
  - b. At the end of the accounting period, Depreciation Expense is closed to Retained Earnings and Accumulated Depreciation remains open until the asset is disposed of.
  - c. At the end of the accounting period, Depreciation Expense and Accumulated Depreciation both remain open until the asset is disposed of.
  - d. At the end of the accounting period, Depreciation Expense remains open until the asset is disposed of and Accumulated Depreciation is closed to Retained Earnings

**Appendix C: Intermediate Financial Accounting Inventory Costing & Valuation**

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## DOLLAR-VALUE LIFO

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We calculated Janice’s ending inventory of gasoline to be \$29,400, using periodic LIFO. Subsequently, Janice decides to implement dollar-value LIFO inventory costing. Assume we do not know ending inventory (EI) in units, but we know EI in dollars. The EI amounts appear below:

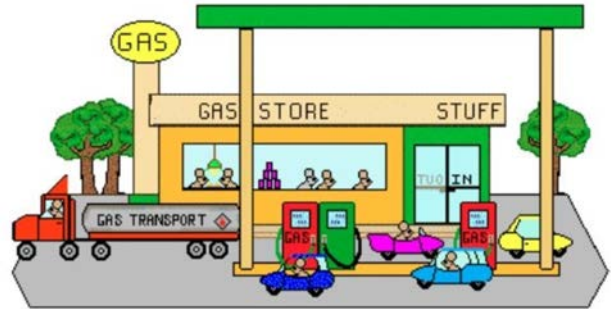
<u>Period</u>	<u>Base period dollars</u>	<u>Current period dollars</u>	<u>Price Index</u>
1 (Base)	\$29,400	\$29,400	1.0
2	\$34,000	\$37,500	??
3	\$45,000	??	1.15
4	???	52,800	1.2

1. What is the price index in Period 2 (round to 5 decimals)?
  
2. How much is the layer added to EI in Period 2 (round to whole dollars)?
  
3. How much is the EI at the end of Period 3 (round to whole dollars)?
  
4. How much is the EI at the end of Period 4 (round to whole dollars)?

## Appendix C: Intermediate Financial Accounting Inventory Costing & Valuation

### Inventory Valuation

Thus far in our discussion of inventory, we have applied LIFO, FIFO, and (Moving/Weighted) Average **costing** methods in both the periodic and perpetual inventory systems to gasoline ... and specific identification to specialty one-of-a-kind crafts at Janice's convenience store. We calculated dollar-value LIFO ending inventory COST to be \$45,974.



Respond to the following questions:

1. Conceptually, at what amount are inventories reported (valued) on the Balance Sheet?
2. Why do companies abandon the historical cost principle when valuing ending inventory to report on the Balance Sheet?
3. What are the two major inventory valuation methods allowed by GAAP to derive ending inventory on the Balance Sheet?
4. Recall, dollar-value LIFO produced an ending inventory figure of \$45,974. Assume the gasoline at the end of the period has a net realizable value is \$45,723. At what amount will the gasoline be reported on the Balance Sheet?
5. Assume Janice has a total sales price for gas of \$48,000, with an estimated cost of disposing of the gas of \$1,000. In addition, Janice has a normal profit margin of 10% of the sales price. Finally, the cost to replace the gas is \$45,000. Applying the lower-of-cost-or-market rule, at what amount will Janice report the inventory for gas on her Balance Sheet?

**Appendix D: Intermediate I Pretest and Posttests**

**Dollar-Value LIFO Inventory Costing**

Please place response on the line provided. Show your work and label your numbers.

Use the following information for Flop Company, who sells flip-flops, to respond to the following questions. Assume the company uses the **periodic** inventory system and **LIFO** inventory costing method.

	<b>Number purchased</b>	<b>Cost per unit</b>
<b>Beginning Inventory</b>	100 pairs	\$4.00
<b>Purchases</b>	<u>50 pairs</u>	\$3.50
<b>Total Units Available to Sell</b>	150 pairs	
<b>Number of units EI</b>	65	

1. What is the amount of Cost of Goods Available for Sale?  
\$ \_\_\_\_\_ (1)
2. How much is the cost of goods sold?  
\$ \_\_\_\_\_ (2)

Assume Flop changes their inventory costing method to **Dollar-Value LIFO** at the beginning of the next period. Also assume the following:

	<b>Base year cost (prices)</b>	<b>Current year cost (prices)</b>	<b>Price Index</b>
Year 1 – EI	\$270	\$270	1.00
Year 2 – EI	\$300	\$390	??
Year 3 – EI	???	\$600	1.5

3. What is the price index in year 2? (round to 2 decimals)  
\_\_\_\_\_ (3)
4. How much is the layer added to EI in year 2? (round to whole dollars)  
\$ \_\_\_\_\_ (4)
5. How much is the EI at the end of the 3<sup>rd</sup> year? (round final answer to whole dollars)

\$ \_\_\_\_\_ (5)

**Appendix D: Intermediate I Pretest and Posttests (Con't)**

**Inventory Valuation**

Please **circle** your selection to the four questions below.

1. Which of the following is correct about net realizable value?
  - a. It is the acquisition cost plus costs to complete and sell.
  - b. It is the selling price.
  - c. It is the selling price plus costs to complete and sell.
  - d. It is the selling price less costs to complete, sell, and transport
  
2. Which of the following is true regarding the designated market value?
  - a. It is always the middle value of replacement cost, net realizable value, and net realizable value less a normal profit margin.
  - b. It should always be equal to net realizable value.
  - c. It may sometimes exceed net realizable value.
  - d. It should always be equal to net realizable value less a normal profit margin
  
3. Muckler Company sells widgets for \$35 each. The cost of one widget is \$32, and the replacement cost is \$9. The estimated cost to dispose of a widget is \$10, and the normal profit margin is 40% of the selling price. At what amount per unit should the widget be reported, applying lower-of-cost-or-market (LCM)?
 

a. \$ 9.	d. \$15.
b. \$11.	e. \$25.
c. \$14.	f. \$32
  
4. Assume the acquisition cost of product Z is \$27, the sale price of product Z is \$35 with selling costs of \$11 and a normal profit margin of \$2. In addition, assume the market value (replacement cost) for product Z is \$25. What is the proper per unit inventory valuation for Product Z, applying the lower-or-cost-or-net realizable value (LCNRV) rule?
  - a. \$27.
  - b. \$25.
  - c. \$22.
  - d. \$24.
  
5. **(NOTE: This statement was on Posttest only)** I believe the use of Janice's convenience store and extending the topics throughout Chapters 8 and 9 has not been helpful to me in learning the material. (no extra credit)
  - a. True
  - b. False

**Table 1: Seven-Step Strategy to Develop In-Class Activities**

<u>Steps</u>	<u>Examples – Comments</u>
1. Identify the topic and/or subtopic	<ul style="list-style-type: none"> <li>• Inventory costing</li> <li>• Accrual accounting</li> <li>• Depreciation</li> </ul>
2. Identify a business entity familiar to students	<ul style="list-style-type: none"> <li>• Lawn care service</li> <li>• Gas station</li> <li>• Construction company</li> </ul>
3. Write a one or two paragraph scenario that combines the selected business and topic	<ul style="list-style-type: none"> <li>• Use simple, understandable, and non-jargon language</li> </ul>
4. Add a pictorial illustration	<ul style="list-style-type: none"> <li>• A picture of the type of business selected might be the easiest to identify</li> </ul>
5. Select an active learning method(s)	<ul style="list-style-type: none"> <li>• Peer teaching</li> <li>• Think-Pair-Share</li> <li>• Mini-cases</li> <li>• Problem-solving</li> </ul>
6. Write at least one relevant and focused question to trigger student thinking and/or action	<ul style="list-style-type: none"> <li>• Questions may or may not be answerable by the student.</li> <li>• The posed questions might generate additional questions from the students.</li> <li>• Allow students to pose additional questions</li> </ul>
7. In-class Discussions	<ul style="list-style-type: none"> <li>• Student-to-Student</li> <li>• Students-to-Faculty</li> </ul>

**Table 2: Scenarios' Development – Existing and New Knowledge**

Topic	Existing Knowledge	New Knowledge
1. Cash and Accrual accounting	Lawn Service: Cash-basis of accounting	Accrual-basis of accounting (revenue and expense recognition)
2. Cost of long-term asset (depreciate cost of asset)	Construction company: Purchase of high-dollar assets	Subsequently expense the asset's cost to the periods benefitted (matching).
3. Inventory cost flow	Convenience store: owner sells merchandise and gasoline. Flow of goods into and out of the convenience store/gas station.	Assign inventory costs to EI and COGS (FIFO, LIFO, Weighted average, Specific ID)

**Table 3: Matched-Paired t-Test Results (\* Percentages)**

<b>Topic</b>	<b>n</b>	<b>Pre-test*</b>	<b>Posttest*</b>	<b>t-stat</b>	<b>p-value</b>
<b>Accrual Accounting</b>	47	66.81	82.13	5.34	0.00
<b>Depreciation</b>	43	51.63	72.09	5.57	0.00
<b>Inventory Costing</b>	49	37.96	53.88	3.75	0.00

**Table 4: Matched-Paired t-Test Results – Intermediate I – Fall 2019 (\* Percentages)**

<b>Topic</b>	<b>n</b>	<b>Pretest*</b>	<b>Posttest*</b>	<b>t-stat</b>	<b>p-value</b>
<b>Inventory Costing: Basics</b>	36	74.44	86.67	4.21	0.00
<b>Inventory Costing: Dollar-Value LIFO</b>	33	38.18	70.91	7.26	0.00
<b>Inventory Valuation: LCM &amp; LIFO</b>	36	25.00	80.00	17.12	0.00

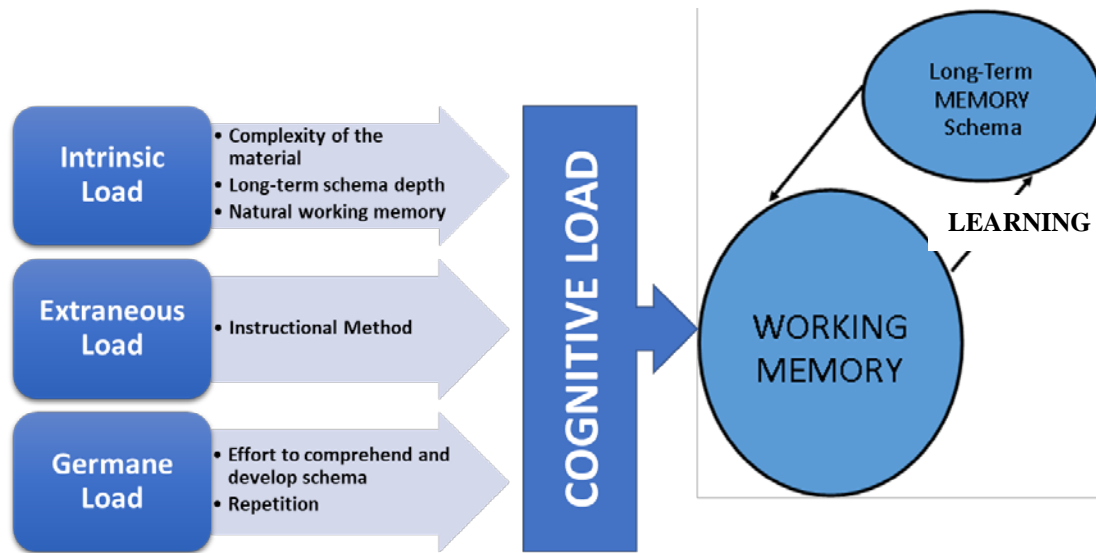
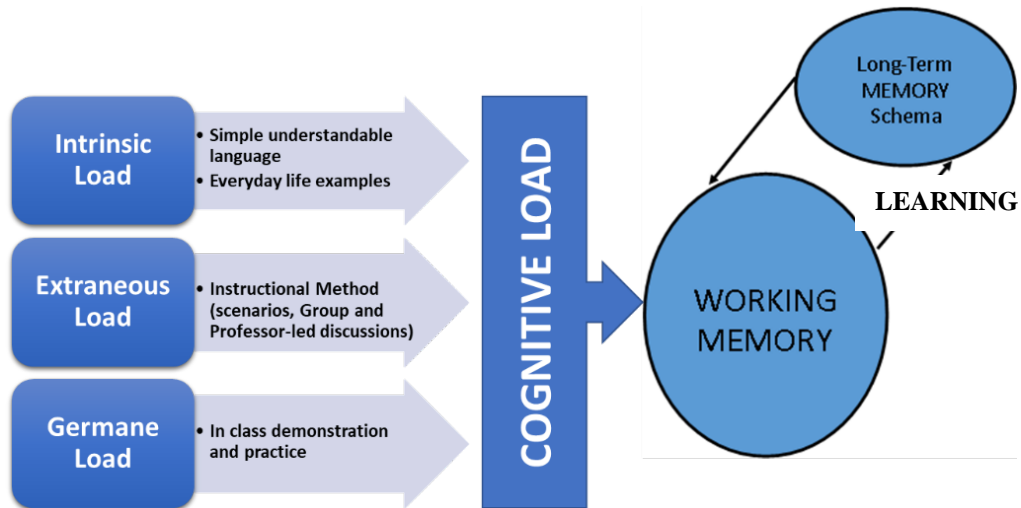


Figure 1: *Cognitive Load Theory: Variables Affecting Working Memory (created from text in Mostyn, 2012).*



**Figure 2: Pedagogical Techniques to Reduce Cognitive Load**

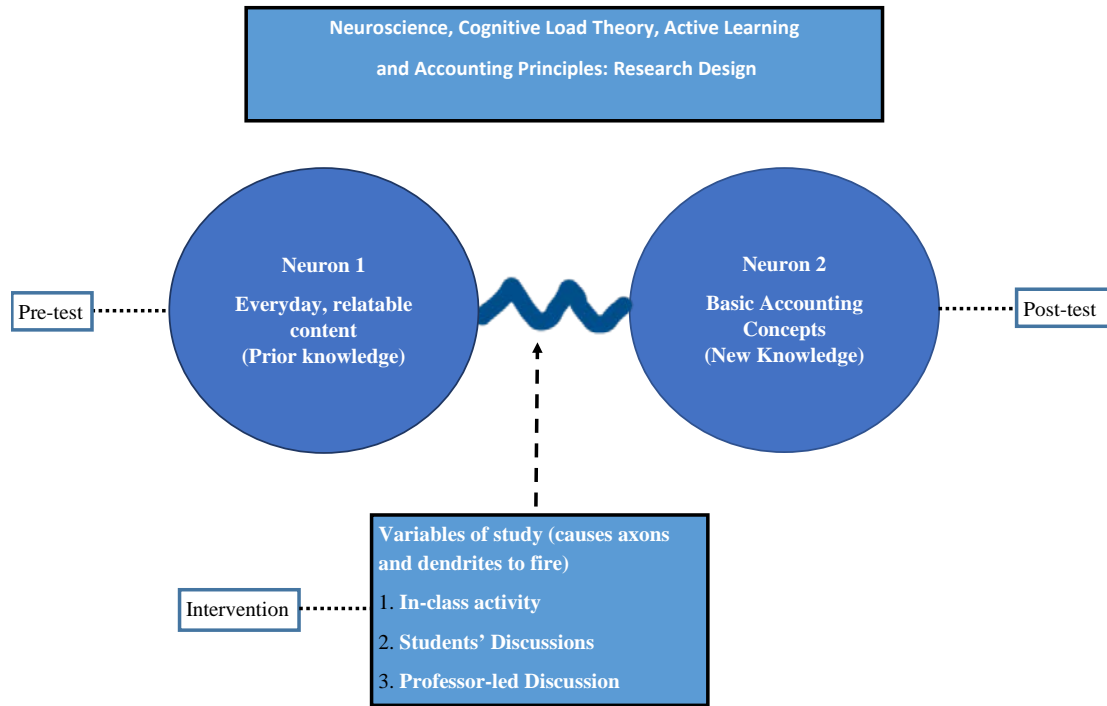


Figure 3: Research Design