Chapter 13
DESIGNING TAX CURRICULUM FOR THE ACQUISITION OF CORE COMPETENCIES

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To prepare accountants for the challenges of a rapidly changing marketplace, the CPA Vision Process (AICPA 1998) identified five core competencies[1] for the profession. These core competencies focus on identifiable personal, business, and accounting/tax skills. This emphasis on core skills and competencies represents a shift from the profession's traditional focus on the acquisition of functional technical accounting knowledge. The academic community is in a unique position to help the accounting profession achieve the goals of the AICPA's Vision Project by reforming accounting curriculum to promote the acquisition of these core skills. However, to successfully implement educational programs that result in the acquisition of skills, educators should understand how cognitive skills are acquired.

This monograph is primarily designed to provide practical teaching methods to improve the rate of learning. To complement this effort, this chapter provides a framework for educators to understand how these educational manipulations affect the acquisition of knowledge. In particular, it provides guidance in selecting teaching methods that lead to the acquisition of cognitive skills. Thus, it serves as a reference for educators in selecting teaching methods that promote the acquisition of the core competencies called for by the profession.

It should be noted that learning ultimately depends on the student and is affected by the student's ability and motivation as well as the teaching methods employed by the instructor. However, these issues are not discussed in this chapter. Instead, the purpose of this chapter is to explain the cognitive process in the acquisition of knowledge. Consequently, it assumes that students have the ability and motivation to acquire the relevant knowledge and skills.

The remainder of the chapter is organized as follows. The first section discusses the Atomic Components of Thought (ACT-R) theory of human cognition (Anderson and Lebiére 1998), which

[1] The core competencies identified by the AICPA are:
1. Communication and Leadership Skills
2. Strategic and Critical-Thinking Skills
3. Customer, Client, and Market Focus
4. Converging Information Interpretations
5. Technologically Adept

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is used to understand the acquisition of cognitive skills. The second section develops a model of learning based on the ACT-R theory. In the third section, this learning model is used to assess the effect different teaching methods have on the acquisition of cognitive skills. The final section concludes with recommendations for tax education.

THE ATOMIC COMPONENTS OF THOUGHT

The ACT-R theory is a "unified theory of cognition" (Newell 1973) which can be used to understand the acquisition and use of knowledge (Anderson 1993). The ACT-R theory[2] has been found to be consistent with findings regarding expertise in several fields including mathematics and computer programming and has been suggested to explain the knowledge-acquisition process in accounting (Bedard and Chi 1993). The ACT-R theory is different from taxonomies of learning such as that of Bloom et al. (1956) because it models the cognitive process in the acquisition and use of knowledge as opposed to providing a classification scheme for the knowledge acquired. It is suggested that educators must first consider the cognitive process in the acquisition of knowledge in order to control the outcomes of that process.

ACT-R is based on the assumption that there are two long-term stores of knowledge:[3] declarative memory and procedural memory. Declarative memory includes facts, instructions, examples, and concepts. It is knowledge that can be recalled and described to others (Anderson 1993). For example, tax declarative knowledge of "gross income" includes: facts such as the statutory definition of gross income; instructions like formulas used in computing gross income (e.g., installment sales); examples of items included and excluded from gross income; and concepts such as the realization principle. Procedural memory, on the other hand, includes our ability of "how to" do things (Anderson 1993). It is the unconscious knowledge we employ in performing a task (Anderson 1993). Therefore, it is knowledge that can only be observed from behavior. An example of procedural knowledge is the ability to write. For instance, in constructing a sentence, we use our declarative knowledge of word definitions and punctuation as well as our ability to use these facts and rules in expressing our thoughts. Procedural knowledge is the unconscious skill we employ in performing the task of writing. When we have extensive practice in a task we often no longer need to rely on our declarative knowledge of the rules (Anderson 1993). Thus, in writing a sentence we do not need to think of capitalizing the first word of a sentence or placing a period at the end, although this knowledge is part of our declarative memory.

The distinction between declarative and procedural knowledge suggests that only having declarative knowledge is not enough to successfully complete a task. One must also acquire procedural knowledge to be able to apply his or her declarative knowledge to a task in a specific situation. Therefore, educators must understand the nature of procedural knowledge if they are going to promote the acquisition of cognitive skills as called for by the profession.

In most human information-processing theories of cognition, procedural knowledge is represented by production rules (Anderson 1993). Production rules are condition-action pairs (IF-THEN rules) that explain performance of a task. The IF part of the statement contains a condition that specifies when the rule is to apply. The THEN part is an action, which specifies what to do IF the condition is satisfied. For example, a single production rule related to determining the character of income from the sale of an asset is:

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[2] This theory has been developed into a working computer model that is capable of modeling in detail a wide range of complex tasks with a high degree of accuracy (Anderson and Lebiére 1998). The ACT-R model can be found at the ACT-R homepage at http://act.psy.cmu.edu.

[3] See Anderson (1993) for a review of evidence in support of this distinction.

IF: the taxpayer sells an asset in a taxable disposition and the goal is to determine character of income from the disposition, .

THEN: determine the purpose and use of the asset sold and classify the result according to the tax law.

The ACT-R theory makes four claims regarding the nature of production rules. They are:

1. Modularity: Each production rule is an independent (modular) piece of knowledge. This is a claim that production rules represent the basic cognitive unit in which cognitive skills are learned and applied.
2. Abstraction: Production rules have variables in the IF (condition) part of the statement. Accordingly, production rules are not limited to a one-to-one mapping of condition to action. Consequently, a single action can apply to a number of different but similar conditions.
3. Goal Factoring: Goal factoring provides that the production rule employed in particular situation depends not only on the external facts of the situation, but also on a person's internal goal. The goal-factoring mechanism serves to link and organize production rules around goals and related sub-goals necessary to complete a task.
4. Asymmetry: The condition-action nature of production rules implies an asymmetry in the application of knowledge. Thus, procedural knowledge acts on data from condition-to-action and not in the reverse (action-to-condition) direction.

The first two characteristics of production rules allow for flexibility in the use of procedural knowledge. The modularity feature provides that the same production rule can be used in multiple tasks. This feature makes it possible for production rules acquired in learning one skill to be integrated into a larger, more complex task without repeating the instruction of the first task. For example, it is not necessary to teach arithmetic skills in the context of computing taxable income. Each task is independent of the other, and therefore, instruction of each task can proceed independently of the other. The abstraction feature also provides flexibility in the application procedural knowledge. For example, a production rule concerning the disposition of a "truck" used in a trade or business is not limited to particular type of asset, such as a truck, but instead can apply to the entire range of section 1231 assets. Thus, production rules do not have to be limited to a single factual situation, but can apply to a range of facts. In a broader sense, these two characteristics allow for skills and sub-skills acquired in learning one task to apply to other related tasks.

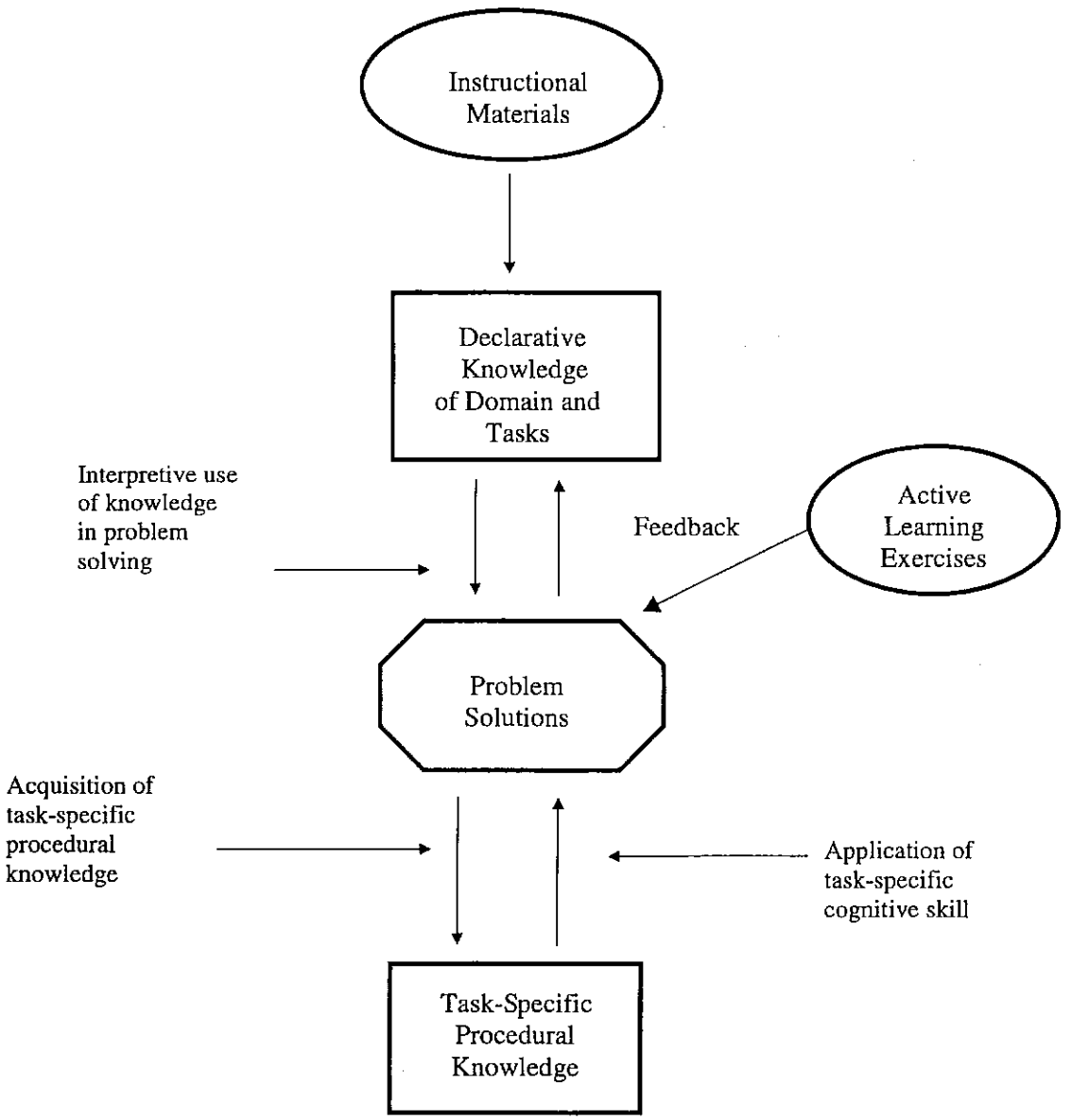
In contrast, the last two characteristics limit the generality of procedural knowledge. These features lead to procedural knowledge that is task-specific. Thus, the goal-factoring mechanism implies that students will develop production rules that are specific to the goal structure of a particular task. In addition, the asymmetry of production rules suggests that students need to acquire mutually exclusive production rules for transactions that operate in opposite directions. Thus, for example, students need to acquire separate and distinct production rules in order to analyze transactions such as issuing debt securities and retiring debt securities even though these tasks share much of the same declarative knowledge.

The acquisition of task-specific procedural knowledge is consistent with research findings regarding expertise (Bedard and Chi 1993; Anderson 1993). For example, experts generally adopt a forward-reasoning strategy working from known facts to either explicit or implicit goals to solve problems. In contrast, novices usually employ a backward-reasoning or data-driven approach. These two approaches differ in the sub-goals used to organize and complete the task (Larkin 1981). Furthermore, the acquisition of specific production rules that automatically apply in known situations provides for efficient responses to known problems and is a documented characteristic of expertise (Bedard and Chi 1993).

LEARNING MODEL

A model of how declarative knowledge and procedural knowledge interact in the acquisition of cognitive skills is presented in Exhibit 1. In the model, there are two classes of inputs: instructional materials and active-learning exercises. Instructional materials can take the form of textbooks, lectures, example problems, demonstrations, or multimedia presentations. Active-learning exercise include practice problems, simulating accounting tasks, analyzing cases, and other assignments that require the active application of knowledge to solve a particular task. The solutions to specific problems are the products or outcomes of the learning process.

EXHIBIT 1
Framework for Learning[a]



[a]Based on a model proposed in Pirolli and Recker (1994).

The model illustrates that the first step in the acquisition of a cognitive skill is the acquisition of declarative knowledge by direct encoding of the instructional materials. Next, students use their declarative knowledge to generate solutions to active-learning exercises. Students acquire procedural knowledge (through an automatic cognitive process) as a by-product of completing these assignments. This process may also serve to correct errors in the learner's declarative knowledge. When the cognitive skill has been mastered, procedural knowledge is used to provide direct solutions to future assignments without the need to rely on the original declarative knowledge of the task.

The ACT-R theory and the proposed learning model offer several insights for educators desiring to design curricula to promote the acquisition of skills.

1. The model suggests that both declarative and procedural knowledge must be acquired to learn a cognitive skill.[4] Declarative knowledge provides students with an understanding of the "what and why" of a task, and procedural knowledge provides students with the "know how" to perform the task.
2. The model suggests that performance is primarily dependent on the level of task-specific procedural knowledge. In the absence of task-specific procedural knowledge, individuals are forced to use a combination of declarative knowledge and general problem skills (Anderson 1993).
3. The model suggests that while declarative knowledge can be acquired through the direct encoding of information, procedural knowledge must be learned by doing. Thus, the ability to write, play chess, or solve complex tax problems can only be acquired through active practice in the task.
4. The model suggests there is a feedback loop from the application of knowledge in solving problems to declarative knowledge. This feedback loop allows for both the creation of new declarative knowledge from insights gained from problem solutions as well as correcting and refining the student's prior understanding of the topic. For example, students may not fully understand the concept of gain deferral until they apply their knowledge to compute the basis of the qualified property in a tax-deferred exchange.
5. The model suggests that while declarative knowledge can be tested through recall, procedural knowledge can only be inferred from performance.

TEACHING METHODS

Tax instructors have a wide variety of teaching methods available to them ranging from lecture to student participation in simulations. Bonner (1999) identified 13 teaching methods available to accounting instructors. In this section, these teaching methods are evaluated based on their effect on the acquisition of declarative and procedural knowledge.

As noted in Exhibit 2, teaching methods 1 through 5 are passive. These methods are primarily designed to convey information. Thus, while these methods are appropriate for the acquisition of declarative knowledge, they do not result in the acquisition of procedural knowledge. The remaining methodologies require students to be actively involved in generating solutions to accounting questions and problems. These techniques are classified as active-learning methods. These methods result in the acquisition of procedural knowledge. However, the structure of the procedural knowledge acquired varies based on the type of active-learning exercise as well as the range of problems assigned. In addition, as previously noted, these active methods may also help

[4] Although research has indicated that it is possible to acquire a skill without first acquiring the underlying declarative knowledge (Anderson and Fincham 1994), it is anticipated that tax educators will want students to acquire the underlying concepts as part of their education.

EXHIBIT 2
Teaching Methods

No.	Method[a]	Type[b]	DK[c]	PK[d]
1	Read text	Passive	Direct	No
2	Read worked-out example problems	Passive	Direct	No
3	Listen to lecture/watch video	Passive	Direct	No
4	Watch demonstration	Passive	Direct	No
5	Interactive lecture	Passive	Direct	No
6	Answer short, objective questions	Active	Feedback	Limited
7	Work short, numerical questions	Active	Feedback	Limited
8	Write and answer questions	Active	Feedback	General
9	Discuss issues with other students	Active	Feedback	General
10	Make oral presentations and answer questions	Active	Feedback	General
11	Conduct tax research	Active	Feedback	Task-Specific
12	Work unstructured tax cases and problems	Active	Feedback	Task-Specific
13	Participate in a demonstration tax skills	Active	Feedback	Task-Specific

DK = Declarative knowledge
PK = Procedural knowledge

[a]Methods suggested by Bonner (1999).
[b]Each teaching method is classified as either passive or active.
[c]The effect of the teaching methods on the acquisition of declarative knowledge is classified as either (direct) from encoding of information or indirectly (feedback) from working practice problems.
[d]The effect of the teaching methods on the acquisition of procedural knowledge is characterized as either None, Limited, General, or Task-Specific. "Limited" refers to the acquisition of narrow technical procedures or rules. "General" refers to the acquisition of general skills such as writing or oral communication. "Task-Specific" recognizes that the procedural knowledge is dependent on the nature of the task or assignment.

students correct their understanding of terms and concepts, thus indirectly increasing their declarative knowledge.

The active-teaching methods can be classified into three categories based on their effect on procedural knowledge:

1. Teaching methods 6 and 7 require the completion of short, objective questions and/or problems. The procedural knowledge acquired by these methods would probably not include complex goal factoring that would allow the knowledge acquired to apply to broader issues and problems. In using these types of exercises, instructors are relying on the modularity feature of procedural knowledge. In other words, the specific procedural knowledge acquired from these exercises can later be plugged into a larger mental routine in more complex problems. The primary benefit from these methods is to get students to process and correct their declarative knowledge. In addition, they should be effective in increasing students' recall of particular terms or concepts.
2. Teaching methods 8 through 10 require students to write and answer questions, discuss tax issues with other students, and make oral presentations. These methods involve complex activities such as written and oral communication. Therefore, these methods should result in the acquisition of procedural knowledge. However, the procedural knowledge acquired would relate to these general skills and not directly to accounting tasks. Again, these tasks are

effective in getting students to process accounting rules and concepts in a deep and meaningful way and thereby increase their understanding of accounting topics. These methods, therefore, would meet learning objectives relating to the acquisition of general communication and thinking skills, as well as increasing and deepening a student's declarative knowledge; however, they would probably not result in the acquisition of task-specific accounting skills.

3. Teaching methods 11 through 13 require students to conduct tax research, work unstructured tax cases and problems, and give demonstrations of accounting/tax skills. These methods would promote the acquisition of procedural knowledge with respect to the specific tax skills practiced. The real benefit from this category of teaching methodologies is that students acquire task-specific procedural knowledge. Specific tax skills in the introductory tax class typically include general tax planning, tax research, evaluating investment alternatives, documenting and communicating tax advice, determining gain or loss on the disposition of assets, and tax planning for new business ventures. Once acquired, these skills are beneficial to a wide array of future tasks and provide a foundation for life-long learning. In advanced tax classes, these skills are honed, and additional skills are taught. In these instances, the new knowledge gained by students is not additional tax facts but the strategies employed by tax experts to solve real-world problems.

The cognitive processes involved in the acquisition and use of knowledge suggest that the instructor must carefully consider the interaction of the teaching method with the desired learning outcome.

CONCLUSION

The changing needs of the accounting profession as indicated by the CPA Vision Process suggest that tax educators should shift from viewing their tax classes as content-driven (teaching the tax law) to the acquisition of core competencies. Based on the ACT-R theory, this chapter provides a model of learning to understand the acquisition of cognitive skills. This model has several implications for tax education in this new environment. First, tax educators need to understand that there is a fundamental distinction between the acquisition of tax rules and concepts (declarative knowledge) and the ability to apply those rules and concepts (procedural knowledge) to solve real-world business and tax problems. Second, procedural knowledge or skills can only be acquired by doing. Thus, teaching methods that involve the active participation of students are essential for the acquisition of skills. Third, because procedural knowledge can not directly be inspected or recalled, it presents unique problems for educators in both designing curriculum and assessing student achievement. For example, if educators are not aware of their own procedural knowledge, they are likely to overlook it when determining learning objectives. In addition, the assessment of a student's level of procedural knowledge is problematic because it can only be inferred from performance. Thus, exams designed to test recall of tax rules and concepts will not evaluate a student's procedural knowledge.

These observations suggest that tax education should be based on the following principles:

1. Instruction should emphasize the development of identifiable personal, business, and accounting/tax skills as called for by the profession.
2. When a skill set has been selected, a cognitive analysis[5] of the task should be conducted to identify the requisite knowledge. The purpose of this step is to identify the procedural knowledge associated with the task. Too often instruction is focused on the tax rules as opposed to the strategies of how those rules are used to solve real-world tax problems.

[5] There are many sophisticated techniques to develop a cognitive model of a task (Anderson 1993). However, often a logical analysis of the task can provide important insights without extensive modeling.

3. Teaching methods should be consistent with the goals of instruction. Thus, passive-teaching methods can be used for the learning objectives regarding the acquisition of declarative knowledge; however, active methods are necessary for the acquisition of procedural knowledge. Most competencies require the acquisition of both declarative and procedural knowledge. Accordingly, a combination of teaching methods is often most effective.
4. Once the knowledge and skills have been identified and the teaching methods selected, established principles of learning (e.g., depth of processing, learning by doing, and learning by example) can be used to facilitate the acquisition of knowledge. Instructors can influence the range and depth of the skill acquired by selecting the type and range of problems they assign. Thus, if students are asked to complete narrow technical problems, they will acquire narrow technical skills. However, if students practice on holistic real-world tax cases, they will acquire broad tax skills.
5. Assessment and evaluation should be consistent with the type of knowledge selected for instruction.

In a rapidly changing world, where technical tax knowledge can quickly become obsolete, tax education should be designed with an emphasis on the acquisition of skills that will allow professionals to meet the demands of a dynamic marketplace. This chapter provides a framework for educators to understand the cognitive processes in the acquisition and use of knowledge. Thus, it serves as a reference for educators in designing curriculum and selecting teaching methods that promote the acquisition of the core competencies called for by the profession.

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