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Questioning Techniques: Research-Based Strategies for Teachers

Questioning techniques are a heavily used, and thus widely researched, teaching strategy. Research indicates that asking questions is second only to lecturing. Teachers typically spend anywhere from 35 to 50 percent of their instructional time asking questions. But are these questions effective in raising student achievement? How can teachers ask better questions of their students? How can current educational research inform practice?

WHY ASK QUESTIONS?

Teachers ask questions for a variety of purposes, including:

- To actively involve students in the lesson
- To increase motivation or interest
- To evaluate students' preparation
- To check on completion of work
- To develop critical thinking skills
- To review previous lessons
- To nurture insights
- To assess achievement or mastery of goals and objectives
- To stimulate independent learning

A teacher may vary his or her purpose in asking questions during a single lesson, or a single question may have more than one purpose.

In general, research shows that instruction involving questioning is more effective than instruction without questioning. Questioning is one of the nine research-based strategies presented in *Classroom Instruction That Works* (Marzano, Pickering, and Pollock 2001).

One important finding is that questions that focus student attention on important elements of a lesson result in better comprehension than those that focus on unusual or interesting elements. Questions should also be structured so that most elicit correct responses.

TYPES OF QUESTIONS

Educators have traditionally classified questions according to Bloom's Taxonomy, a hierarchy of increasingly complex intellectual skills. Bloom's Taxonomy includes six categories:

- Knowledge – recall data or information
- Comprehension – understand meaning
- Application – use a concept in a new situation
- Analysis – separate concepts into parts; distinguish between facts and inferences
- Synthesis – combine parts to form new meaning
- Evaluation – make judgments about the value of ideas or products

Some researchers have simplified classification of questions into lower and higher cognitive questions. *Lower cognitive questions* (fact, closed, direct, recall, and knowledge questions) involve the recall of information. *Higher cognitive questions* (open-ended, interpretive, evaluative, inquiry, inferential, and synthesis questions) involve the mental manipulation of information to produce or support an answer.

Regardless of the classification, traditional wisdom holds that the higher cognitive questions lead to higher-quality answers and increased learning and achievement. However, the research has mixed

conclusions in this area. Some studies found that higher level questions did indeed produce deeper learning, while others found that not to be the case.

According to some studies, lower cognitive questions (knowledge and comprehension on Bloom's Taxonomy) may be most beneficial for primary students. Lower cognitive questions are also more effective when the goal is to impart factual knowledge and commit it to memory.

This finding does not mean that primary teachers should avoid all higher cognitive questions. Certainly, primary students need to have chances to speculate, imagine, and manipulate the information being presented. Some research, however, suggests that for these youngest students, these questions should be used more sparingly.

Higher cognitive questions (application, analysis, synthesis, and evaluation) should make up a higher percentage of questions asked above the primary grades. Studies show that a combination of lower and higher questions is more effective than the exclusive use of one or the other. Increasing the use of higher cognitive questions can produce superior learning gains for older students, particularly those in secondary school, and does not reduce student performance on lower cognitive questions.

It is important to note, though, that simply asking these kinds of questions does not guarantee higher responses or greater learning gains. Students need explicit instruction in answering these types of questions, including making inferences. This instruction, in conjunction with the use of higher cognitive questions, can positively impact student achievement.

The use of a high frequency (50 percent or more) of higher cognitive questions with older students is positively related to increases in on-task behavior, length of student responses, the number of relevant contributions, the number of student-to-student interactions, student use of complete sentences, speculative thinking, and relevant questions posed by students.

HOW MANY QUESTIONS? WHEN?

How many questions should a teacher ask? And at what point during the lesson? Frequent questioning has been shown to be positively related to learning facts, but simply asking a greater number of questions does not facilitate the learning of more complex material. Just as with higher cognitive questions, it may be necessary to include explicit instruction to promote student learning of complicated concepts.

Teachers often pose questions prior to reading. Research shows that while this strategy is effective for older students, those with high ability, and those interested in the subject matter, it is not as effective for younger students and poor readers, who tend to focus only on the material that will help them answer the questions.

WAIT-TIME

Wait-time is another crucial factor in questioning techniques. Wait-time can be defined as the amount of time a teacher allows to elapse after he or she has posed a question. (A less frequently used and researched definition is the amount of time that a teacher allows to elapse before responding after a student stops speaking.) While traditional wisdom advocates a brisk pace of instruction to maintain interest and cover more material, research shows that slowing slightly to include more wait-time promotes achievement.

In the classrooms studied, the average wait-time after a question was posed was one second or less. Students perceived as slow or poor learners were afforded less wait-time than students viewed as more capable. This amount of wait-time is not sufficient for students, particularly for those that experience difficulty.

Studies show that for lower cognitive questions, a wait-time of three seconds is most effective in terms of achievement. Shorter or longer times were less positively correlated with student success.

For higher cognitive questions, no wait-time threshold was observed. Researchers noted that students seemed to become more engaged and successful the longer the teacher waited (within reason, of course).

Increased wait-time is related to a number of student outcomes, including improved achievement and retention, greater numbers of higher cognitive responses, longer responses, decreases in interruptions, and increased student-student interactions. These outcomes are quite similar to those observed with an increased frequency of higher cognitive questions. In fact, researchers believe that a causal relationship may exist between the two: higher cognitive questions require more wait-time, and more wait-time allows for the implementation of higher cognitive discussions.

FEEDBACK: REDIRECTING, PROBING, AND RESPONDING

A teacher's response to students' answers is just as important as the question asked. A response may redirect students when an incorrect answer is given or students misinterpret the question. Teachers may probe for further explanation when a partial answer is given. Finally, teachers may validate a correct response.

Research in this area shows that redirection and probing are effective when they are explicitly focused on student responses. Vague or critical feedback (such as "That's not right, try again") has been shown to be unrelated to achievement.

Acknowledging correct responses is necessary and effective. Praise that is used sparingly, is directly related to the response, and is sincere and credible is also positively related to student achievement.

IN CONCLUSION

How can teachers make use of these findings? Teachers often have little or no training in questioning techniques, so being familiar with the research is a good place to start. Improving in this area requires a reflective and metacognitive approach. For example, teachers may choose to:

- Plan and write out the questions to be used in a lesson. How many are lower cognitive questions? Higher cognitive questions? Is the percentage appropriate for the age and ability level of your students?
- Anticipate possible student responses, especially partially correct or incorrect ones. How will you probe for further information or redirect?
- Ask a colleague to observe a lesson, paying particular attention to the types of questions and student responses. Meet to discuss the observations and plan for improvement.
- Videotape yourself teaching a lesson. When you watch, record your wait-time for each question. Also note if you provide longer wait-times to certain students. Or examine your feedback. Are you specific and focused on the students' responses?

- Seek out resources and professional development that can help you improve your questioning techniques. If possible, start a study group with colleagues.

https://beyondpenguins.ehe.osu.edu/issue/energy-and-the-polar-environment/questioning-techniques-research-based-strategies-for-teachers

QUESTIONING STRATEGIES

PLANNING QUESTIONS

Effective questioning sessions in classroom require advance preparation. While some instructors may be skilled in extemporaneous questioning, many find that such questions have phrasing problems, are not organized in a logical sequence, or do not require students to use the desired thinking skills.

Levels and types of questions

Questioning should be used to achieve well-defined goals. An instructor should ask questions that will require students to use the thinking skills that he or she is trying to develop. Bloom's Taxonomy is a hierarchical system for ordering thinking skills from lower to higher, where each level requires a student's mastery of the skills below it. It is not essential that an instructor be able to classify each question at a specific level. The taxonomy is introduced as a tool which is helpful for defining the kinds of thinking skills instructors expect from students and for helping to establish congruence between the instructor's goals and the questions he or she asks.

People often refer to "lower-level" and "higher-level" questions or behaviors, rather than assigning a specific level to those questions or behaviors. Lower-level questions are typically at the remember, understand, and apply levels of the taxonomy and are most appropriate for:

- evaluating students' preparation and comprehension
- diagnosing students' strengths and weaknesses

- reviewing and/or summarizing content

Higher-level questions involve the ability to analyze, evaluate, or create, and are most appropriate for:

- encouraging students to think more deeply and critically
- problem solving
- encouraging discussions
- stimulating students to seek information on their own

Typically, an instructor would vary the level of questions within a single class period. For example, an instructor might ask the higher-level question, "How can style of writing and the thesis of a given essay be related?" If she gets inadequate or incorrect student response to that question, she might ask lower-questions to check whether students know and understand the material. For example, she might then ask, "What is the definition of *thesis statement*?" or "What are some characteristics of different writing styles?"

In addition to asking questions at various levels of the taxonomy, an instructor might consider whether he is asking closed or open questions. A closed question is one for which there are a limited number of acceptable answers, most of which will usually be anticipated by the instructor. For example, "What is the definition of an adjective?" An open question is one for which there are many acceptable answers, most of which will not be anticipated by the instructor. For example, "What is an example of an adjective?"

Both open and closed questions may be used at any level of the taxonomy:

	Lower-level	Higher-level
Closed	What are the stages of cell division?	Given the medical data before you, would you say this patient is intoxi suffering from a diabetic reaction?
Open	What is an example of an adjective?	What are some ways we might solve the energy crisis?

STEPS FOR PLANNING QUESTIONS

- Decide on your goal or purpose for asking questions. Your goal should help you determine what levels of questions you will ask.
- Select the content for questioning. Choose material which you consider important rather than trivial. Students will study and learn based on the questions you ask. Do not mislead them by emphasizing less important material.
- Ask questions that require an extended response or at least a "content" answer. Avoid questions that can be answered "yes" or "no" unless you are going to follow with more questions to explore reasoning.
- Until you are quite skilled at classroom questioning you should write your main questions in advance. This is called "scripting." Arrange your list in some logical sequence (specific to general, lower level to higher level, a sequence related to content). Should you think of additional or better questions during the questioning process, you can be flexible and add those or substitute them for some of your planned questions. However, having a prepared list of

questions will help to assure that you ask questions appropriate for your goals and representative of the important material.

- Phrase your questions so that the task is clear to students. Questions such as "What about foreign affairs?" do not often lead to productive answers and discussion. "What did we say about chemical bonding?" is too general unless you are only seeking a review of any material the students remember.
- Your questions should not contain the answers. Avoid implied response questions when you are genuinely seeking an answer from the class. A question such as "Don't we all agree that the author of the article exaggerated the dangers of agent orange to strengthen his viewpoint?" will not encourage student response.
- When planning your questions, try to anticipate possible student responses. Anticipating student responses should help in your planning by forcing you to consider whether the phrasing is accurate, whether questions focus on the goal you have in mind, and whether you have enough flexibility to allow students to express ideas in their own words. You might consider the following:
    - What are some typical misconceptions that might lead students to incorrect answers?
    - Am I asking an open or closed question?
    - What type of response do I expect from students, a definition? Example? Solution?
    - Will I accept the answer in the students' language or am I expecting the textbooks' words or my own terms?
    - What will my strategy be for handling incorrect answers?
    - What will I do if students do not answer?

Handling student responses to questions

An important aspect of classroom interaction is the manner in which the instructor handles student responses. When an instructor asks a question, students can either respond, ask a question, or give no response.

HANDLING STUDENT RESPONSES TO QUESTIONS

An important aspect of classroom interaction is the manner in which the instructor handles student responses. When an instructor asks a question, students can either respond, ask a question, or give no response.

Strategies to use when students respond

- **Reinforcement:** The instructor should reinforce student responses and questions in a positive way in order to encourage future participation. The instructor can reinforce by making positive statements and using positive nonverbal communication. Proper nonverbal responses include smiling, nodding and maintaining eye contact, while improper nonverbal responses included looking at notes while students speak, looking at the board, or ruffling papers. The type of reinforcement will be determined by:
    - The correctness of the answer. If a student gives an answer that is off-target or incorrect, the instructor may want to briefly acknowledge the response, then think of ways to help the student provide a correct answer. The instructor could use strategies such as probing, paraphrasing, or asking the question in a different way.
    - The number of times a student has responded. Instructors may want to provide a student who has never responded in class with more reinforcement than someone who responds often.

      Be sure to vary reinforcement techniques between various verbal statements and nonverbal reactions. Try not to overuse reinforcement in the classroom by overly

praising every student comment. Students begin to question the sincerity of reinforcement if every response is reinforced equally or in the same way.

- **Probing:** The initial response of students may be superficial. The instructor needs to use a questioning strategy called probing to make students explore initial comments. Probes are useful in getting students more involved in critical analysis of their own and other students' ideas. Probes can be used to:
    - Analyze a student's statement, make a student aware of underlying assumptions, or justify or evaluate a statement. ***Instructor***: *What are some ways we might solve the energy crisis?* ***Student***: *I would like to see a greater movement to peak-load pricing by utility companies.* ***Instructor:*** *What assumptions are you making about consumer behavior when you suggest that solution?*
    - Help students deduce relationships. Instructors may ask students to judge the implications of their statements or to compare and contrast concepts. ***Instructor****: What are some advantages and disadvantages of having grades given in courses?* ***Student 1****: Grades can be a motivator for people to learn.* ***Student 2****: Too much pressure on grades causes some students to stop learning, freeze, go blank.* ***Instructor****: If both of those statements are true, what generalizations can you make about the relationship between motivation and learning?*
    - Have students clarify or elaborate on their comments by asking for more information. ***Instructor:*** *Could you please develop your ideas further? Can you provide an example of that concept?* ***Student:*** *It was obvious that the crew had gone insane.* ***Instructor***: *What is the legal definition of insane?* ***Student***: *It was a violation of due process.* ***Instructor:*** *Can you explain why?*
- **Adjust/Refocus:** When a student provides a response that appears out of context, the instructor can refocus to encourage the student to tie her response to the content being discussed. This technique is also used to shift attention to a new topic. ***Instructor:*** *What does it mean to devalue the dollar?* ***Student:*** *Um—I'm not really sure, but doesn't it mean that, um, a dollar doesn't go as far as it used to? Does that mean it's devalued?* ***Instructor:*** *Well, let's talk a little bit about another concept, and that is inflation. How does inflation affect your dollar?*

Strategies for responding to student questions

There are many ways in which an instructor can respond to questions from students. However, all strategies begin with this important step: *Listen to the student's question*. After you are certain that you understand the question, be sure that other students have heard and understood the question. Then proceed with one of the following strategies:

- Answer the question yourself. This strategy is best when you have little time remaining in class. The disadvantage of this approach is that you do not encourage student-to-student interaction or independent learning.
- Redirect the question to the class. This strategy helps to encourage student-to-student interaction and to lessen reliance on the instructor for all information.
- Attempt to help the student answer his own question. This may require prompting through reminders of pertinent previously learned information. Or this strategy may require you to ask the student a lower-level question or a related question to begin his thought process. The advantage of this strategy, as in redirecting, is that the student may learn the process of searching for answers to his own questions rather than relying on the teacher. The risk is that the process can be embarrassing or so threatening that the student will be too intimidated to ask questions in the future. Obviously some human compassion is called for when using this strategy.

- Ask the student to stop after class to discuss the question. This strategy is most appropriate when a student raises complicated, tangential questions or when a student is obviously the only one who does not understand a point and a simple answer does not clarify it for the student. Even in these situations there are risks in using this strategy. Students may be intimidated from raising questions in class. The instructor may think that only the questioning student does not understand when actually a number of students are having the same problem.
- Refer the student to a resource where she can find the answer.
- Defer the question until a more appropriate time if the question is not connected to the material you're covering. *Be sure to note the question and the student, and to return to the question* at a more appropriate time.

No matter which strategy you use you should return to the student after addressing the question and determine whether the response has satisfied the student.

If you don't know the answer to a student question *never fake an answer*. Admit that you cannot answer the question and then select one of these strategies or others you find appropriate:

- Ask whether someone in the class can answer the question. Most times after class you should follow this with an attempt to determine whether the information provided was accurate or based on sound reasoning and credible sources.
- Either propose a plan for obtaining evidence for answering the question or ask the students to suggest how the question could be investigated.
- If possible, suggest a resource where the student can find information. The resource may be written material, another faculty or staff member, a student, or someone from the community.
- Volunteer to find the answer yourself and report back to the class. Make sure you actually do return with the answer if you choose this option.

Strategies to use when students don't respond

- **Redirect:** When a student responds to a question, the instructor can ask another student to comment on his statement. One purpose of using this technique is to enable more students to participate. This strategy can also be used to allow a student to correct another student's incorrect statement or respond to another student's question. ***Instructor:*** *Ali, do you agree with Mark's comment?* ***Instructor:*** *From your experience, Aisha, does what Vito said seem true?* ***Instructor:*** *Li, can you give me an example of the concept that Pat mentioned?*
- **Rephrasing:** This technique is used when a student provides an incorrect response or no response. Instead of telling the student she is incorrect or calling upon another student, the instructor can try one of three strategies:
    - The instructor can try to reword the question to make it clearer. The question may have been poorly phrased. ***Instructor:*** *What is neurosis?* ***Student:*** *(No response)* ***Instructor:*** *What are the identifying characteristics of a neurotic person?*
    - The instructor can provide some information to help students come up with the answer. ***Instructor:*** *How far has the ball fallen after 3 seconds?* ***Student:*** *I have no idea.* ***Instructor:*** *Let's break down the question, Ann. How do we measure distance?*
    - The instructor can break the question down into more manageable parts. ***Instructor:*** *What is the epidemiology of polio?* ***Student:*** *I'm not sure.* ***Instructor:*** *What does "epidemiology" mean?*

- **Using "wait time":** One factor that can have powerful effects on student participation is the amount of time an instructor pauses between asking a question and doing something else (calling on a student or rewording the question). Research on classroom questioning and information processing indicates that students need at least three seconds to comprehend a

question, consider the available information, formulate an answer, and begin to respond. In contrast, the same research established that, on average, a classroom teacher allows less than one second of wait-time. After teachers were trained to allow three to five seconds of wait-time the following significant changes in their classrooms occurred (from Rowe, 1974):

- The number of students who failed to respond when called on decreased.
- The number of unsolicited but appropriate responses increased.
- The length of student responses increased.
- The number of student statements where evidence was used to make inferences increased.
- The number of responses from students identified by the teacher as less able increased.
- The number of student-to-student interactions increased.
- The number of student questions increased.

Allowing wait-time after a student response or question also produced significant changes in classroom interaction. The most notable change was that the instructor made fewer teaching errors characterized by responding illogically or inappropriately to a student comment.

On the other hand, too much wait-time can also be detrimental to student interaction. When no one seems to be able to answer a question, more wait-time will not necessarily solve the problem. Experts say that waiting more than 20-30 seconds is perceived as punishing by students. The amount of wait-time needed in part depends upon the level of question the instructor asks and student characteristics such as familiarity with content and past experience with the thought process required.

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50 Activities for Developing Critical Thinking Skills

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Introduction

Critical Thinking: "What" and "Why"

The Analysis Factor

Today's employee is bombarded with organizational oxymorons. In this age of paradox, we are expected to keep our heads above water shored by contradiction. Learning is a life-long process, yet we are forced to absorb it in machine-gun bursts. Advice broken down into sound bites is offered to us constantly, yet we are asked instead to draw big pictures, envision far-off, uncertain futures, and operate from strategic, well-planned positions. We absorb facts coming at us faster than the speed of light, yet we struggle for the clarity and creativity critical if we are to make wise use of this new knowledge. And we know one thing with certainty: We have to do more with less, and we must do it in far less time.

Continuous learning and the imaginative application of it are needed if the organization itself is to continue. Imaginative thought, described by Tom Peters as the "only source of real value in the new economy," originates with well-informed employees who employ critical thinking to translate knowledge into competitive advantage. By critical thinking, we refer to thought processes that are quick, accurate, and assumption-free. (They are often creative as well.) Such processes help us view, with a critical eye, the problems, decisions, and situations that require appropriate reaction and action.

"Critical," after all, is derived from the Greek word *krisis,* which means "to separate." When life presents us with turning points, when we are faced with situations that require decisive action, when we need plans that will yield positive consequences, then we also need critical thinking. Such thinking allows us to separate ourselves from the crisis that can suck us into disaster and permits us, instead, to forge new pathways to success.

Non-traditional thinking, grounded in traditional, logical thought, enables us to determine exactly what the crisis is and how to move beyond it. Let us use this true story involving a medical crisis as an example.

A middle-aged man called his doctor in the middle of the night. He described the pains his wife was having, diagnosed them as appendicitis (which he himself had experienced), and told the doctor he was bringing the woman into emergency.

The doctor, however, was much less concerned. He diagnosed the problem as stomach cramps, advised the man to give her ginger ale, and suggested that an appointment be made in the morning for an office visit. The man, fortunately, persisted.

Not used to having his medical judgment questioned, the doctor spoke authoritatively: "It *cannot* be her appendix," he declared. "I distinctly remember removing your wife's appendix eight years ago. And I have never heard of a woman having a second appendix!"

Before hanging up and driving his wife to the hospital, the man shot back, "Did you ever hear of a man having a second wife?"

Had the doctor thought more critically, he would have realized the flaws in his logic. He would have used the basic precept on which rational thought is based: The Principle of Identity. This principle would have led him to accept the logic of the statement that no woman can have two appendixes, and then to question the identity of the woman. Had he done so, he would have not only accepted his own statement as true, but would have realized that a second woman could have that second appendix.

Another principle, The Principle of Excluded Middles, asserts that a statement is either true or false—it cannot be both. Thinking about "excluded middles" will help us examine the statements we make and the attitudes we possess, the very fixedness of which can prevent us from solving problems and actually create new ones. A statement like "Leaders such as Adolf Hitler effect positive change" cannot be simultaneously both true and false. This statement is actually predicated on two separate premises, the second of which is questionable:

1. Leaders effect positive change.
2. Adolf Hitler was a leader.

Critical thinking about these two statements requires us to define what is meant by the word "leader" and then to determine if the example of Hitler falls within the established criteria. Critical thinking also requires us to clarify terms that not only confuse but that may create expensive misunderstandings. This sentence, for example, has two possible meanings:

"Your consultant may not charge a fee for his or her location services."

The phrase "may not" could mean "is not permitted to." It could also mean, however, "may not opt to charge a fee, although he or she *could* charge one if he or she wished to."

The Creativity Factor

More than logical, linear thought is required when change slams us into the wall labeled "no established precedent." Non-traditional thinking is required to create the non-traditional systems needed for the non-typical situations that present themselves with ever-increasing rapidity. There are times when breakthrough thinking is the only force that can move us beyond the mundane and into the rarefied stratum of true innovation. With logical thought, we analyze what is there. With creative thought, we contemplate what *isn't* there. "Vision" was defined by Jonathan Swift as "the art of seeing the invisible."

Imagination is what takes vision out of its tunnel. And once freed from a confining place, vision can become an innovation-driven reality. Creative thought is not the private domain of the rare few who are able to see something new when others look at something old. Rather, each of us has an unlimited reservoir of creative potential. Unfortunately, as we mature, we manage to surrender our remarkable ability to envision, an ability Einstein himself regarded as more important than knowledge.

To illustrate, a famous longitudinal study of creative potential followed a group of students over a 17-year period. The *same test* was administered each time to these students. When the students were five years old, 92% of them were found to be "very creative." By age ten, that figure had dropped to 37%. When the children were fifteen, they were tested again. At this age, the number of children deemed "very creative" had dropped to 12%. Finally, the same students were tested in college. How many were found to be "very creative" at this age? Only 2%!

Critical thinkers use both types of thinking, depending on the demands of the situation. The ideal is to be "lateralized" in your thought processes, meaning that you can employ either type of cognition equally well.

Creative thinkers are able to leave behind perfectly logical answers that, unfortunately, are not solving the problems. Instead of persevering, trying to force-fit a round solution into a square problem, such thinkers are willing to explore a different approach. Creative thinkers are risk-takers.

A simple exercise will illustrate what we mean. The following combination of letters represents a sentence from which one particular vowel has been removed. If you can figure out what that vowel is and re-insert it eleven times, in eleven different places, you will be able to determine what the sentence is saying.

VRYFINXMP
LARXCDSW
HATWXPCT

Most problem-solvers soon realize the missing letter is "e," probably because the word "very" seems to jump out at them. They work very hard to construct the sentence with "very" as its first word. "Very" is *not* the first word, however; "every" is. When conviction and determination prevent us from exploring alternative options, we limit our potential for thinking critically. (The whole sentence reads, "Every fine exemplar exceeds what we expect.")

The Speed Factor

Caught in the middle of a veritable knowledge explosion, we find, more than ever before, that (s)he who hesitates may indeed be lost. With amazing frequency, individuals are showing a reluctance, for example, to use so-called snail-mail to transmit their thoughts when electronic mail can connect us with people halfway around the world in mere seconds. This reluctance has its parallel in organizations wary of employing those whose thinking processes move at a snail's pace.

Management guru Tom Peters likes to point out that in 1985, a typical memory chip held a million bits of information. In less than a decade, the number had increased to sixteen million. Projections for the year 2030 include 16 terabits or 16 *trillion* bits of information. As he in his inimitably down-to-earth vernacular expresses it, "We ain't seen nothin' yet."

Speed in and of itself is a necessary, but not sufficient, condition for critical thought. It must be supplemented with either creative or analytical thought—and sometimes with both. Hasty reactions unaccompanied by deliberate thought can have disastrous results at both personal and corporate levels.

The Benefits of Critical Thinking

When crises arise in our personal or professional lives, we are often required to respond quickly. The quick response, however, is always predicated on accurately identifying the problem. Such attention to the input enhances the likelihood that outputs will be positive. This focus on improved outcomes that are faster, better, cheaper and of higher quality is what continuous improvement is all about.

Management studies underscore the need to develop our collective smarts. Consider the following:

> *A recent report by Kepner-Tregoe, Inc. found two-thirds of managers and hourly workers estimating that less than 50% of their collective brainpower was being used by the organizations for which they worked.*

In the Kepner-Tregoe study cited above, only 8% of managers and 7% of hourly workers would compare their organizational thinking to a Ferrari, in terms of quality and speed. However, there is a renewed interest in the subject of learning today. Individuals, teams, and whole institutions are devoting themselves to sharpening cerebral skills. The need to think critically is truly a valuable commodity. In some respects, it is a necessity.

50 Activities for Developing Critical Thinking Skills is designed for decision-makers and problem-solvers who don't always have the luxury of advance preparation.

Given sufficient lead time, most of us could prepare responses or presentations reflective of our abilities, and come up with replies and responses worthy of our backgrounds and training. But what happens when we are called upon to make a statement "on the spot," to make a decision without having all the facts, to solve a problem that will only be exacerbated by delay? Often, we become paralyzed by the urgency of the moment. Our thought processes stop. Our organizational abilities abandon us. But the ability to think quickly and speak quickly formulated thoughts is not an innate ability. *It can be developed.* The exercises in this book parallel Lee Iacocca's advice to would-be executives: "The best thing you can do for your career is learn to think on your feet."

The collection included in **50 Activities for Developing Critical Thinking Skills** also emphasizes creative thinking, and stresses communication skills in keeping with recent research findings. Consultant Andrew Sherwood considers communication and financial knowledge the most valuable of all workplace skills.

Running through the fabric of all these activities, though, are problem-solving threads. Dr. Roger Flax surveyed 1,000 executives and found that the skills most needed among employees were problem-solving, writing, and time management, in that order. It's been said that at the most basic level, everything comes together; it is all intellectually integrated, if we regard life as a series of problems to be solved. Quick thinking, creative thinking, and problem-solving skills *all* help us to think critically.

Format of the Book

The three most important aspects of critical thinking—quick thinking, creative thinking, and analytical thinking—are covered by a series of skill-building exercises.

Quick Thinking. What enables one person to respond to an unexpected prompt fluidly and flawlessly, while another person stumbles and mumbles and fumbles for words? Often the distinguishing factor is that one person does not practice thinking on one's feet, while another person does. The practice exercises in this section are useful, but they are also entertaining. They will develop critical thinking skills—especially important in those situations that force us to keep our wits about us.

Creative Thinking. Unfortunately, many perfectly able problem-solvers damn themselves by declaring that they are not creative and should not be expected to come up with creative solutions. The truth is that we all have creative potential. We may have allowed the potential to be submerged, but it lies within us, nonetheless. The exercises in this section show participants how to strip away layers of self-doubt, self-criticism, and self-cynicism in

order to re-discover their creative cores.

Analytical Thinking. Despite the plethora of problems confronting us on a daily basis, few of us have had formal training in problem-solving. The exercises in this section employ tools

for solving problems logically (based on the scientific approach of defining the problem, generating a list of possible solutions, selecting a solution, and then implementing, evaluating, and making adjustments as needed). The Five-Why tool will force us as problem-solvers to uncover the root cause of the problem, which will lead to a solution that permits expedient and results-oriented action.

For Quick Reference

This matrix sequences the activities as you will encounter them in each of the three sections, specifies the amount of time required for each of the three sections, and specifies the amount of time required for each activity, in terms of minutes. The basic construct of the activities is depicted as well: Individual assignments call for reflection and self-assessments; Tasks for Pairs require participants to work as partners. There are also Small Group exercises, in which three or four participants tackle a problem or challenge together. Finally, there are Large Group activities, asking six or more participants to collaborate.

The Letter "P" designates the need for advance preparation, which is minimal in all cases. The typical advance preparation involves the duplication of materials and the arrangement of seats in ways that are most conducive to participant involvement.

Quick Thinking

Time (min.)	Exercise	Individual	Pair	Small Group	Large Group
20	The Name Game				✓P
15	Attending to Attention			✓P	
25	Rhymed Reductions				✓P
15	The Endless Question		✓P		
20	The Questionable Question			✓	
15	The K-W-I-C Technique	✓P			
15	Verbal Velocity				✓
20	On a Roll with Roles			✓P	
15	Juxtaposed Pairs			✓P	
25	Presidential Pairs				✓P
20	The Umbrage Not Taken		✓P		
5	If the Hat Fits…	✓P			
20	Brainstorming/Brainsqueezing	✓P			
10	Perceptual Shifts	✓P			
15	Table Turning			✓P	

25	Organizational Oxymorons			✓P	
25	Stratification			✓P	

Creative Thinking

Time (min.)	Exercise	Individual	Pair	Small Group	Large Group
15	Particular Virtues				✓P
20	Per Mission				✓
15	Perspicacious Perspectives	✓			
15	Turnarounds			✓P	
20	Peerless Recognition			✓P	
15	(Finger) Food for Thought		✓P		
15	Try! Umph!			✓P	
25	Left is Right. So is Right.		✓P		
25	Ms. Matches and Mr. Matches	✓P			
20	Cre8—GetN2It			✓P	
15	Think Outside the Locks				✓P
15	Thinking Is an Art	✓P			
15	A Kin to Kinesthesia			✓P	
10	Low and High Logos			✓P	
15	Blues on Parade		✓P		
20	Scrambled Pegs		✓P		
25	Ban Banalogies			✓P	

Analytical Thinking

Time (min.)	Exercise	Individual	Pair	Small Group	Large Group
35	Crisis Critiques			✓P	
25	Trend-Spotters			✓P	
30	The Triple-A Approach				✓P
15	"Meta" for You			✓	
20	A Foolery of Fun		✓P		
5+	Whisps and Whisper				✓P
20	Patterned Organization		✓P		
15	Pro 'n' Con'd				✓P
25	Direct Responses				✓P
20	What's on First				✓P
20	In Your Sights				✓
20	Giving Problems a Why'd Berth				✓P
15	Leaning Toward Lao-Tzu			✓	
25	Resource-Full			✓P	
15	Living Problems, Lively Solutions			✓	
25	Mother Necessity, Father Time		✓		

Format of the Exercises

Each activity begins with an *Overview* or brief explanation of what the activity entails and its significance for critical thinkers.

This is followed by the *Objective*, which is written as an answer to the question, "What does this activity do?" Objectives are typically written from the facilitator's or the participant's perspective, but we have chosen to write these as clear statements of purpose.

The *Supplies* listed in the third entry are standard supplies for adult learning situations, inexpensive and readily available in most training rooms.

The *Time* listed is an approximation; it may vary according to the number of participants and their levels of expertise. Allow additional time for optional extended activities (designed to reinforce key points), or when using the debriefing questions that appear at the end of each activity. The activities can be expanded to considerably longer periods when these two optional elements are built in.

Complicated or excessive *Advance Preparations* sometimes discourage a facilitator from using specific activities. For this reason, activities have deliberately been kept simple and user-friendly.

The *Participants/Applications* section provides information on the ideal number of participants and the most appropriate times and places for the activity within the instructional sequence.

The actual lessons begin with an *Introduction to Concept.* These mini-lectures contain background information that permits easy transitions to the concepts being presented. They contain the text the facilitator can use or paraphrase to introduce the lesson. Examples are provided throughout the Introductions when illustrations are required.

The *Procedure* is a sequential listing of the steps to be followed as the activity is conducted. As simply as possible, the facilitator is given information essential to each exercise in order to maximize the effectiveness of the instructions.

Included in the *Procedure* are suggestions for *Extending the Activity.* These will help reinforce the concept being presented or the skill being reinforced, and can be used immediately following the activity or at a later time as a review or refresher exercise.

Workplace Connections are suggestions for extending the learning beyond the classroom.

They encourage the facilitator and the participant to apply the lessons learned to other situations and expand upon the basic concepts presented.

Questions for Further Consideration have been included at the end of each activity in order to strengthen the application between training and the actual work that attendees do when they return to their offices or workplaces. The questions can be asked by the facilitator before the session begins (the list could be sent to attendees several days prior to the start of the course), during the session, or at the end of the session as a means of debriefing and achieving closure. Ideally attendees will continue to ask and answer these questions long after the training program itself has concluded. Three distinct groups of people within any organization will benefit from **50 Activities for Developing Critical Thinking Skills:**

1. Trainers will enrich their presentations by including fast-paced, interactive exercises that stimulate both thought and group cohesiveness, regardless of the topic of the meeting or lecture.
2. Learners will benefit from exposure to a wide array of strategies for framing problems and formulating solutions.
3. Organizations will profit because improved thinking on the part of employees always leads to improved contributions. Intellectual capital that is not capitalized on represents the losses to which Dr. W. Edwards Deming refers: “The greatest losses are unknown and unknowable.”

Adaptability of 50 Activities for Developing Critical Thinking Skills

Although this book was designed with the corporate trainer/facilitator in mind, the activities lend themselves to any classroom setting (from academic settings to the adult training programs offered by public and private businesses). We encourage you to share them with others, whether they sit before you as learners or beside you as co-workers.

To paraphrase Thomas Mann: “The activity, even the most challenging activity, brings us together. It is silence that isolates.” I first alluded to the need for verbal connectedness nearly

twenty years ago, when I left education for a new life and a new career on the West Coast. I wrote then in *The New York State English Record*, "Those of us who are leaving education, temporarily or permanently, may feel a need to break the 'chain reaction' of which Neruda speaks in *Goodbyes:*

Introduction

I spread myself, no question;
I turned over whole lives,

changed skin, lamps, and hates,
it was something I had to do, not
by law or whim,

more of a chain reaction…"

This collection was also something I *had to do.* It permits me to say "Hello" again.

#48: Resource-full

Overview: After exposure to two interesting problems, participants will employ the Force-Field Analysis to focus their thinking on resources that could be tapped in the process of solving a given problem.

Objective: To develop the use of analytical thinking via a structured format.

Supplies:
- Flipchart
- Marking pens

Time: Approximately 25 minutes

Advance Preparation: Draw the Force Field Analysis (as shown in step 4 of the procedure) on the flipchart but keep it covered until the appropriate time.

Participants/ Application: This exercise works with any size group at any point when a cerebral energizer is needed. The exercise can be used to begin a session if a question like this is posed to the group: "What do you envision as the ideal state of affairs as far as [name topic of course you are facilitating] is concerned?" The analysis required by the Force Field Tool can also be related to various discussions that arise during the course of the day. If used as an end-of-session exercise, the question for the group would be, "Where do we go from here?" This question will lead to the broad division of forces (both restraining and driving) that will help participants achieve an ideal state.

Introduction to Concept:

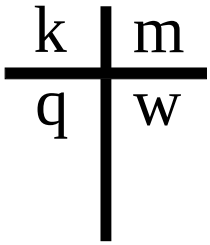
Often, we fail to find the solutions we need because we fail to use the resources we have. We wear blinders, it seems, that prevent us from using what is right in front of us or right inside of us. Or we impose imaginary limits upon ourselves and assume that we are not allowed to proceed in a particular fashion. In truth, though, there are fewer rules or impediments than we think there are.

A good example of how available resources aren't always used to solve an important problem is this one involving a creative engineering class at M.I.T. The instructor had placed two ping-pong balls at the bottom of a metal cylinder, which was bolted to the floor of the science lab. The cylinder was about seven inches wide and about five feet high. The students had one full hour to remove the ping-pong balls from the cylinder. They could not leave the room but were free to use anything in the room. The professor encouraged them to work together, reminding them that if they found a solution, they would all pass the final exam and if they did not, they would all fail. They all failed. Had you been in that room, how would you have solved the problem? [Pause. Elicit solutions.]

Procedure:

1. The answer to the M.I.T. problem is "water," which students could have taken from the faucets in order to float the balls to the top. After challenging the class with the M.I.T. problem, ask participants to solve this next problem. [**Note:** It is important to set up this problem by using a colored magic marker to draw the lines and a different color to draw the letters.

   In the following diagram, which letter does not belong?



2. Call on various participants to explain their answers and then give the correct one: The letter "t," which most people don't even "see," is out of place because it is bigger, thicker, and of a different color than the other letters.
3. Psychologist Kurt Lewin devised a problem-solving tool that asks us to consider the current state of affairs and to juxtapose it with an ideal state of affairs. Having done that, we now consider what driving forces (indicated by a plus sign) will help us achieve the idealized state by using existing resources. Next, we think about the restraining forces (depicted by a minus sign) that may be preventing us from achieving the desired conditions.
4. Continue with this mini-lecture:

   The Force Field Analysis is depicted as a large "T," as you can see here. [Show diagram on flipchart.] *It's a valuable tool for analyzing a problem, ascertaining its causes, and evaluating the resources available for achieving the desired effect. An example of a problem that might be subject to such analysis is the illiteracy rate in America—1 out of 5 adults is functionally illiterate. That is the current status; ideally, there would be no such thing as illiteracy. The next step involves asking what forces could be used to bring us to the ideal state. Finally, we would consider what forces are causing the rate to be so high or keeping us from reaching the idea. By reviewing the two columns, we can next decide the course of action that should be pursued.*

Current state:	20% illiteracy
Ideal state:	100% literacy

Driving Forces (+)	Restraining Forces (-)
government intervention	busy lives
volunteer program	too much television
public service ads	high dropout rates
athletes as mentors	single parent homes
involvement of business community	immigration

5. Divide the class into small groups of four or five and give each team a sheet of chart paper. Have each group identify a problem at the top of the chart paper and report its current and ideal states. The problem could be one currently facing them as businesspeople or us all as a society.
6. Give each group another group's chart paper and ask members to list both the Driving and the Restraining forces for the problem listed.
7. After about 15 minutes, return the papers to the original groups and ask them to add further Driving and Restraining forces and then to select the one force (in either column) that—if they could direct their energies to it—they think could most effect the ideal solution.
8. Call on a spokesperson from each team to report on their selection.

Extending the Activity:

1. Have participants interview one another to learn what special talents/knowledge/abilities they have. Keep a classroom or corporate list of these resources and draw upon various individuals at various times for various projects.
2. Periodically do a brief force field analysis of issues raised by participants that relate to the subject matter of the course.
3. Begin the class with a large force field analysis addressing this issue: *"How can we maximize the investment in training, after the training?"* The current research is discouraging: Less than half of participants in training programs return to work and effect

changes based on the new learning they have acquired. The ideal, of course, would be to have every participant put to use the new skills/concepts they acquired immediately after their return to the workplace.

4. Begin a collection of instances when slavish adherence to rules results in loss to an individual or organization. For example, after transferring to a new school in Seattle, a youngster asked his parents if he could go back to his old school. The reason for his request: The new school did not permit boys to work in the library. The no-boys rule meant considerable intellectual loss for the new school because… the fourth-grader who returned to View Ridge was none other than Bill Gates!

Workplace Connections:

1. If participants have not been asked by their supervisors, "What is the greatest contribution you can make to this organization?" encourage them to at least ask the question of co-workers or team members with whom they work.
2. We sometimes overlook available resources because we have not tapped the wealth of historical precedents. Suggest that participants study what has gone before in order to accomplish what is yet to be. In other words, what has been done in the past that might facilitate the solutions currently being sought or implemented?

Questions for Further Consideration:

1. What rules do you feel should be changed?
2. What do you think Tom Peters means when he says, "If you have gone a whole week without being disobedient, you are doing yourself and your organization a disservice?"
3. What resources—human and other—remain untapped in your organization?
4. Do you agree with author James Fixx, who asserts, "In solving puzzles, a self-assured attitude is half the battle?"
5. Kurt Lewin, originator of the Force Field Analysis method, has a model of change that calls for "Thawing," "Changing," and "Refreezing." Assume you wanted to make some positive change in the workplace. How, what, where, when, and possibly who would you thaw, change, and refreeze?

#49: Living Problems, Lively Solutions

Overview: "Autonomy of object" refers to the problem-solving process of making a problem come alive in order to find a possible solution. Participants will work in small groups to solve a problem of their own choosing in this manner.

Objective: To provide participants with a problem-solving tool.

Supplies: None required

Time: Approximately 15 minutes

Advance Preparation: Arrange the group, if logistics permit, into subgroups of five members.

Participants/ Application: Because this exercise generates lively discussion, it works well as an ice-breaking activity. Applicable to any size group, it can also be used during the training session or at its conclusion. All that is needed for these last two applications would be a problem that arose naturally during the preceding training.

Introduction to Concept:

"Autonomy of object" is a technique requiring the problem-solver to actually personify the problem by placing it in the context of a different time or a different place. Interesting and novel solutions to the problem are frequently embedded within the mental associations we normally make with a particular era.

Let us say that graffiti is a problem in a given neighborhood. If the problem were personified, the graffiti might be seen as a bandit in the Wild West era. The Wild West might make you think of a "posse," and conceivably a posse would be formed to patrol the neighborhood looking for the offenders. This scenario might also make you think of sheriffs. By extension, then, perhaps the police could be asked to patrol more often than they currently do, or could be turned to for advice. Wild west-thinking might also lead you to badges, with their shiny, reflective surfaces. These thoughts could result in an invitation to a chemist to discuss chemicals that might be sprayed on select surfaces to deflect the paint.

Procedure:

1. Begin by listing numerous problems on the board or flipchart. Use problems related to workplace issues, if possible.
2. Prepare a second list, with input from participants, of various eras/locations different from the present. For each era and location, free-associate words related to those times and places.
3. Divide the class into small groups next and ask participants to select a problem and an era or location. They will then devise a possible solution by making the problem come alive (as was done with the graffiti-as-bandit situation).
4. Have the groups share their solutions.

WORKSHEETS

https://www.teach-nology.com/worksheets/critical_thinking/

Is Truthiness Enough? Classroom Activities for Encouraging Evidence-Based Critical Thinking

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Abstract

Teaching students how to think critically and develop lifelong habits of evidence-based inquiry outside of the classroom is a primary goal for educators today. This paper de- scribes nine activities designed to promote evidence-based critical thinking in college or high school classrooms in any discipline. We have developed a seven step process for critical thinking, with teaching modules designed to build skills in these steps in an en- gaging, active way. The modules involve a variety of teaching methods, including use of video, discussion, debate, and homework assignments. We begin with fun, engaging, less emotionally-laden topics such as toys that claim to read brain waves or pictures of ghosts and then progress to more serious topics such as use of medical marijuana and racial pro- filing in airports. The modules were designed to stimulate interest in our students and could easily be modified to encourage students to think more deeply about current issues in the news or local community. There is evidence that these modules can increase moti- vation to think critically outside the classroom (Burke, Sears & Kraus, 2012) and help students evaluate their own belief systems (Burke, Sears, Kraus, & Roberts-Cady, in press). Further, we report on data suggesting that, when combined with deductive reason- ing activities, these modules can boost students' critical thinking skills.

Keywords: Critical thinking, teaching, classroom activities, paranormal beliefs.

Today's students are drowning in 'facts.' They have information readily available at eve- ry moment on their internet-connected devices. Google and Wikipedia alone can answer most questions at the touch of a screen or click of a mouse. Easy access to information makes the memorization of basic facts—once the hallmark of education—largely irrele- vant in the modern world. The vast amount of information available calls instead for hon- ing of different skills. While students are repeatedly reminded not to believe everything they read or see on TV or other media devices, many still consider

on-line open source sites to be acceptably reliable sources of information. Thus, choosing which information merits attention and knowing how to weigh the evidence for supposed ‘facts’ are criti- cally necessary skills for the information age. Consumers of information must be able to delineate between well supported claims and those that rely on ‘truthiness,’ or using a gut-sense feeling instead of empirical evidence or thinking to determine truth (Colbert, 2005). Truthiness is also defined as "the quality of preferring concepts or facts one wishes to be true, rather than concepts or facts known to be true" (Merriam-Webster)

2006). A major challenge for educating young and emerging adults is helping them to develop critical thinking skills that translate beyond the classroom walls and will allow them to make informed choices based more on truth than truthiness (Paul, 2005; Wyer, 2009).

Critical thinking is a complex concept that has been defined in a number of ways, includ- ing as metacognition (Paul, 2005), as logical argument analysis (Watson & Glaser, 2006), and as careful weighing of the evidence to support a claim (Bensley, 1998). While most educators agree that it is vital to teach critical thinking (Flores, Matkin, Burbach, Quinn & Harding, 2012; Wyer, 2009), we do not always agree on the definition or specific skills we are hoping to instill in students (Chenault & Duclos-Orsello, 2008). With this chal- lenge in mind, we set out to create classroom modules that promote critical, empirically- based thinking skills. We based the modules on Bernstein's (2007) five steps for critical thinking. He proposed that students needed to think about the claim ('what am I being asked to believe?'), evaluate the evidence, consider alternative interpretations of the evi- dence, and, finally, draw conclusions. These steps are similar to the subtests in the Wat- son-Glaser critical thinking test (inference, recognition of assumptions, deduction, inter- pretation and evaluation of arguments; Watson & Glaser, 2006). In addition to these con- structs, we sought to address potential barriers to critical thinking, such as biases, emo- tional reasoning, overuse of personal experience or small case studies, and reliance on authority (Myers, 2009) directly in our modules. We therefore created the following sev- en steps to critical thinking as the foundation around which we then designed our class- room teaching modules.

Critical Thinking: Seven Steps

5. What am I being asked to <u>believe or accept</u>?
6. What <u>evidence</u> is available to support the claim?
7. What <u>alternative</u> ways are there to interpret the evidence?
8. Rate the evidence/alternatives on 0-10 scale based on <u>validity/strength</u>
9. What <u>assumptions or biases</u> came up when doing the above steps?
   (e.g., using intuition/emotion, authority, or personal experience rather than science)
10. What <u>additional evidence</u> would help us evaluate the alternatives?
11. What <u>conclusions</u> are most reasonable or likely?

We were aware that students might be initially resistant to focusing on critical thinking, as this type of thinking requires more cognitive effort than simply relying on authority or intuition (Browne & Freeman, 2000). We were thus careful in our design to choose en- gaging and timely topics as well as utilize considerable active learning to optimize stu- dent motivation. We designed nine brief critical thinking (CT) modules for use about once per week throughout the semester. We tested these modules in a wide variety of col- lege psychology classrooms, ranging from introductory psychology to research methods and senior seminar, before ultimately implementing them in a newly designed course called "Critical Thinking in Psychology." The

activities were structured such that, each week, we built upon the steps that had been the focus of the previous week's

example, the first activity centered on identifying claims and evidence, and the next module added in brainstorming about alternative interpretations of evidence. Each mod- ule featured an informational presentation and associated class activity (e.g., discussion, debate, or writing assignments) about a different controversial topic or issue such as med- ical marijuana, whether vaccines can cause autism, ghost photos, racial profiling, dog breed bans, and psychic powers. The topic areas could easily be modified to follow cur- rent debates of interest to students, but we believe that active learning is important to stu- dent engagement in the material. For development of critical thinking, our impression is that scaffolding the seven steps across sessions would be optimal. However, instructors could use and adapt individual exercises depending on the context and goals of their course.

We will discuss several of these modules in depth to illustrate how we present critical thinking in an active way in the classroom, as well as other modules with less detail to provide ideas for you to build from in your own classrooms.

The Modules

Module 1: Star Wars Force Trainer - This module is a stimulating introduction to the steps of critical thinking. We bring a Star Wars Force Trainer to class ($45; Uncle Mil- ton, 2009). This is an educational toy that claims that by "utilizing dry neural sensor technology, the headset reads and interprets your brainwaves" (NeuroSky, 2011). The learning guide that accompanies the toy discusses various types and functions of brain waves and compares the toy to EEG machines that develop relaxed concentration (pre- sumably theta waves). The guide claims that the user's relaxed brain waves cause a small ball to move up a tube attached to the sensor. Students read the material that comes with the toy, along with an article on the future of brain-controlled devices that hypothesizes that the future holds help for Alzheimer's patients and kids with ADHD through these devices that use electrodes to monitor concentration (Hammock, 2009). The students then watch a short clip on YouTube to illustrate how the toy works: http://www.youtube.com/ watch?v=6MFOduNUE8U.

We have students identify the claims the manufacturer is making about the Force Trainer. Encouraging brainstorming of claims before looking at evidence is an important first step to critical thinking, one that is often overlooked in the rush to judgment. Once we gener- ate a list of claims (such as that the machine is accurately reading and interpreting brain waves, and objects can be moved by developing certain brain waves), we ask students to test the device. This is when the fun begins. Many students do think that when they con- centrate carefully the ball is moved farther, and they begin to be convinced that the initial claims might be true. Testimonials from parents of autistic children who claim the force trainer helped their child learn to relate better with others and other YouTube evidence also exist to support these claims.

We then move to step 3, generating other ways to interpret the evidence, as well as ideas for testing alternative hypotheses for how the Force Trainer works (which is part of step 6). These range from trying the Force Trainer on non-animate objects (which

does not

work, supporting the manufacturer's claims) to trying it on dogs (which is possible but difficult, so we push for other ideas) to trying it on things that conduct electricity but do not have brain waves, like root vegetables. Left to brainstorm long enough, most groups develop the idea to try the force trainer on other parts of their own bodies. Not surpris- ingly, most students' knees have the same ability (if not greater) to move the ball 'with the force of theta waves' as their heads. This is an obvious problem for the manufac- turer's claim (we are not aware of any brain waves in our legs) and a memorable lesson in critical thinking. Students learn that there might be multiple explanations for the evi- dence they see with their own eyes, and may start to think that critical thinking can be fun and valuable.

Module 2: Photos of Ghosts - The second module also focuses mainly on identifying claims and thinking of alternative explanations for the existing evidence. We start with a few statistics from a 2011 Rasmussen poll that suggests that 31% of adults believe in ghosts (Rasmussen Reports, 2011). We then show a PowerPoint slide show of supposed ghost pictures and have students evaluate the claims and the evidence. It is important not to skip the first step of evaluating claims. Many students want to simplify the claim to state that ghosts exist, but if prodded, they will recognize that there are more embedded claims, such as that ghosts can be photographed with certain technology. We then move to the evidence of ghosts provided by the photographs. Being skeptical of photos found on the web is second nature to today's students, but we ask them to come up with other explanations beyond Photoshop. In one classic picture of a ghost hugging a child, for ex- ample, the ghost in question could be smoke from the photographer's cigarette. We also discuss optical illusions such as the Muller-Lyer illusion where you 'see' something that does not exist by filling in missing parts of a pattern you expect to find (Muller-Lyer, 1889).

We end this discussion by questioning whether the alternative explanations for the photo- graphic evidence actually mean that ghosts do not exist. When we first ask what we have concluded, often students jump directly to 'ghosts do not exist' but, if questioned, they conclude that ghosts may or may not exist, but they cannot be photographed. Astute stu- dents will point out that we have not actually supported that claim either, and that we simply think that *these* photos are probably not of ghosts. This final discussion is most useful in evaluating claims, evidence, and alternatives, and is an important caution to not over-step one's data. It also introduces the fact that using critical thinking does not neces- sarily mean you cannot believe in paranormal phenomenon—rather, it simply requires you to examine the evidence for your beliefs. As an instructor and scientist, maintaining this openness to possibility is important, especially early in the modules so as not to al- ienate students.

Module 3: Astrology activity - Many students read their horoscope regularly, with some degree of belief in those predictions, so this module is highly relevant for them and may engender resistance if not handled carefully. As with each module, we ask students to brainstorm about the basic claim of astrology (step 1). One simple claim is that personal- ity types are associated with particular Zodiac signs. We ask students to

tell us what evi- dence there is to support this claim (step 2). They generally offer personal anecdotes or

stories in which their horoscope was correct or where the description given based on their birth Zodiac sign has been accurate. Because we have already focused on step 3, alterna- tive ways to interpret evidence, in this module we spend more time discussing step 5, bi- ases and assumptions. We discuss cognitive biases such as illusory correlation (Hamilton & Gifford, 1976) and confirmation bias (Nickerson, 1998; Watson, 1960). We then ask students to brainstorm how they could use the scientific method to test the claim (step 6). After brainstorming about methods, we give students a handout with 12 personality pro- files that come from a book on astrology (March & McEvans, 1982). We ask them to cir- cle the description that best describes their personality. Once they have made their choice, we show them the "correct" answers, that is, which descriptions go with what birthdates according to the astrology book. We then count how many students circled the personality description that is supposed to correspond to their birthdate. As the "correct" answers are revealed, those students who have chosen the right answers rejoice, and those who did not have a match are usually more subdued. We can see the attraction of confir- mation bias clearly. This leads to a discussion of how many students should match before we are convinced that the correct answers represent more than chance. In a class of 25 students, for example, one would expect about two or three to guess correctly if the choices were random since the odds are 1-in-12. We can also discuss how small numbers that occur naturally by chance can be over-interpreted. Students who are really thinking critically will point out that astrology could still be correct, but that our descriptions may have come from a weak source (i.e., outdated book), for which they get bonus points. We end with a brief review of the scientific literature that shows no empirical support for predicting personality using birth dates (Saklofske, Kelley, & McKerracher, 1982; Tyson, 1980).

Module 4: Psychic abilities - In this module, we use a short video clip of Uri Geller to introduce the claims of his psychic abilities (we show the first 6 minutes of http://www.youtube.com/watch?v=M9w7jHYriFo). We then ask students to individually write down what they see as the claim (step 1), the evidence that supports the claim (step 2), alternative explanations for the evidence (step 3), and to create a study design that would fairly evaluate the claim (step 6). After they have each designed a study, we show the students the next 7-minutes from the same video (above) that shows Uri Geller failing to produce results on the Tonight Show. We discuss the ironic finding that after the show aired, belief in psychic ability actually increased. We then visit the James Randi Educa- tional Foundation website (http://www.randi.org/site/), which is devoted to the scientific study of psychic claims. We discuss their one million dollar challenge, which states that "the JREF will pay US$1,000,000 (One Million US Dollars) ("The Prize") to any person who demonstrates any psychic, supernatural, or paranormal ability under satisfactory ob- servation." (JREF, 2012). This challenge has existed since 1964, and well over a thou- sand applicants have tried to win the prize. To date, not one single person has been able to prove their psychic abilities in a scientific test. This website also provides interesting examples of tests designed by the Foundation.

Module 5: Pit bull Ban - In module 5, we start with a newspaper article about

banning pit bull dog breeds in Denver, CO (Kass, 2005). As in the previous module, we have stu- dents write individual answers for step 1, the claim, and step 2, the evidence provided.

We then focus squarely on step 4, evaluating the existing evidence. We write all the evi- dence from the article on the board and have students rank order each statement from most convincing to least. This ranking process, done in discussion with peers, is an effec- tive way to get students thinking about what constitutes compelling evidence and why. The goal for this module is not to come to a conclusion about the pit bull ban, but rather to recognize that we do not yet have enough information to make a decision. We end with a discussion of what additional evidence would be needed to make a fair decision about whether pit bulls should be banned. Note that this module can easily be modified to focus on virtually any currently newsworthy event (e.g., did the FBI or CIA miss something years earlier in the case of the Boston Bombers?).

Module 6: Deal or No Deal – In this module, we focus primarily on step 5, the biases that come onto play when making decisions. We emphasize metacognition here, which is thinking about your thinking. We begin with a clip of the TV game show *Deal or No Deal* at http://www.youtube.com/watch?v=hmZFHjQfx-o and ask students to think about biases that might come into play and lead the contestant to make decisions that they later regret. Screening in over 40 countries, *Deal or No Deal* became an international televi- sion sensation in the 21st century (Deal or No Deal Countries, 2012). Once students are introduced to the game, we show a clip of a contestant who was offered $603,000.00 and ended up with $1.00 (http://www.youtube.com/watch?v=MQ40bwT-0fU), directing stu- dents to pay particular attention to the biases in the advice given to the contestant. We then have students make a plan for how they would make decisions in this game, and ask a volunteer to play the game while other students give them (hopefully) solid advice (http://www.nbc.com/Deal_or_No_Deal/game/flash.shtml). This is an excellent exercise to show how difficult it is to stick to a rational plan in the face of high emotions and peer pressure.

A scientific study of the show (Post, van den Assem, Baltussen, & Thaler, 2008) found that several cognitive heuristics come into play that can explain contestants' decisions. Notably, the *break-even effect* causes losers to take greater risks due to incomplete adap- tation to prior losses, and the *house-money effect* leads contestants who do well in early rounds to make riskier decisions later because the money they currently hold does not seem like it is theirs. Ironically, risky decisions in this instance lead to both the biggest losses AND the biggest winnings in *Deal or No Deal*, while rational strategies typically yield more moderate amounts of prize money. This interactive experience in decision- making may help students identify the pressures that could lead to poor choices in other life situations. Social pressure to stay at a party and drink, for example, often sways stu- dents who have rational plans to get a good night's sleep or study. Students can generate their own examples of situations in which critical decision-making would be valuable.

Module 7: Autism and Vaccines - This module is similar to module 4 on psychic phe- nomena in that we start with a video presentation and evaluate the evidence for the claims. However, in this instance, we are focusing on real-world problems and families

who are making life and death decisions with high emotional load. We show a CBS news segment about a court case in which Michael and Theresa Cedillo tried (and failed) to prove that vaccines were responsible for their child's severe autism

(http://www.youtube.com/watch?v=r0GOkS0uXWE). The video provides a forum for both sides to present their evidence. Students are asked to pay close attention to the types of evidence presented by each side, and weigh strengths and weaknesses of these argu- ments (step 4). Students then draw conclusions and explain what evidence they used to reach those conclusions (step 7). The emotional component of the mother's grief over her child's condition is also discussed, and links can be made to the student's own experience with *Deal or No Deal*. With more class time, instructors could also show Jenny McCar- thy and Jim Carrey, two popular celebrities, discussing their beliefs about the vaccine- autism link on *Larry King Live* at http://www.youtube.com/watch?v=HX-SCdjDOrA; despite the lack of scientific basis for their beliefs, these movie stars have convinced many parents to forego essential vaccinations for their children (step 5). Almost one quar- ter of parents currently believe that vaccines might be dangerous, and, accordingly, child vaccination rates are declining at a rate of 3-4% per year (Nixon, 2010). We invite stu- dents to think about what information they would need to make a sound decision about vaccination for their own families, and, finally, we present scientific evidence that chil- dren who are vaccinated tend to have *lower* rates of developmental disorders, including autism (Andrews et al., 2004).

Modules 8 & 9: Topics in the news: medical marijuana and profiling - These last two modules will be considered together, as they each involve debate methods and are de- signed to get students thinking about real-world controversies and social issues using our seven-step method. The medical marijuana issue is an examination of a recent decision by our college campus to ban the use of medical marijuana, which is legal in our state. We divide the students into two groups based on their initial leaning for or against the ban. Students are assigned to argue the alternate point of view from their own initial reac- tion. Those who do not have strong feelings pro or con are divided in such a way as to balance group size. The homework is for all students to bring in at least three pieces of evidence for their assigned side of the debate (step 2). We then have an in-class debate in which each side presents its case, uninterrupted, using their best evidence. After each group has presented their case, they may directly question each other. Following the de- bate, students are then asked to write an individual essay on their own beliefs, and sup- port their view with evidence (steps 4 and 7). Many mention that arguing a point they did not originally believe caused them to look more closely at the evidence, and many either changed their view, or became more open to the other side's argument. The goal was clearly to formulate an informed decision for themselves while being mindful of the evi- dence used to form this opinion.

The module about racial profiling took the process a step farther. We examined evidence for and against racial profiling, beginning with a discussion of current use of racial profil- ing by airline security, and expert views on profiling by TSA (Press, 2009). We then dis- cussed the case of racial profiling by Maryland State Police (ACLU, 2010) as well as lo- cal profiling by looking at ads in our city newspaper that list "no dogs, no smokers, no students." Many students have had experiences of similar

discrimination, because many landlords believe that students might in fact be worse renters on average. This leads to a lively discussion of when/if scientific evidence trumps moral reasoning. Is it right to pro- file in the name of public safety? Should your 80 year-old grandmother be searched in the

airport as often as a strong young man? Do landlords have the right to only rent to people over 30 years old or people with full time jobs? It is important to note that critical think- ing is one way to answer these questions, but social justice and morality might also be a necessary part of the equation.

Empirical Support for the Modules

We examined the effectiveness of these modules with 128 college students and found that they encourage students to use critical thinking more in their daily lives and to critically evaluate their own beliefs, particularly about paranormal phenomena (Burke, Sears, Kraus & Roberts-Cady, in press). Although our modules significantly reduced paranor- mal beliefs from pre- to post-semester testing, they did not, when used by themselves, change scores on the Watson–Glaser Critical Thinking Appraisal, Form S (WGCTA–FS; Watson & Glaser, 2006), which is primarily a test of deductive reasoning. For an in-depth discussion of these findings and a critique of the current literature examining testing of critical thinking, see Burke, Sears, Kraus & Roberts-Cady (in press).

Because our initial study did not show increases in deductive reasoning skills, in the Spring of 2013, the third author (BLB) modified his "Critical Thinking in Psychology" (CT) course to include 10 minutes per week of deductive reasoning practice along with several of the modules described above and some new ones along student interest (e.g., the value of a college degree, critical thinking of religion). The deductive reasoning prac- tice used problems similar to the Watson-Glaser test although with psychology examples. These problems typically present a short statement with a variety of possible conclusions. Test takers are asked to evaluate the strength of each conclusion and identify assumptions that appear to have been made. Students completed problems individually, and then dis- cussed their answers in small groups, explaining their reasoning to their peers. The entire class later discussed the correct answers.

In this current study, we compared the CT class (n=20) results to those of an introductory math class, which was used as a control group (n=19). Pre and post semester testing in- cluded The Revised Paranormal Belief Scale (RPBS; Tobacyk, 2004; Tobacyk & Mil- ford, 1983) and the WGCTA-FS test of critical thinking skills (Watson & Glaser, 2006).

Mixed model 2(pre/post) X 2(CT/math) ANOVAs with alpha set at .05 were used to ex- amine results. As expected from previous studies of our modules, we found a significant interaction between pre-post measures of paranormal belief and class, $F(1, 35)=9.60$, $p=.004$, $\eta^2=.215$. The math group had pre and post test scores of 84.76 (*SD*=20.86) and
84.97 (*SD*=20.91) respectively. The CT class had pretest scores similar to the math students with an average of 81.85 (*SD*=21.89), but a significantly lower posttest average of 65.85 (*SD*=20.29).

Critical thinking scores also showed significant interactions, $F(1, 32)=5.03$, $p=.03$, $\eta^2=.136$. The math scores on the WGCTA-FS were virtually identical throughout the se- mester, averaging 21.50 ($SD=2.96$) at pretest and 21.29 ($SD=4.53$) at posttest. The CT students started higher, perhaps because they are more advanced students. Their pretest

average was 28.10 (*SD*=5.87) but they also improved significantly over the semester, with a posttest average of 32.30 (*SD*=5.51).

Although these results are preliminary in nature, they show clear promise for our method of teaching critical thinking. It is interesting to note that the students who had the deduc- tive reasoning with the modules increased their CT scores by an average of 17%, while in our previous study, philosophy students, who were trained in deductive reasoning without use of the modules, increased only 8% on average (Burke, Sears, Kraus & Roberts-Cady, in press). It is therefore possible that the active, engaged learning promoted by the mod- ules is useful above and beyond standard deductive logic skill training and may be opti- mal when combined with them.

Conclusions

These modules are suggestions for how to get students to exercise their critical thinking muscles. They can be used individually or as a series of building modules in almost any class—psychology or beyond—that has critical thinking as one of its goals. Each could be adapted to fit the interests of your students and hot topics of the day or of your city/campus. It is our hope that the descriptions of these modules herein will spur teach- ers into creating their own interactive ways to foster more critical thinking in the class- room. Many researchers argue that critical thinking is a vital life skill and lament the lack of effective critical thinking training in higher education (Flores, Matkin, Burbach, Quinn & Harding, 2012; Paul, 2005; Wyer, 2009). Our modules contain the key features pro- posed by Browne and Freeman (2000) for critical thinking classrooms: active learning, developmental tension, and fascination with the contingency of conclusions.

Recent reports suggest that many people are using YouTube as a daily source of news, and that reliance on sources that have no established standards for accuracy is growing rapidly (Pew, 2012). Clearly, students (and society) would benefit from more practice at looking deeper than the surface 'truthiness' of information. Our hope is that this habit of mind will become engrained with repeated practice, and will be used in everyday life such as medical decisions, better informed consumer choices, and political decisions. If educators work together toward this goal, we can encourage a generation of students who know how to think for themselves and do not simply believe whatever they read or see on the internet.

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Extending the Activity:

1. Have a current copy of the local newspaper available. Distribute a section or several pages to each group. Ask them to use the autonomy-of-object procedure to make the problem come alive and then to identify a lively solution for the problem.
2. Discuss the simple technique of *personification,* which makes an inanimate object come alive. Extend the discussion to workplace situations by asking participants to first list issues that concern them, and then to regard those issues from a new perspective by completing one or more of the following prompts:

   "If this problem could talk, it would say…"
   "If this problem could think, it would realize…"
   "If this problem could hear, it would have known…" "If this problem could create, it would have made…"
   "If this problem could be dressed, it would look like…"

Workplace Connections:

1. Ask a group of five supervisors/managers to volunteer to do the following: They will use the autonomy-of-object technique to ameliorate a workplace situation. Then, they will report back to their respective subordinates the success they had with the technique. If it worked well for them, encourage the supervisors to occasionally solve problems this way with their subordinates.
2. A genius has been defined as someone who shoots at something nobody else can see—and hits it. To generate this kind of visionary thinking, ask for a volunteer to call participants at least once during the next six months with this question, *"What are you looking at that no one else can see?"* To be sure, there are no guarantees that such prodding will result in lively solutions. But it may very well increase the number of invisible targets being hit.

Questions for Further Consideration:

1. The autonomy-of-object technique works because it stimulates thoughts we would not have had without the special context in which we place the problem. What other techniques do you know of to stimulate free association or brainstorming?