

## **10-Minute Training: Developing Critical Thinking Skills with Logic Games**

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*Successful auditors must be adept at evaluating various types of evidence, determining reasonable responses to inquiries, and brainstorming possible means of verifying information. Many students have had limited experience with developing critical reasoning and abstract deduction skills that are necessary to be successful. I describe the use of logic games in undergraduate auditing courses to encourage critical thinking and problem solving as well as to increase student engagement. By using brief, non-accounting related logic games, I introduce these concepts to students in an everyday setting that allows them to continue their development outside the classroom. Survey responses and game results for 30 auditing and AIS students show that student game scores improve, and students perceive the logic games help develop their critical thinking abilities. Overall, I believe the logic games are an effective and efficient tool that may be useful in other courses to encourage students to invest more fully into the development of reasoning skills.*

*Keywords: instructional resource, critical thinking, problem solving, teamwork, accounting*

### **INTRODUCTION**

Among the skills and competencies described in the AICPA Core Competency Framework (2017), problem solving and decision making are often the most difficult to develop in a classroom. Academic literature has identified analytical critical reasoning and complex problem-solving (Crawford, Helliard, & Monk, 2011); (Abraham & Jones, 2016); (Willits, 2010) as key areas necessary for future success in practice. Additionally, previous literature has studied the increasing and difficult need to develop student communication skills, including listening (2013). Cultivating these skills generally involves trial and error, which many students are uncomfortable doing in front of other students. One method to address this issue is to use games. This paper describes the use of brief logic games throughout the semester to improve student engagement in problem-solving activities and classroom participation.

The logic games consist of short (under 10 minute) activities that are repeated many times throughout the semester. They are easy to grade, if desired, or simply tracked for classroom participation scores. Instructor preparation involves printing out quiz sheets for class, assigning student pairs, and providing up to 10 minutes for the activity. Once completed, the instructor provides the answer and debriefs difficulties students had reaching it. This setting encourages more involvement as the students receive immediate feedback on how to solve the problems and are given another chance later in the course.

There are many classroom tools to aid students in deriving the maximum benefit from their accounting courses. These include daily quizzes (Braun & Selers, 2012), extra credit opportunities (Westermann & Thibodeau, 2016), interactive lectures (Stone, 2014), and mini-cases (Brenner, Jeancola, & Watkins, 2015), among others. The benefits of these short logic games over other classroom tools is that they do not require any specific topic to have been covered prior to the games, they can be repeated throughout the semester permitting students to monitor their own improvement, they allow collaborative learning, and they provide a means for students to continue their learning outside the classroom.

In the next section, I identify the learning objectives of this training activity. Next, I describe the administration of the logic games in the classroom. This is followed by a summary of student feedback and objective results. The final section provides conclusions.

## **LEARNING OBJECTIVES**

Lifelong learning is one key to success for accounting students and teaching students *how* to learn is a step in that development. Previous literature has discussed the need to incorporate transferable skills into accounting curriculum (Stoner & Milner, 2010); (Willits, 2010); (Crawford, Helliard, & Monk, 2011). Other research has examined factors and tools that contribute to student learning, such as comfort with class participation (Dallimore, Hertenstein, & Platt, 2010); development of listening skills (Stone, Lightbody, & Whait, 2013); the use of concept maps (Simon, 2015); and active learning with immediate feedback (Diaz, 2016).

This training provides opportunities for students to apply and develop critical-thinking, problem-solving, and communication skills in a universal setting. It is vital for students to take the time, both within and outside of class to practice these skills. This approach also teaches students how these skills can be transferable from one subject to another, and encourages them to make connections between various topics, as suggested by Stoner and Milner (2010) and Simon (2015). After using the training activities presented here, students should be able to:

1. Use deductive reasoning to solve structured problems with limited information.
2. Ask probing questions and update assumptions based upon the responses.
3. Brainstorm with teammates regarding approaches to complex questions.

## **THE ACTIVITY**

### **Overview**

I developed the 10-minute-training approach in my undergraduate auditing and advanced auditing courses to develop student deductive reasoning skills in a broader setting. Many students struggle not only with critical thinking, but with translating skills and knowledge to different settings (Stone, Lightbody, & Whait, 2013). Basic auditing concepts in risk assessment, fraud evaluation, and evidence analysis were learned in one semester but seemingly forgotten by the next. Thus, using logic games with no accounting content provided a means of emphasizing the universal nature of many of these skills. This also allows for repetition of the games, as there is no need to match them to course content. The different types of training activities encourage students to avoid memorizing a solution path and instead develop more universal problem-solving skills. The questioning required in the primary activity enables them to improve listening skills and interpretation of non-verbal cues.

### **Instructor Preparation and Implementation**

There are two specific types of games: a student-led 20 Questions game and pre-selected logic puzzles. Given the short nature, they can be administered every class period, weekly, or more sporadically based on instructor preferences. They can be used to begin classes to encourage timely attendance or at the end to wrap up the material. Preparing the games should take less than 15 minutes per week. In fact, the entire semester preparation could be completed prior to the first class. The only

administration time necessary during the semester would be tracking grades or participation. The flexibility of both the material and the frequency allows for minimal effort on the part of the instructor for valuable benefits.

Some of the activities require pairs of students, others can be completed individually. I find mixing this requirement assists all students to get the advantage of teamwork with limited free riding. Typically, the students are assigned to the same pairs each time to benefit from the familiarity; however, this is optional. The instructor should assign pairs (if using them), hand out the puzzles or answer sheets, and give ten minutes for the activity. At the end of the time, the instructor should collect the handouts, provide the solution to the puzzle as needed, and score the student activity. Providing the answer helps students to determine where they struggled or what incorrect assumptions they made. This helps them to improve the next time. To assist instructors, Table 1 presents answer sheet for the 20 Questions game.

I suggest that the first and last training activities consist of the 20 Questions games. These are easy for students to understand, allow for interaction with fellow students, and drive the creativity, critical thinking and listening skills of both parties. Additionally, these games provide students with immediate feedback on their progress. From a preparation standpoint, they are also very simple as only a standardized answer sheet, as provided in Table 1 is needed.

For the other training activities, instructors will need to prepare handouts prior to class. To assist, a list of suggested websites with printable activities is provided below. For the other activities, there are many online sites that provide free games. However, many of these sites provide online-only versions. Below are three sites with a variety of printable free games that can be used by instructors in class. They provide an assortment of types of puzzles and levels of complexity to give instructors flexibility.

- <https://brainbashers.com/logic.asp>
- <https://www.puzzlebaron.com/portfolio-category/printable-puzzles/>
- <http://www.puzzles.com/PuzzlePlayground/NonManipulativePuzzlesHome.htm>

Depending on the frequency of the training activities, instructors may opt for multiple versions of the same activity or a variety of activities. Experience with classroom implementation has shown that students prefer to have several tries at the same type of activity (albeit different actual games) to provide a self-assessment opportunity rather than a single use of each type of activity. Since part of the learning objective with this training is to teach students the importance of taking ownership of their learning, providing several attempts can be helpful to developing this approach.

### **Timing of the Activity**

Class periods can vary noticeably for each course. This variation should be taken into account. Factors such as frequency of class meetings (once per week or multiple times per week), class start time (day or evening), student body composition (commuters or residential students) should be considered when determining the frequency of the trainings and their placement in the class period. I suggest the trainings be administered at least weekly for greatest benefit. However, instructors should consider the trade-off of training activities and lecture time based upon their personal preferences.

I have found that using these training activities at the beginning of class is an efficient method of focusing students on the class and preparing them for the remaining class material. If grading the activities, this has the added benefit of encouraging on-time attendance. However, instructors should consider their students' academic-life issues in determining the practicality of such timing. Given the generic nature of the activities however, using them at other points in the class has benefits as well. The activities take no more than 10 minutes for students to complete, which would provide a suitable break in long class periods or to divide dense lectures. Overall, instructors should determine the timing based upon the class structure and their goals for the course.

### **Scoring**

As discussed above, scoring the training activities is optional. Each activity will provide a physical record to track for participation or assignment grades. If using for participation, instructors may consider

a binary structure (attempted or not) or they may consider a tiered structure (successfully completed, unsuccessfully attempted, not attempted). For assignment grading based upon success, more complex options are available depending on the activity. Note that scoring the activities is generally an inverse calculation as the fewer questions asked or less time needed logically earns a higher score. Because there are two basic types of activities, two different scoring structures will be needed.

For the 20 Questions game, one suggestion for grading is included on the answer sheet in Table 1. It provides for differential grading for the answerer and the questioner. The answerer earns a higher score for each question asked without a successful solution. The questioner earns a higher score for each question (of the 20 possible) not needed, with a minimum score of 50% of the points available for failing to solve the game. I find that this encourages both parties to remain fully engaged as they have competing interests. Other options could include incremental grading (full credit for quick solutions, half credit for slower ones, etc.) for questioners with the reverse for answerers.

For the logic puzzles, grading options vary based upon the type of activity chosen. Some activities may have one solution while others may require several correct answers. Given this variability, I do not recommend a specific grading scheme. However, I have found that students are more willing to work on the training activities if there is a minimum score when they are unsuccessful. This lets them earn something for their effort and encourages them to consider how to improve the score.

Finally, as these are in-class activities, student absences will affect their participation or assignment grade. I explicitly explain that no in-class activities can be made up and include wording to that effect in the syllabus. However, I also take into account the number of times the activity will be used in class to provide some flexibility. For example, I offer the activities in each class for 2 points each. Since I typically teach auditing as a twice weekly course, this provides 28 activities per semester. However, I set the maximum number of points possible for training activities to 40, less than the total available (56) during the semester. This causes occasional student absences, and student struggles with specific activities, to have minimal impact on the grade.

## **STUDENT FEEDBACK**

I collected data regarding students' success on the training activities and their perceptions of the activities in one section of undergraduate auditing and one section of AIS at an eastern university during the Fall 2018 semester. As a secondary measure of the transferability of the skills, I collected data for students in one section of intermediate accounting and one section of managerial accounting at the same university during the Fall 2018 semester. I used a modified version of the Braun and Sellers (2012) questionnaire, the Hess, Haney and MacPhail (2017) questionnaire, the Westermann and Thibodeau (2016) questionnaire, and a review of prior literature to design the survey instrument. I distributed the survey online during the last week of the semester. Students were awarded minimal extra credit for completing the survey.

For those that are unfamiliar with playing 20 Questions or would like a reference to provide students, I recommend <https://www.wikihow.com/Play-20-Questions>. This site provides a simple explanation of the process and strategies for winning the game.

Student performance on the training activities can be compiled in an answer sheet as shown in Table 1 below.

**TABLE 1**  
**20 QUESTION ANSWER SHEET**

**Date:** \_\_\_\_\_

**Answerer:** \_\_\_\_\_

**Questioner:** \_\_\_\_\_

**Questions**

<b>Question</b>	<b>Answer</b>		<b>Game Solved?</b>
1	Y	N	
2	Y	N	
3	Y	N	
4	Y	N	
5	Y	N	
6	Y	N	
7	Y	N	
8	Y	N	
9	Y	N	
10	Y	N	
11	Y	N	
12	Y	N	
13	Y	N	
14	Y	N	
15	Y	N	
16	Y	N	
17	Y	N	
18	Y	N	
19	Y	N	
20	Y	N	

**Object to Identify:** \_\_\_\_\_

**Answerer Score**

<b>Base</b>	<b>+</b>	<b>Total</b>	<b>=</b>	<b>Score</b>	<b>÷</b>	<b>Max</b>	<b>=</b>	<b>%</b>	<b>*</b>	<b>Max</b>	<b>=</b>	<b>Points</b>
		<b>Asked</b>		<b>Earned</b>		<b>Score</b>		<b>Score</b>		<b>Points</b>		<b>Earned</b>
20	+		=		÷	40	=		*	2	=	

**Questioner Score**

<b>Base</b>	<b>-</b>	<b>Total</b>	<b>=</b>	<b>Score</b>	<b>÷</b>	<b>Max</b>	<b>=</b>	<b>%</b>	<b>*</b>	<b>Max</b>	<b>=</b>	<b>Points</b>
		<b>Asked</b>		<b>Earned</b>		<b>Score</b>		<b>Score</b>		<b>Points</b>		<b>Earned</b>
40	-		=		÷	40	=		*	2	=	

The student survey is located in Table 2 below.

**TABLE 2**  
**STUDENT SURVEY REGARDING TRAINING ACTIVITY BENEFITS**

Statement	Strongly Disagree 1	Disagree 2	Neither Agree or Disagree 3	Agree 4	Strongly Agree 5
1. I enjoyed the training activities.					
2. The training activities were understandable.					
3. The training activities helped me understand the need to critical thinking in the accounting profession.					
4. I gained experience completing tasks under time pressures.					
5. As a result of the training activities, I came to class more prepared to begin learning than I would have.					
6. As a result of the training activities, I was better able to answer questions in class than I would have.					
7. As a result of the training activities, I improved my ability to critically approach complex problems.					
8. As a result of the training activities, I was better able to evaluate information than I had been.					
9. As a result of the training activities, I am better able to brainstorm about problem-solving activities.					
10. As a result of the training activities, I learned the course material better than I would have otherwise.					
11. The use of the training activities has had a positive impact on my approach to other courses.					
12. The use of the training activities has had a positive impact on my project and exam grades.					

## CONCLUSION

Success in the rapidly changing auditing profession requires strong critical-thinking, analytical-reasoning, and communication skills as well as the ability to learn new skills and new applications of existing skills. This paper describes the repeated use of logic games to assist students in developing these skills. The training activities take no more than 10 minutes each and do not need to be tied to specific course content. Once completed, students receive immediate feedback on their success and instructors can use the activity to explain the missing steps on the failures. Instructor preparation is minimal and straightforward, allowing instructors to incorporate it into courses in a variety of ways. Overall, I find the flexibility of the training activities provides opportunities to teach students the adaptability of necessary skills. This, in turn, can encourage more self-teaching and improves students' ability to connect material in different classes.

The results of student performance and the survey of student perceptions were completed by 30 students. These show that student performance improved with repetition of the activities. Additionally, the survey responses identified several benefits of the training activities.

This paper describes a flexible tool for encouraging the development of students' critical thinking, analytical reasoning and communications skills. I present evidence of its effectiveness in undergraduate auditing and AIS courses. However, I do not test whether the training activities provide stronger benefits than other available activities. Future research may consider a means of ranking alternative activities based upon their efficacy. Also, this paper notes that many types of logic puzzles can be used in this manner but leaves to future research to evaluate the relative benefits of the different options. Finally, these training activities are designed for in-class administration and have not been adapted to online settings.

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