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An Excel Planning and Teaching Decision Aid for Bonner's Conceptual Framework

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ABSTRACT

Bonner (1999, 2008) prescribes a conceptual framework entitled "Choosing teaching methods based on learning objectives: An integrative framework" to plan and teach accounting. Bonner's conceptual framework involves a holistic-mapping-process in which an instructor holistically maps a set of accounting learning objectives (ALO), general learning objectives (GLO), necessary conditions (NC), and teaching methods (TM). The scope of this paper is aimed at developing an Excel planning and teaching decision aid (EDA) for Bonner's holistic-mapping-process. This EDA neither replaces nor supplants the conventional judgment-based planning and teaching process. By presenting and making the EDA available, perhaps accounting information systems researchers will be motivated to independently validate the EDA, to investigate many of the related issues such as comparing the EDA's efficacy/usefulness to conventional planning and teaching process, and to assess its application to other specializations in accounting, such as managerial accounting or taxation.

INTRODUCTION

In 1999, Bonner prescribed a conceptual framework entitled "Choosing teaching methods based on learning objectives: An integrative framework" to plan and teach accounting. Since then, Barth's (2008) call for using pedagogical conceptual framework have motivated the authors to plan and teach accounting based on Bonner's (1999, 2008) conceptual framework. Bonner's conceptual framework involves a holistic-mapping-process in which an instructor holistically maps a set of accounting learning objectives (ALO), general learning objectives (GLO), necessary conditions (NC), and teaching methods (TM). In this paper, following Albrecht and Sack's (2002) call for pedagogical innovation, we develop an Excel planning and teaching decision aid (EDA) for the holistic-mapping-process of Bonner's conceptual framework. This EDA assists, but does not replace, the holistic-mapping-process of Bonner's conceptual framework. Also, it supports, but does not supplant, the conventional judgment-based planning and teaching process (Bernstein, 1996). However, the EDA offers several significant advantages over the conventional judgment-based process. First, the EDA, as a decision aid, lessens an instructor's cognitive strain of the holistic-mapping-process under Bonner's conceptual framework. Second, the EDA, based on computational logic, reduces potential error of judgment heuristics under the conventional judgment-based planning and teaching process (Kahneman & Shane, 2002). Third, the EDA application, which utilizes the common Excel software, is easy to set up. Fourth, the Excel application, once it is set up, provides a fast and rigorous way of

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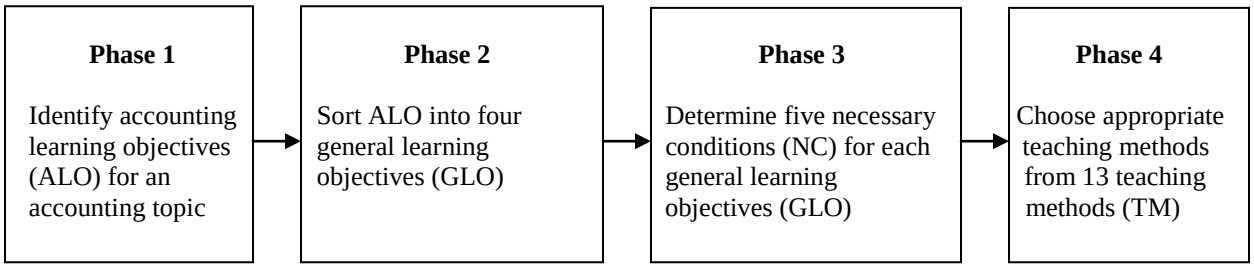
identifying the optimum teaching methods for a particular course. Fifth, the Excel application can be recycled and used across semesters or academic years for updated course materials (Gibson, Buche, & Waite, 2008). Last but not least, the Excel application documents the instructor's effectiveness and efficiency in planning and teaching, which complements the students' documents/evaluations of the instructor's teaching performance (Sullivana & Skanes, 1974).

The remainder of this paper is organized as follows. First, we describe four phases of Bonner's conceptual framework and its holistic-mapping-process. Second, an Excel planning and teaching decision aid (EDA) is derived from Brown and Gibson (1972) and Ammarapala and Luxhøj (2000) for Bonner's holistic-mapping-process. We rewrote Brown and Gibson's basic equation in pedagogical terms to set up the EDA (see details in Appendix A) and explain how the EDA generates four tables (a critical value table, an objective value table, a subjective value table, and a sensitivity index table) for a sensitivity analysis that prioritizes teaching methods. Third, we illustrate how an instructor uses the EDA to plan and teach Chapter 10 of Arens, Elder, and Beasley's *Auditing and Assurance Services*, 13th edition, 2009 (see details in Appendix B).

BONNER'S CONCEPTUAL FRAMEWORK

Bonner (1999, 2008) prescribes a conceptual framework for choosing teaching methods based on learning objectives. Figure 1 shows four phases of Bonner's conceptual framework and its holistic-mapping-process.[1]

Figure 1: Bonner's (1999, 2008) Conceptual Framework.



In Phase 1 of Bonner's conceptual framework, an instructor begins by identifying accounting learning objectives (ALO) for a particular accounting topic. According to Bonner (1999, 2008), the instructor should consider students' prerequisite skills in identifying the accounting learning objectives (ALO). If students do not have the prerequisite skills, acquiring such skills should be identified as one of the accounting learning objectives (ALO). For example, since students learning about the topic of fraud auditing should know the accounting and legal definition of fraud, the instructor should identify learning the definition of fraud as one of the accounting learning objectives (ALO).

[1] We acknowledge the valuable suggestion and continuous support of Sarah Bonner in developing the EDA based on her conceptual framework. Our discussion here focuses on the holistic-mapping-process of her conceptual framework. Readers looking for a full discussion or critical analysis of the conceptual framework may refer to Bonner's (1999, 2008) paper and book.

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In Phase 2 of Bonner's conceptual framework, the instructor sorts the accounting learning objectives (ALO) into four general learning objectives (GLO). The four general learning objectives (GLO) are: (GLO1) Verbal Information, (GLO2) Intellectual Skills – Discrimination and Concepts, (GLO3) Intellectual Skills – Rules and Higher – Order Rules, and (GLO4) Cognitive Strategies.

In Phase 3 of Bonner's conceptual framework, the instructor determines a set of five necessary conditions (NC) for each of the four general learning objectives in Phase 2. The five necessary conditions are: (NC1) describe/demonstrate expected performance, (NC2) facilitate recall of well-organized knowledge base or facilitate recall of prerequisite concepts, (NC3) deliver meaningfully organized material, provide definition and distinctive features, or explain/demonstrate application, (NC4) facilitate elaboration of material or work examples in different contexts, and (NC5) elicit expected performance and provide practice. According to Bonner's conceptual framework, the first (NC1) and fifth (NC5) necessary conditions in Phase 3 are the same, but the second (NC2), third (NC3), and fourth (NC4) necessary conditions vary among the four general learning objectives (GLO) in Phase 2 as follows:

(GLO1) Verbal Information, the necessary conditions (NC) are:

(NC1) describe/demonstrate expected performance,

(NC2) facilitate recall of well-organized knowledge base,

(NC3) deliver meaningfully organized material,

(NC4) facilitate elaboration of material, and

(NC5) elicit expected performance and provide practice.

(GLO2) Intellectual Skills – Discrimination and Concepts, the necessary conditions (NC) are:

(NC1) describe/demonstrate expected performance,

(NC2) facilitate recall of prerequisite concepts,

(NC3) provide definition and distinctive features,

(NC4) work examples in different contexts, and

(NC5) elicit expected performance and provide practice.

(GLO3) Intellectual Skills – Rules and Higher – Order Rules, the necessary conditions (NC) are:

(NC1) describe/demonstrate expected performance,

(NC2) facilitate recall of prerequisite concepts,

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(NC3) explain/demonstrate application,

(NC4) work examples in different contexts, and

(NC5) elicit expected performance and provide practice.

(GLO4) Cognitive Strategies, the necessary conditions (NC) are:

(NC1) describe/demonstrate expected performance,

(NC2) facilitate recall of well-organized knowledge base and facilitate recall of prerequisite concepts,

(NC3) explain/demonstrate application,

(NC4) work examples in different contexts, and

(NC5) elicit expected performance and provide practice.

Lastly, in Phase 4 of Bonner's conceptual framework, the instructor holistically maps the accounting learning objectives (ALO), the four general learning objectives (GLO), and the five necessary conditions (NC) to a set of 13 teaching methods (TM). The 13 teaching methods (TM) are: (TM1) read text, (TM2) read worked-out problems/questions, (TM3) listen to lecture/watch video, (TM4) watch demonstration, (TM5) listen to and participate in lecture, (TM6) answer short objective questions, (TM7) write and answer questions, (TM8) work short numerical problems, (TM9) work longer cases and problems, (TM10) discuss issues with other students, (TM11) conduct research, (TM12) make oral presentations and answer questions, and (TM13) participate in demonstrations. Figure 2 illustrates the holistic-mapping-process of Bonner's (1999, 2008) conceptual framework.

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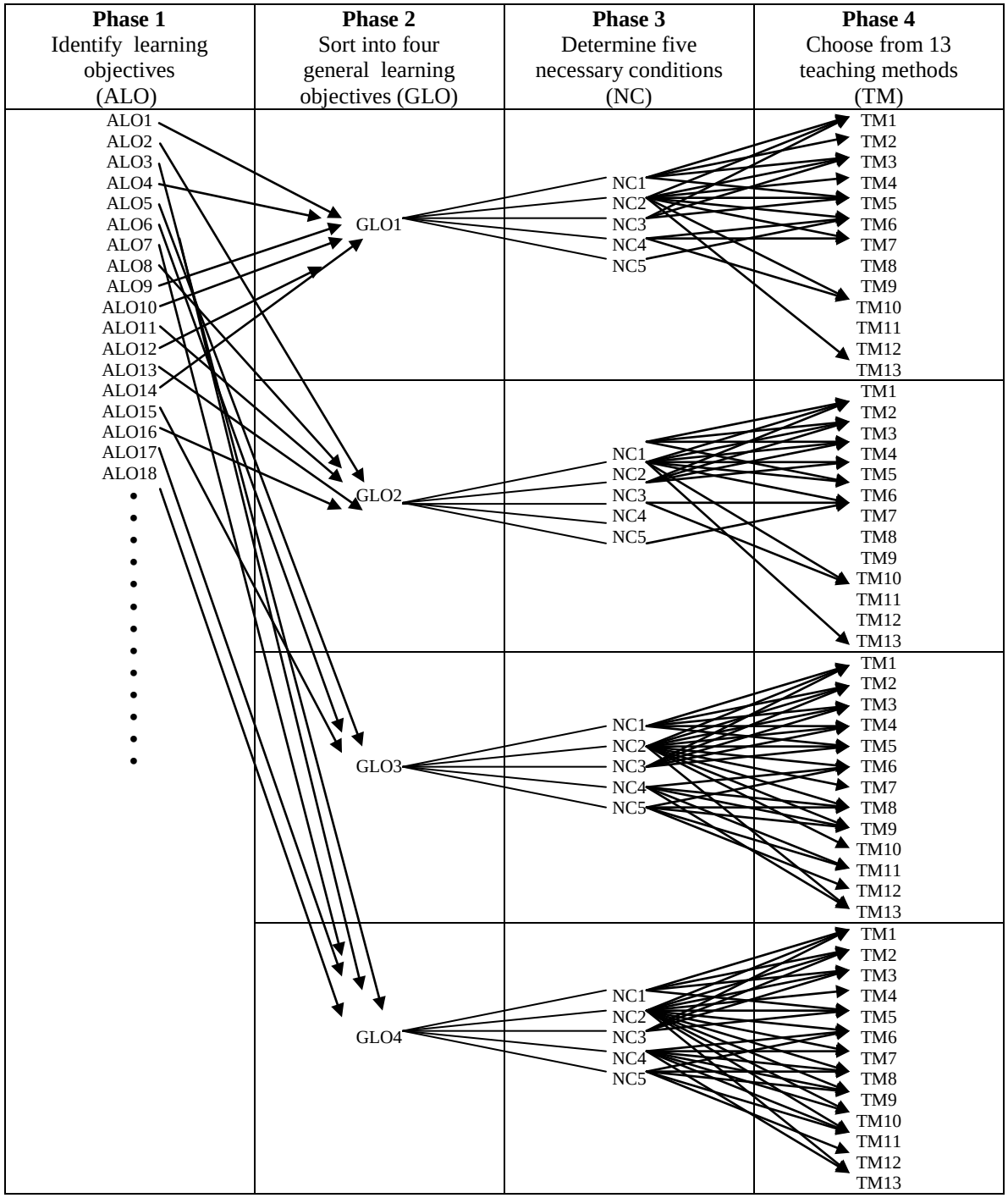
Figure 2: Holistic-mapping-process of Bonner's (1999, 2008) conceptual framework.



DEVELOP AN EXCEL PLANNING AND TEACHING DECISION AID FOR BONNER'S HOLISTIC-MAPPING-PROCESS

An Excel planning and teaching decision aid (EDA) for Bonner's holistic-mapping-process is derived from Brown and Gibson (1972) and Ammarapala and Luxhøj (2000). Brown and Gibson's model of facility site selection is applicable to Bonner's (1999, 2008) model of teaching method selection for several reasons. First, both models share the same theoretical framework that can be traced to Newell and Simon's (1972) theory of human problem solving. Brown and Gibson's model solves engineers' facility site selection problem; likewise, Bonner's model solves educators' teaching method selection problem. Second, in addressing the selection problem, both models seek to minimize judgment error according to Kahneman and Tversky's (2000) concept of human judgment heuristics. Brown and Gibson's model seeks to minimize the judgment heuristics of "representativeness" of engineers; likewise, Bonner's model seeks to minimize the same judgment heuristics of teachers. Third, the underlying mathematics in Brown and Gibson's model matches Bonner's model after the basic equation is rewritten in accounting pedagogical terms (see Appendix A). Last but not least, among the few models that integrate both objective and subjective factors in decision making (e.g., Drake, 1998; Giddens & Gaasch, 2003; Higgins, Hajkowicz, & Bui, 2008; Saaty, 2009; Vinekar, Teng, & Chennananeni, 2009), Brown and Gibson's model is the one most applicable to Bonner's holistic-mapping-process.

Since Brown and Gibson used engineering terms that are ordinarily not familiar to an accounting instructor, we rewrote their basic equation using accounting pedagogical terms as follows (see details of the derivation in Appendix A):

$$\textbf{Sensitivity Index}_i = C_i [(W) (O_i) + (1 - W) (S_i)]$$

Where:

Sensitivity Index$_i$ = the sensitivity index for the ith teaching methods (TM), where $0 \leq$ sensitivity index ≤ 1,

C_i = the net critical value for the necessary conditions (NC) of the ith teaching method (TM),

where $C_i = 0$ or 1,

O_i = the net objective value for the learning objectives (GLO) of the ith teaching method (TM), where $0 \leq O_i \leq 1$ and $\sum_{alli} O_i = 1$,

S_i = the net subjective value for the learning objectives (GLO) of the ith teaching method (TM), where $0 \leq S_i \leq 1$ and $\sum_{alli} S_i = 1$, and

W = the weight assigned by an instructor to the net objective value, O_i, where $0 \leq W \leq 1$.

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An instructor enters the critical, objective, and subjective values into the EDA, which then generates four tables (a critical value table, an objective value table, a subjective value table, & a sensitivity index table) for a sensitivity analysis that prioritizes the instructor's teaching methods. The EDA, as shown in Appendix C, is available upon request.

We now illustrate how an instructor uses the EDA to teach a three-credit auditing to approximately 80 senior undergraduate students in two 1¼ hours classes per week per semester in a large public university in the United States. In this illustration, the instructor plans to teach Chapter 10 of Arens, Elder, and Beasley's *Auditing and Assurance Services* (13th edition, 2009). First, following Phase 1 of Bonner's conceptual framework (see Figure 1), the instructor identifies eight auditing learning objectives (ALO) listed at the beginning of Chapter 10 (page 289):

ALO1 = Describe the three primary objectives of effective internal control.

ALO2 =Contrast management's responsibilities for maintaining internal control with the auditor's responsibilities for evaluating and reporting on internal controls.

ALO3 = Explain the five components of the COSO internal control framework.

ALO4 = Obtain and document an understanding of internal control.

ALO5 = Assess control risk by linking key controls and control deficiencies to transaction-related audit objectives.

ALO6 = Describe the process of designing and performing tests of controls.

ALO7 =Understand Section 404 requirements for auditor reporting on internal control.

ALO8 =Describe the differences in evaluating, reporting, and testing internal control for non-public companies.

Next, following Phase 2 of Bonner's conceptual framework, the instructor sorts the eight auditing learning objectives (ALO) into the four general learning objectives (GLO) as follows:

ALO1 = GLO1 (Verbal Information)

ALO2 = GLO2 (Discrimination and Concepts)

ALO3 = GLO2 (Discrimination and Concepts)

ALO4 = GLO3 (Rules and Higher-Order Rules)

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ALO5 = GLO4 (Cognitive Strategies)

ALO6 = GLO1 (Verbal Information)

ALO7 = GLO3 (Rules and Higher-Order Rules)

ALO8 = GLO1 (Verbal Information)

Then, the instructor maps the four general learning objectives (GLO) in Phase 2, the five necessary conditions (NC) in Phase 3, and the 13 teaching methods in Phase 4. The EDA generates four Tables for this mapping process.

Critical values for the thirteen teaching methods

In Table 1, the instructor evaluates each teaching methods (TM) according to his teaching style[2] and enters a critical value of 1 or 0 to indicate whether a necessary condition (NC) is or is not met by a particular teaching method (TM). The EDA then generates the net critical value (C_i) and shows either 'eliminate' or 'consider' in the 'Status' column.

Table 1: Critical values for all thirteen teaching methods.

TM Teaching Methods	Critical Values (1 or 0) of the NC (Necessary Conditions)					C_i Net Critical Value	Status
	NC1	NC2	NC3	NC4	NC5		
TM1	1*	1	1	0*	1	0	Eliminate
TM2	1	1	1	1	1	1	Consider
TM3	1	0	0	0	1	0	Eliminate
TM4	1	1	1	0	1	0	Eliminate
TM5	1	1	1	1	1	1	Consider
TM6	1	0	0	0	1	0	Eliminate
TM7	1	1	1	1	1	1	Consider
TM8	1	1	1	1	1	1	Consider
TM9	1	0	1	0	1	0	Eliminate
TM10	0	1	0	0	0	0	Eliminate
TM11	1	1	1	0	1	0	Eliminate
TM12	1	1	1	0	1	0	Eliminate
TM13	0	0	1	0	0	0	Eliminate

* The instructor evaluates each teaching methods (TM) according to his teaching style and enters a critical value of 1 or 0 to indicate whether a necessary condition (NC) is or is not met by a

[2] This instructor evaluates the 13 teaching methods (TM) based on his teaching style. In general, instructors may evaluate them based on their teaching styles (e.g., active mentoring), philosophies (e.g., interdisciplinary learning), preferences (e.g., online teaching) or modes (e.g., video conferencing). The basis of the evaluation is flexible as long as it eliminates those TMs that do not meet the necessary conditions for using them.

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particular teaching method (TM). The EDA then generates the net critical value (C_i) and shows either 'eliminate' or 'consider' in the 'Status' column.

Where:
NC1 = describe/demonstrate expected performance
NC2 = facilitate recall of well-organized knowledge base or facilitate recall of prerequisite concepts
NC3 = deliver meaningfully organized material, provide definition and distinctive features, or explain/demonstrate application
NC4 = facilitate elaboration of material or work examples in different contexts
NC5 = elicit expected performance and provide practice
TM1 = read text
TM2 = read worked-out problems/questions
TM3 = listen to lecture/watch video
TM4 = watch demonstration
TM5 = listen to and participate in lecture
TM6 = answer short objective questions
TM7 = write and answer questions
TM8 = work short numerical problems
TM9 = work longer cases and problems
TM10 = discuss issues with other students
TM11 = conduct research
TM12 = make oral presentations and answer questions
TM13 = participate in demonstrations

C_i = Net critical value for the i^{th} Teaching Method (TM)

The function of Table 1 is to eliminate those teaching methods that do not meet all the five necessary conditions (NC). For example, for TM1 (read text), the instructor enters a critical value of 1 to four necessary conditions - NC1 (describe/demonstrate expected performance), NC2 (facilitate recall of well-organized knowledge base or facilitate recall of prerequisite concepts), NC3 (deliver meaningfully organized material, provide definition & distinctive features, or explain/demonstrate application) and NC5 (elicit expected performance and provide practice) - to indicate that they are met by TM1 (read text); but, he enters a critical value of 0 to NC4 (facilitate elaboration of material or work examples in different contexts) to indicate that it is not met by TM1 (read text).

For each teaching method (TM), the EDA generates a net critical value (C_i) of either 0 or 1 for a TM as follows:

C_i = 1 for a TM if all of its five NC have a critical value of 1, and

C_i = 0 for a TM if one of its five NC has a critical value of 0.

For example, TM1 has a critical value (C_i) of 0 since one of its five NC has a critical value of 0. On the other hand, TM2 has a C_i of 1 since all of its five NC have a critical value of 1. A C_i of 1 means that the i^{th} teaching method (TM) is to be consider further. The EDA then shows either 'eliminate' or 'consider' for each TM in the 'Status' column in Table 1. In this illustration, nine of the thirteen TM are eliminated since they do not meet one or more of the necessary conditions (NC). Four TM for further consideration are TM2 (read worked-out problems/questions), TM5

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(listen to and participate in lecture), TM7 (write & answer questions), and TM8 (work short numerical problems).

Objective values for the teaching methods and general learning objectives

In Table 2, the EDA generates a table of objective values for the teaching methods (TM) and general learning objectives (GLO).

Table 2: Objective values for the teaching methods and general learning objectives.

TM Teaching Methods	Enter Teaching Time for the TM (Teaching Methods) and GLO (General Learning Objectives) for Chapter 10 of Arens, Elder and Beasley (13th edition, 2009)					O_i Net Objective Value
	GLO1 Verbal Information (ALO1,6,8)	GLO2 Discrimination and Concepts (ALO2,3)	GLO3 Rules and Higher-Order Rules (ALO4,7)	GLO4 Cognitive Strategies (ALO5)	Total Teaching Minutes*	
TM2	1	4	3	2	10	0.240
TM5	10	5	2	3	20	0.120
TM7	3	2	0	0	5	0.480
TM8	0	3	8	4	15	0.160
Total Teaching Minutes	14	14	13	9	50	1.000

* The instructor enters teaching time for the four TM based on his scheduled class time of 1 hour and 15 minutes. He enters a total of 50 minutes for the four TM, which leaves 25 minutes for class interaction and gap-filling. The EDA generates the net objective value (O_i).

Where:
TM2 = read worked-out problems/questions
TM5 = listen to and participate in lecture
TM7 = write and answer questions
TM8 = work short numerical problems
ALO1 = Describe the three primary objectives of effective internal control
ALO2 = Contrast management's responsibilities for maintaining and reporting on internal controls with the auditor's responsibilities for understanding, testing, and reporting on internal controls
ALO3 = Explain the five components of the COSO internal control framework
ALO4 = Obtain and document an understanding of internal control
ALO5 = Assess control risk by linking key controls, significant deficiencies, and material weaknesses to transaction-related audit objectives
ALO6 = Describe the process of designing and performing tests of controls
ALO7 = Understand Section 404 requirements for auditor reporting on internal control

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ALO8 = Describe the differences in evaluating, reporting, and testing internal control for nonpublic companies

O_i = Net objective value for the i^{th} Teaching Method (TM)
The function of Table 2 is for the instructor to enter the teaching time for the four teaching methods (TM) for Chapter 10 of Arens, Elder, and Beasley (13^{th} edition, 2009). In this illustration, the instructor's scheduled class time is 1 hour and 15 minutes;[3] he enters a total of 50 minutes for the four teaching methods, which leaves 25 minutes for class interaction and gap-filling. Table 2 also shows he enters 20 minutes to TM5, in which students listen to and participate in his lecture; 15 minutes to TM8, in which students work on some short numerical problems; 10 minutes to TM2, in which he reads the worked-out problems, and 5 minutes to TM7, in which he writes and answers questions.

Next, the EDA generates the net objective value (O_i) for each of the teaching methods (TM). For example, the net objective value (O_i) for TM2 is generated as follows:
Net objective value (O_i) for TM2 =

$$\frac{\mathbf{1}}{\mathbf{TM2\ min\ (1/TM2\ min + 1/TM5\ min + 1/TM7\ min + 1/TM8\ min)}} =$$

$$\frac{\mathbf{1}}{\mathbf{10\ (1/10 + 1/20 + 1/5 + 1/15)}} = \mathbf{0.240}$$

All the net objective values (O_i) in Table 2, in conjunction with all the net subjective values (S_i) in Table 3 below, will later be used in Table 4.

Subjective values for the teaching methods and general learning objectives

In Table 3, the EDA generates a table of subjective values for the teaching methods (TM) and General Learning Objectives as shown in Table 3.

[3] This instructor enters the teaching time for the four teaching methods (TM) based on his scheduled daily class time. In general, instructors may enter the teaching time based on their scheduled daily, weekly or semester class time.

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Table 3: Subjective values for the teaching methods and general learning objectives.

TM Teaching Methods	Rate the Relevance and Relative Relavance[1] of the GLO (General Learning Objectives) to Chapter 10 of Arens, Elder, and Beasley (13th edition, 2009)								
	GLO1		GLO2		GLO3		GLO4		Total
	5	5/28	8	8/28	8	8/28	7	7/28	28
	Rate the Effectiveness and Relative Effectiveness[2] of the TM (Teaching Methods) to Chapter 10 of Arens, Elder, and Beasley (13th edition, 2009)								S_i Net Subjective Value
TM2	8	8/28	8	8/33	4	4/21	6	6/26	0.232
TM5	9	9/28	8	8/33	6	6/21	7	7/26	0.276
TM7	9	9/28	8	8/33	2	2/21	5	5/26	0.202
TM8	2	2/28	9	9/33	9	9/21	8	8/26	0.290
Total	28		33		21		26		1.000

[1]The instructor rates the relevance of the four general learning objectives (GLO) on a 10-point scale with 1 = least relevance and 10 = most relevance. The EDA generates the relative relevance for each GLO.

[2]The instructor subjectively rates the effectiveness of the TM (Teaching Methods) on a 10-point scale with 1 = least effective and 10 = most effective. The EDA generates the relative effectiveness for each TM.

The EDA generates the net subjective value (S_i) based on the relative effectiveness and relative relevance ratings.

Where:
TM2 = Read worked-out problems/questions
TM5 = Listen to and participate in lecture
TM7 = Write and answer questions
TM8 = Work short numerical problems
GLO1 = Verbal information
GLO2 = Discrimination and concepts
GLO3 = Rules and higher order rules
GLO4 = Cognitive strategies

S_i = Net subjective value for the i^{th} Teaching Method (TM)

The function of Table 3 is for the instructor to rate (a) the relevance and relative relevance of the general learning objectives (GLO) and (b) the effectiveness and relative effectiveness of the teaching method (TM) for Chapter 10 of Arens, Elder, and Beasley (13th edition, 2009). In this illustration,

(a) The instructor rates the relevance[4] of the four general learning objectives (GLO) on a 10-point scale with 1 = least relevance and 10 = most relevance. The EDA generates the relative relevance for each GLO.

(b) The instructor rates the effectiveness[5] of the TM (Teaching Methods) on a 10-point scale with 1 = least effective and 10 = most effective. The EDA generates the relative effectiveness for each TM.

Then, the EDA generates the net subjective value (S_i) based on the relative effectiveness and relative relevance ratings. For example, the net subjective value (S_i) for TM2 is generated as follows:

S_i for TM2 = [(Relative Relevance GLO1)(Relative Effectiveness of TM2 to GLO1) + (Relative Relevance GLO2)(Relative Effectiveness of TM2 to GLO2) + (Relative Relevance GLO3)(Relative Effectiveness of TM2 to GLO3) + (Relative Relevance GLO4)(Relative Effectiveness of TM2 to GLO4)] = [(5/28)(8/28)+(8/28)(8/33)+(8/28)(4/21)+(7/28)(6/26)] = 0.232.

Notice that the net objective values (O_i) in Table 2 and the net subjective factor value (S_i) in Table 3 are normalized to 1.000. This is necessary to preserve the relationship of the objective and subjective values for each teaching method (TM) as compared to all other teaching methods and to ensure that the net objective values (O_i) will be compatible with the net subjective values (S_i).

Sensitivity index$_i$ for a sensitivity analysis

In Table 4, the EDA combines the net objective and subjective values to generate the Sensitivity Index$_i$ for a sensitivity analysis that prioritizes the four teaching methods (TM).[6]

For example, the EDA generates the Sensitivity Index$_i$ for TM2 as follows:

$$\textbf{TM2's Sensitivity Index}_i = C_i [(W) (O_i) + (1 - W) (S_i)]$$
$$= 1[(W) (0.240) + (1 – W) (0.232)]$$

where W is the weight of the net objective values (O_i). The EDA generates the Sensitivity Index$_i$ in Table 4 for the four TM in columns 'When W = 0' (numbers are from Table 3) and 'When W = 1' (numbers are from Table 2).

[4] A rule of thumb for rating relevance is to consider the extent to which each GLO is pedagogically linked to a particular accounting topic.

[5] A rule of thumb for rating effectiveness is to consider the extent to which each TM maximizes students' learning experience of a particular accounting topic.

[6] Bonner's holistic-mapping-process stops at the teaching methods (TM) (see Figures 1 and 2). The EDA goes further to prioritize the TM by performing a sensitivity analysis based on the weight (W) that the instructor assigns to the objective factor value (O_i) (see Figure 3).

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Table 4: Sensitivity Index.
Sensitivity Index = S_i when W = 0, and the Sensitivity Index = O_i when W = 1

Teaching Methods (TM)	When W = 0, Sensitivity Index = Net Subjective Values (S_i)[1]	When W = 1, Sensitivity Index = Net Objective Values (O_i)[2]
TM2 Read Worked-Out Problems/Questions	0.232	0.240
TM5 Listen to and Participate in Lecture	0.276	0.120
TM7 Write and Answer Questions	0.202	0.480
TM8 Work Short Numerical Problems	0.290	0.160

[1] See Table 3 for the Net Subjective Values (S_i).
[2] See Table 2 for the Net Objective Values (O_i).

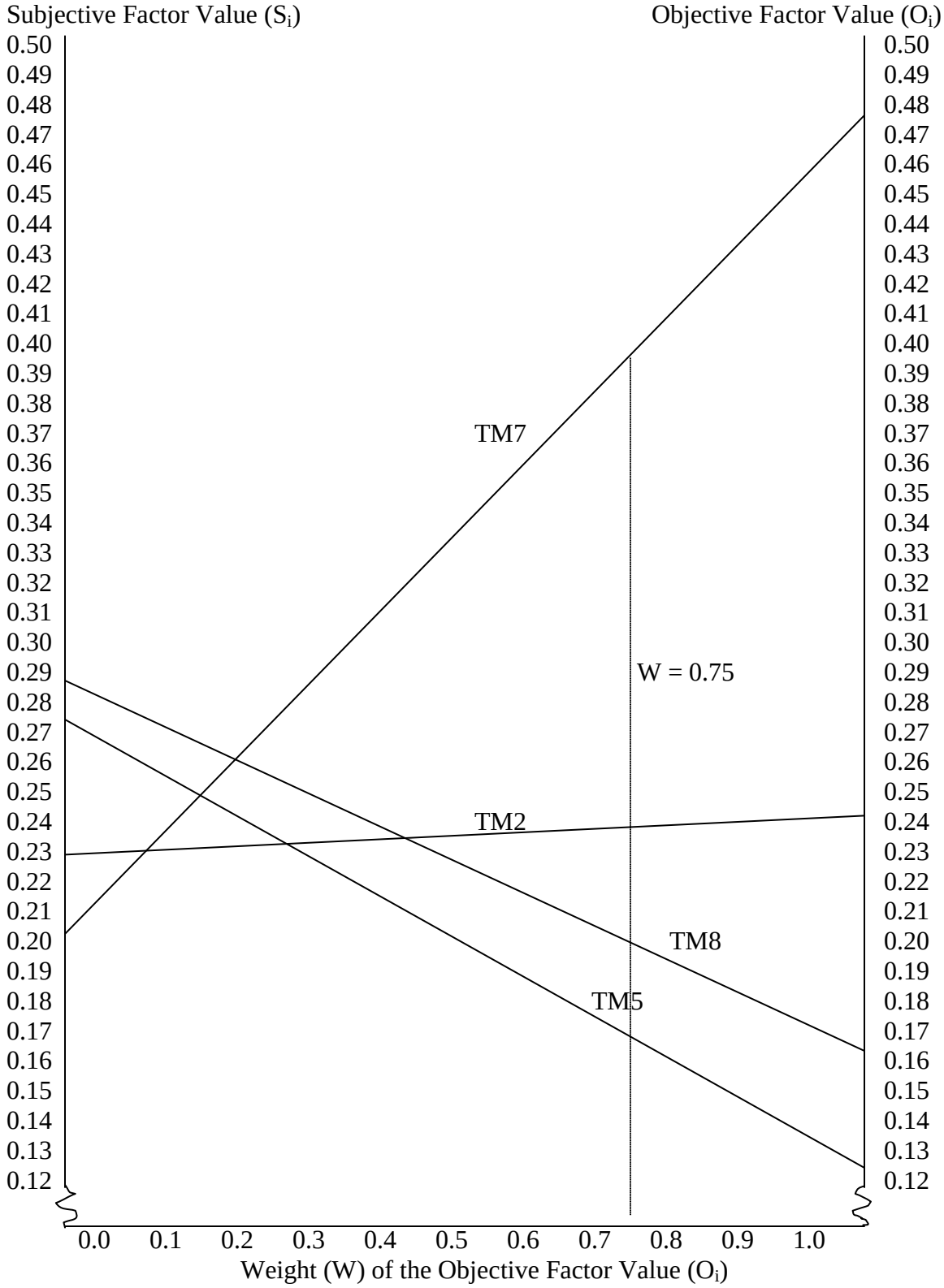
The EDA combines the net objective and subjective values to generate the Sensitivity $Index_i$ for a sensitivity analysis. Where:

W = The weight (importance) of the net objective values (O_i) relative to the weight (importance) of the net subjective values (S_i).

Notice that the weight (W) of the net objective values (O_i) is not assigned by the instructor until the last Table. This is purposely omitted until now to demonstrate how the instructor can perform a sensitivity analysis based on the Sensitivity $Index_i$ by plotting the net objective values (O_i) and subjective values (S_i) of the four TM against the weight (W) of the net objective values (O_i) as four linear functions, which are represented by the four horizontal TM lines in Figure 3. This sensitivity analysis lets the instructor prioritizes the four TM according to the weight (W) he assigns to the net objective values (O_i) by considering the importance of the net objective values (O_i) relative to the importance of the net subjective values (S_i). In this illustration, the instructor judges the objective 'teaching time' value (O_i) to be three times as important as the subjective 'relevance and effectiveness' value (S_i); therefore, the weight (W) of the net objective values is approximately 0.75, which is represented by the vertical line at W approximately equal to 0.75 in Figure 3. The intersections of the vertical W line and the four horizontal TM lines in Figure 3 represent the instructor's prioritization of the four TM in descending order as follows:

TM7 = Write and answer questions
↓
TM2 = Read worked-out problems/questions
↓
TM8 = Work short numerical problems
↓
TM5 = Listen to and participate in lecture

Figure 3: A sensitivity analysis that prioritizes the four teaching methods.



Appendix B provides a detailed account of the instructor applying TM7, TM2, TM8, and TM5 to Chapter 10 of Arens, Elder, and Beasley (13th edition, 2009). Appendix C shows a screen shot of what the instructor enters as the critical values (1 or 0), objective values (1 to 50 minutes), and subjective values (1 to 10 points), and the EDA generates the rest for the holistic-mapping-process of Bonner's conceptual framework. The EDA is available upon request.

CONCLUSIONS

Bonner's (1999, 2008) conceptual framework for planning and teaching involves a holistic-mapping-process in which an instructor holistically maps a set of accounting learning objectives (ALO), general learning objectives (GLO), necessary conditions (NC), and teaching methods (TM). Following Barth's (2008) call for using pedagogical conceptual framework, we plan and teach accounting based on Bonner's (1999, 2008) conceptual framework. Also, following Albrecht and Sack's (2002) call for pedagogical innovation, we develop an Excel planning and teaching aid (EDA) for Bonner's holistic-mapping-process. This EDA assists, but does not replace, the holistic-mapping-process of Bonner's conceptual framework. Also, in congruence with Bernstein's (1996) view on technology, this EDA supports, but does not supplant, the conventional judgment-based planning and teaching process.

The scope of this paper is aimed at developing the EDA for Bonner's holistic-mapping-process. By presenting and making the EDA available, perhaps accounting information systems researchers will be motivated to independently validate the EDA. To date, the EDA's algorithms and specification were validated in terms of the method employed and the results obtained by three accounting instructors (Schipper & Joosten, 1996). However, more independent validation is needed to ensure the EDA's integrity and to increase its level of reliability (Ganesan, 2009). Finally, accounting information systems researchers need to investigate many of the related issues such as comparing the EDA's efficacy/usefulness to conventional planning and teaching process, or assessing its application to other specializations in accounting, such as managerial accounting or taxation (Chen, Monahan, & Feng, 2009; Mashaw, 2009). Ultimately, we hope the EDA is verified to be adequate for Bonner's holistic-mapping-process, to be accurate for planning and teaching accounting, and to be equally useful to other specializations in accounting.

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APPENDIX A

We rewrote Brown and Gibson's (1972) basic equation in pedagogical terms to set up the EDA for Bonner's holistic-mapping-process.

A sensitivity index for each teaching method is defined as:

$$\text{Sensitivity Index}_i = C_i [(W) (O_i) + (1 - W) (S_i)] \quad [1]$$

where:

Sensitivity Index$_i$ = the sensitivity index for the ith teaching methods (TM), where $0 \leq$ sensitivity index ≤ 1,

C_i = the net critical value for the necessary conditions (NC) of the ith teaching method (TM), where $C_i = 0$ or 1,

O_i = the net objective value for the general earning objectives (GLO) of the ith teaching method (TM), where $0 \leq O_i \leq 1$ and $\sum_{alli} O_i = 1$,

S_i = the net subjective value for the general learning objectives (GLO) of the ith teaching method (TM), where $0 \leq S_i \leq 1$ and $\sum_{alli} S_i = 1$, and

W = the weight assigned by an instructor to the net objective value, where $0 \leq W \leq 1$.

The net critical value (C_i) is defined as:

$$C_i = \prod_j CI_{ij} \quad [2]$$

where CI_{ij} is defined as the critical value index for the jth necessary condition (NC) with respect to the ith teaching method (TM). The critical value index for each teaching method is either 1 or 0 depending on whether it meets/not meets the necessary conditions (NC). Note that if any critical value index is 0 then C_i and sensitivity index$_i$ are 0, thus indicating that the teaching method should be excluded from further consideration.

The net objective value (O_i) is defined as:

$$O_i = [OH_i \times \sum_i (1/OH_i)]^{-1} \quad [3]$$

where OH_i is the total objective minutes (teaching minutes) for the ith teaching method (TM). Development of [3] is based on (i) the spread of the minutes spent on each general learning objective (GLO), (ii) the relationship of the total objective minutes (teaching minutes) for each teaching method as compared to all other teaching methods is preserved, and (iii) the sum of objective value (O_i) is equal to 1.

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The net subjective value (S_i) is defined as:

$$S_i = \sum_k (SR_k \text{ x } SE_{ik}) \quad [4]$$

where:

SR_k = the relative subjective relevance of the k^{th} general learning objective (GLO) to an auditing topic, and

SE_{ik} = the relative subjective effectiveness of the i^{th} teaching method (TM) to achieve the k^{th} general learning objective (GLO).

The last term of equation [1] is the net objective value weight, W, which is the importance of the net objective value (O_i) relative to the importance of the net subjective value (S_i). The value of W is determined by the instructor.

The Sensitivity $Index_i$ can now be redefined in terms of the preceding factors as:

$$\text{Sensitivity Index}_i = \{\prod_j CI_{ij}\}\{W \text{ x } [OH_i \text{ x } \sum_i (1/OH_i)]^{-1} + (1\text{-}W) \text{ x } \sum_k (SR_k \text{ x } SE_{ik})\} \quad [5]$$

$$= C_i [(W) (O_i) + (1 - W) (S_i)] \quad [1]$$

A teaching method that receives the highest Sensitivity Index, as defined by [5], has priority over all other teaching methods.

APPENDIX B

We illustrate how an instructor uses the EDA to plan and teach Chapter 10 'Section 404 Audits of Internal Control and Control Risk' of Arens, Elder, and Beasley's *Auditing and Assurance Services* (13^{th} edition, 2009). Below is a detailed account of how the instructor applies I.TM7, II.TM2, III.TM8, and IV.TM5.

Total class time = 1hour 15 minutes.
Time spend on the four TM = 50 minutes.
Time for class interaction and gap-filling = 25 minutes.

I. TM7 Write and answer questions

For homework assignment, the instructor has students prepare written answers for Discussion Question and Problem #10-37 at the back of Chapter 10. In class, he divides students into groups to discuss their answers.

This Discussion Question and Problem #10-37 covers:

1. Discrimination and Concepts GLO2 and Auditing Learning Objectives ALO2 and 3
2. Rules and Higher-Order Rules GLO3 and Auditing Learning Objectives ALO4 and 7

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3. Cognitive Strategies GLO4 and Auditing Learning Objective ALO5.

Discussion Question and Problem #10-37:

Lew Pherson and Vera Collier are friends who are employed by different CPA firms. One day during lunch they are discussing the importance of internal control in determining the amount of audit evidence required for an engagement. Pherson expresses the view that internal control must be evaluated carefully in all companies, regardless of their size or whether they are publicly held, in a similar manner. His CPA firm requires a standard internal control questionnaire on every audit as well as a flowchart of every transaction area. In addition, he says the firm requires a careful evaluation of the system and a modification in the evidence accumulated based on the controls and deficiencies in the system.

Collier responds by saying she believes that internal control cannot be adequate in many of the small companies she audits; therefore, she simply ignores internal control and acts under the assumption of inadequate internal controls. She goes on to say, "Why should I spend a lot of time obtaining an understanding of internal control and assessing control risk when I know it has all kinds of weaknesses before I start? I would rather spend the time it takes to fill out all those forms in testing whether the statements are correct."

(a) Express in general terms the most important difference between the nature of the potential controls available for large and small companies.
(b) Criticize the positions taken by Pherson and Collier, and express your own opinion about the similarities and differences that should exist in understanding internal control and assessing control risk for different-sized companies.

(c) Discuss whether Collier's approach is acceptable under existing auditing standards for either public or non-public companies.

(d) Describe what additional procedures Pherson must perform if auditing the financial statements of a public company.

II. TM2 Read worked-out problems/questions

For homework assignment, the instructor has students read Chapter 10. In class, he randomly selects students to read aloud their answers to 4 of the 29 Review Questions at the back of Chapter 10.

1. Review Question #10-1: Describe the three broad objectives management has when designing effective internal control. This Review Question covers Verbal Information GLO1 and Auditing Learning Objectives ALO1, 6 and 8.

2. Review Question #10-4: What two components of internal control must management assess when reporting on internal control to comply with Section 404 of the Sarbanes-Oxley Act?

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This Review Question covers Discrimination and Concepts GLO2 and Auditing Learning Objectives ALO2 and 3.

3. Review Question #10-6: What is the auditor's responsibility for obtaining an understanding of internal control? How does that responsibility differ for audits of public and nonpublic companies?

This Review Question covers Rules and Higher-Order Rules GLO3 and Auditing Learning Objectives ALO4 and 7.

4. Review Question #10-21: Distinguish a significant deficiency in internal control from a material weakness in internal control. How will the presence of one significant deficiency affect an auditor's report on internal control under PCOAB standards? How will the presence of one material weakness affect an auditor's report on internal control under PCOAB standards?

This Review Question covers Cognitive Strategies GLO4 and ALO5.

III. TM8 Work short numerical problems

In class, the instructor reinforces students' understanding of the relationship between internal control and the audit risk model by working out and explaining Discussion Questions and Problem #9-31 from prior Chapter 9 on Materiality and Risk.

This Discussion Question and Problem #9-31 covers:

1. Verbal Information GLO1 and Auditing Learning Objectives ALO1, 6 and 8
2. Rules and Higher-Order Rules GLO3 and Auditing Learning Objectives ALO4 and 7
3. Cognitive Strategies GLO4 and Auditing Learning Objective ALO5.

Discussion Questions and Problem #9-31:
Following are six situations that involve the audit risk model as it is used for planning audit evidence requirements. Numbers are used only to help you understand the relationships among factors in the risk model.

	Situation					
Risk	1	2	3	4	5	6
Acceptable audit risk	5%	5%	5%	5%	1%	1%
Inherent risk	100%	40%	60%	20%	100%	40%
Control risk	100%	60%	40%	30%	100%	60%
Planned detection risk	-	-	-	-	-	-

(a) Explain what each of the four risks means.
(b) Calculate planned detection risk for each situation.

(c) Using your knowledge of the relationships among the foregoing factors, state the effect on planned detection (increase or decrease) of changing each of the following factors while the other two remain constant:
   i. A decrease in acceptable audit risk.
   ii. A decrease in control risk.
   iii. A decrease in inherent risk.
   iv. An increase in control risk and a decrease in inherent risk of the same amount.

(d) Which situation requires the greatest amount of evidence and which requires the least?

IV. TM5 Listen to and participate in lecture

There is no Powerpoint slide for Chapter10 in the Database of Powerpoint slides accompanying Arens, Elder, and Beasley's *Auditing and Assurance Services,* 13th edition 2009. This instructor makes up 12 Powerpoint slides based on the Instructor's Resource Manual and uploads them into iLearn Learning Management System (similar to Black Board Learning Management System). In class, students listen to and participate in the interactive iLearn lecture, in which the instructor lectures on the twelve Powerpoint slides and the students ask questions of the instructor.
These 12 Powerpoint slides cover:

1. Verbal Information GLO1 and Auditing Learning Objectives ALO1, 6 and 8
2. Discrimination and Concepts GLO2 and Auditing Learning Objectives ALO2 and 3
3. Rules and Higher-Order Rules GLO3 and Auditing Learning Objectives ALO4 and 7
4. Cognitive Strategies GLO4 and Auditing Learning Objective ALO5.

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APPENDIX C

A screen shot of what the instructor enters as the critical values (1 or 0), objective values (1 to 50 minutes), and subjective values (1 to 10 points), and the EDA generates the rest for the holistic-mapping-process of Bonner's conceptual framework. The EDA is available upon request.

Table 1
Critical Values for
All 13 TM

Table 2
Objective Values for
Considered TM and GLO

Table 3
Subjective Values for
Considered TM and GLO

Table 4
Sensitivity
Index

TABLE 1 Critical Values for All Thirteen Teaching Methods							Table 2 Objective Values for Chosen TM & GLO						Table 3 Subjective Values for Chosen TM & GLO								Table 4 Sensit	
TM	NC1	NC2	NC3	NC4	NC5	Status	GLO1	GLO2	GLO3	GLO4	Time	Net O	GLO1	5	GLO2	8	0.286	8	GLO4	7	Net S	W 0.75
TM1	1	1	1	0	1	Eliminate					0	0					0				0.000	0
TM2	1	1	1	1	1	Consider	1	4	3	2	10	0.24		8		8	0.242	4		6	0.232	0.238
TM3	1	0	0	0	1	Eliminate					0	0					0				0.000	0
TM4	1	1	1	0	1	Eliminate					0	0					0				0.000	0
TM5	1	1	1	1	1	Consider	10	5	2	3	20	0.12		9		8	0.242	6		7	0.276	0.159
TM6	1	0	0	0	1	Eliminate					0	0					0				0.000	0
TM7	1	1	1	1	1	Consider	3	2	0	0	5	0.48		9		8	0.242	2		5	0.202	0.41
TM8	1	1	1	1	1	Consider	0	3	8	4	15	0.16		2		9	0.273	9		8	0.290	0.193
TM9	1	0	1	0	1	Eliminate					0	0					0				0.000	0
TM10	0	1	0	0	0	Eliminate					0	0					0				0.000	0
TM11	1	1	1	0	1	Eliminate					0	0					0				0.000	0
TM12	1	1	1	0	1	Eliminate					0	0					0				0.000	0
TM13	0	0	1	0	0	Eliminate					0	0					0				0.000	0
						Total	14	14	13	9	50	1									1.000	

Instructor's Input

Instructor's Input

Instructor's Input

Instructor's Input

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