7 Thinking

Figure 7.1 Games like basketball require many types and levels of thinking. Players and coaches must analyze their opponents' offense and defense, solve problems related to opposing players' skills and their own team's weaknesses, and constantly create through split-second decision making. (Credit: San Francisco Foghorn / Flickr / Attribution 2.0 Generic (CC BY 2.0))

Chapter Outline

Introduction

Student Survey

How do you feel about the ways you think? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning "least like me" and 4 meaning "most like me." These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. I understand how to approach problem-solving.
2. I have creative potential.
3. I often think about how I'm learning
4. I know how to find and evaluate valid information.

You can also take the Chapter 7 Survey (https://openstax.org/l/collegesurvey07) anonymously online.

STUDENT PROFILE

"I never considered myself a problem solver. I was more creative. I wrote music and fiction, and saw myself in a musical theater career. Two years of college and two majors later, I had moved into a related pathway: entertainment management. I was thrilled to find something that suited my passions and gave me a great shot at a number of jobs. But I hadn't counted on the business and math courses I needed to take. Solving these types of problems wasn't in my skill set. I didn't have the background, and kept missing half the ideas. I started going to the academic success center and office hours, and managed to keep my grades in the passing range. But I wasn't excelling and couldn't stay ahead. It was a struggle.

"During a study session, a success counselor noticed that I was approaching a problem all wrong. She helped me for the next hour -- not working on the problem itself, but on how I was thinking about it and others like it. She asked me about the information I knew, how I put it together, and so on. She taught me a progression of steps to analyze the components, get the data I needed, ignore the unimportant information, and run the numbers. Then she had me watch a TED talk (https://openstax.org/l/criticalthinking) with some more information.

"I realized that it wasn't my prior knowledge that was holding me back. It was the way I was thinking about the work. I started asking my professors more about how to approach the courses -- how to think about them. I didn't start getting A's right away, but I did get better results, and even felt more creative as I started to try new things."

About This Chapter

In this chapter, you'll be introduced to different ways of thinking about the way you think. By the time you complete this chapter, you should be able to do the following:

- Describe *thinking* as a process and the reasons it is important.
- Discuss the importance of *creative thinking* and ways of generating original ideas.
- Define *analytical thinking*, its component parts, and outcomes.
- Articulate the process and importance of *critical thinking*.
- Describe the best approaches to *problem-solving*.
- Define *metacognition* and describe ways to become thoughtful about your thinking.
- Define *information literacy* for college students.

Whether we admit it or not or even consider it or not, we cannot stop thinking. We think during intense work situations, while we're playing games, when we eat, as we watch a movie, even during meditation that purports to empty the mind of all thought. Skilled and practiced yogis may be able to get into a state that resembles non-thinking, but most of us keep thinking all the time. Perhaps as you read these lines, you doubt their accuracy suggesting that you don't really think when you're just relaxing with friends. But you do. You may think about the other people in the group and what you do or do not know about them. You may wonder what you'll eat for your next meal. Your mind may flit to question whether you locked the door on the way out. Or you may debate internally whether you'll finish on time the assignment due for one of your classes. Now, you may not act on any of those random thoughts during this relaxing time, but you *are* nonetheless thinking. As you begin this exploration of thinking, consider all the ways we turn to technology to assist with our thinking and how thinking impacts and defines various careers.

When you consider the word *thinking,* does your mind drift toward:

a. School
b. Work
c. Relationships

d. Free time

Reflect on your answer, and write one or two sentences on why you associate this idea with thinking.

In this chapter, we'll look more closely at several distinct types of thinking including creative, analytical, and critical thinking, all of which come into play for problem-solving. We'll also explore the multitude of resources available relative to understanding and enhancing your thinking skills, all of which constitutes metacognition, the practice of thinking about your thinking.

7.1 What Thinking Means

Estimated completion time: 8 minutes.

Thinking is one of those hard-to-pinpoint aspects of life we typically don't analyze much—like breathing or walking or sleeping. We constantly think, and becoming more attuned to how we think and what we do when we encounter new ideas is an excellent habit to pursue.

> **"If you're going to do anything as much as you think, you might just as well learn about it and hone this skill."**

You may have read quotes or inspirational slogans that claim *you are what you think.* What does that mean? Can you *think* yourself into a good mood? Can you *think* you have a million dollars in your pocket? Does that mean you are the next music sensation if you often sing at parties? Not necessarily, but consider Jose, for instance. He isn't a rock and roll star, but Jose spends a lot of his leisure time thinking about music, analyzing performances, memorizing his favorite musicians' characteristics, buying fan clothing, and even designing a creative means to explain his excitement for music to his friends through a homemade video. Jose certainly could allow his fascination to seep into other aspects of his life. Do you have a hobby or interest you spend a lot of time thinking about?

Many people go to great lengths to attend a concert by a favorite music star. They think creatively about how to save enough money for tickets; they think analytically about scheduling their other obligations to have time off work to attend or how to make up work in their college classes. This much planning involves a great deal of thinking, and not all about music. In the example about Jose, thinking directs the actions of the person doing the thinking. So, in fact, what we think *does* influence who we are and how we act. We have many resources available to be more effective thinkers, and learning about these resources gives us options.

GET CONNECTED

Apps and search engines literally bring thinking to our fingertips. Consider how often you visit Google. The use of this familiar site has become so commonplace as to render the proper name of the company into a verb—*to google* a topic. Basic calculators or word-processing software programs are other simple examples of technology we often use without recognizing them as thinking aids.

While apps, software programs, thinking games, and thought exercises may help you stretch your brain, don't let their simplicity fool you into thinking that cultivating an inquisitive, thoughtful mind is easy or automatic. Thinking is as complex as it is necessary for our success in life. Some tools you may find useful are applications that provide challenges using mind puzzles are Peak (https://www.peak.net/) and Elevate (https://www.elevateapp.com/). These training apps offer brain training that varies from quick matching memory games to more sophisticated thought-processing speed scenarios. You can even use a straightforward tool like a flashcard app, such as Chegg Prep (https://www.chegg.com/flashcards), to create

your own thinking games -- using word associations or pictures to help you connect topics and build your skills.

A familiar element of the thinking apps is a progression tracker to help thinkers improve their focus and memory as well as to learn and practice math and verbal skills over time. Researchers are still investigating the correlation between thought-invoking game playing and the decrease in mental agility, memory, and cognitive vitality. Early studies have produced numerous findings, including a long-term investigation of the onset of Alzheimer's disease conducted with nuns; you can look up the *Nun Study* to learn more, or go to this article (https://openstax.org/l/nunstudy).

7.2 Creative Thinking

Estimated completion time: 28 minutes.

Questions to consider:

- How can you go about generating original ideas?
- What is the best way to approach working with unconventional ideas?

Has anyone ever told you that you have a flair for the creative? If so, celebrate! That's a good personality trait to nurture. Creativity is needed in all occupations and during all stages of life. Learning to be more in tune with your own version of creativity can help you think more clearly, resolve problems, and appreciate setbacks. You're creative if you repurpose old furniture into a new function. You're also creative if you invent a new cookie recipe for a friend who has a nut allergy. And you're using creativity if you can explain complex biological concepts to your classmates in your lab class. Creativity pops up everywhere. When creative thinking comes into play, you'll be looking for both original and unconventional ideas, and learning to recognize those ideas improves your thinking skills all around.

Would you learn more about the French Revolution by eating foods popular in that era? What if you were to stop using your phone for all non-emergency communication to understand how news flowed in the early 20th century? These examples present creative ways to approach learning the experiences of a specific time in history. When actors want to learn about a character they'll be playing, they often engage in method acting to immerse themselves in the role. They may maintain a different accent or wear only clothes their character would wear even when they are not at rehearsals, all so they can feel what it was like for their character. Think of ways you may be able to apply method acting to your learning experiences.

WHAT STUDENTS SAY

1. Which type of thinking do you think is most important for your academic studies?
   a. Creative thinking
   b. Analytical thinking
   c. Critical thinking
2. In which area do you have the most difficulty being creative?
   a. Writing
   b. In-class discussions/activities
   c. Personal life
   d. Problem-solving

e. Finding resources/help

3. In which course areas or activities do you make the most use of problem-solving skills?
   a. Math or quantitative classes
   b. Computer or technical classes
   c. Social science classes
   d. Real-life situations

You can also take the anonymous What Students Say (https://openstax.org/l/collegesurvey6-12) surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

Which type of thinking do you think is most important for your academic studies?

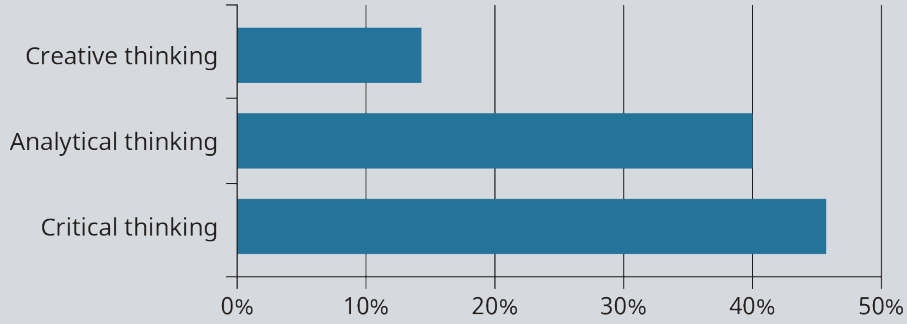

Figure 7.2

In which area do you have the most difficulty being creative?

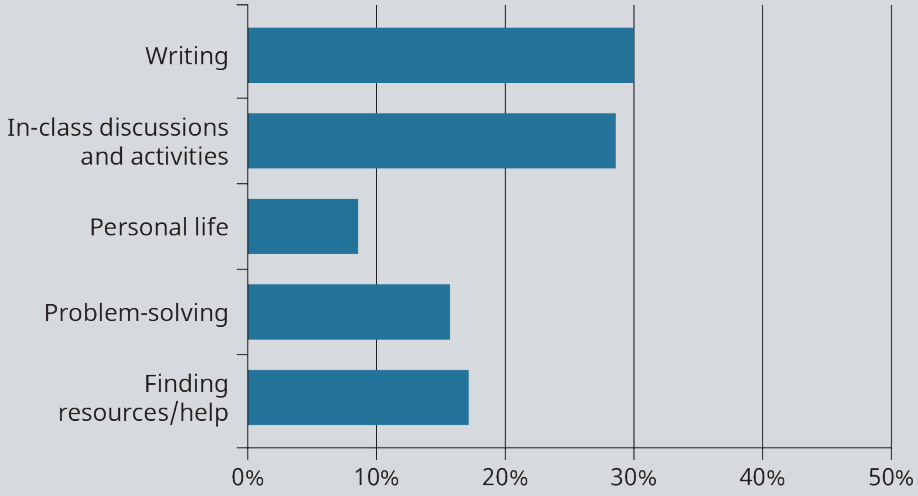

Figure 7.3

In which course areas or activities do you make the most use of problem-solving skills?

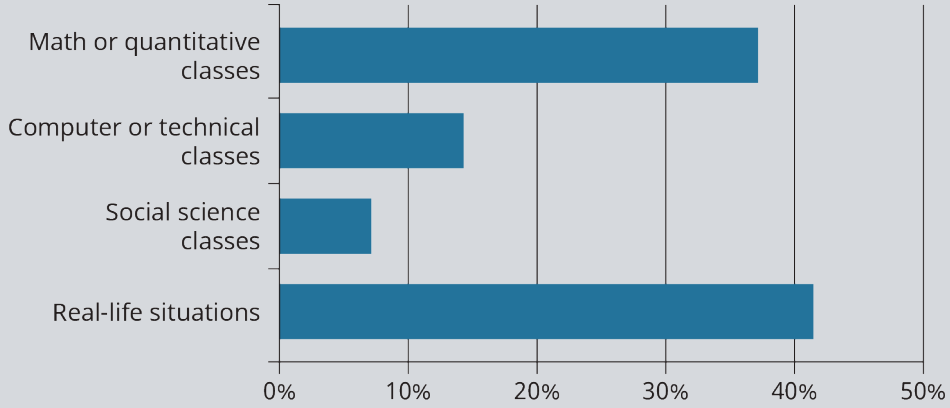

Figure 7.4

ANALYSIS QUESTION

In what ways could thinking creatively help you be a better student? Write a one-paragraph reflection on that aspect and how you could realistically go about being more creative.

ANALYSIS QUESTION

Some people say creativity is the realm of children. Can you think of how a child's curiosity and willingness to explore may help you understand a college discipline that is unfamiliar to you now? Write a one-paragraph reflection on how you could use curiosity toward one of your most difficult courses in college.

Creativity doesn't always present itself in the guise of a chart-topping musical hit or other artistic expression. We need creative solutions throughout the workplace—whether board room, emergency room, or classroom. It was no fluke that the 2001 revised Bloom's cognitive taxonomy, originally developed in 1948, placed a new word at the apex—*create.* That is the highest level of thinking skills. As noted in previous chapters, we do all need to use and develop the lower thinking skills that include remembering, applying, and analyzing, but true intelligence and successful thinking move beyond these levels to invention.

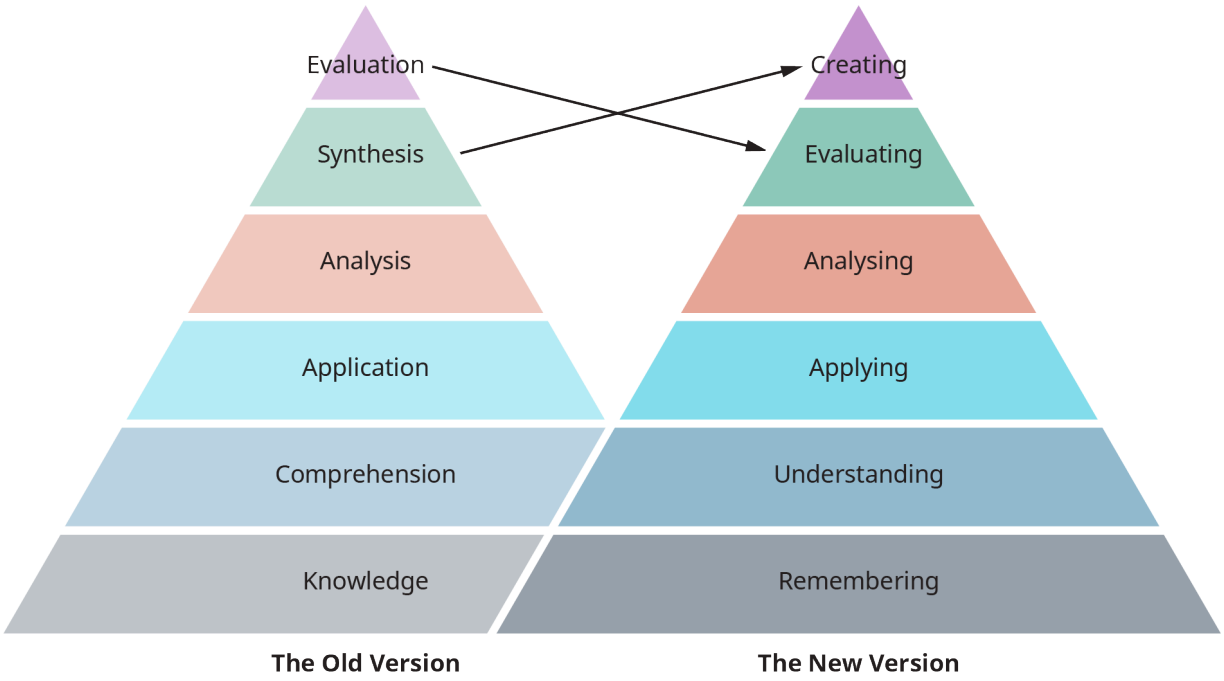

Figure 7.5 Bloom's Taxonomy is an important learning theory used by psychologists, cognitive scientists, and educators to demonstrate levels of thinking. Many assessments and lessons you've seen during your schooling have likely been arranged with Bloom's in mind. Researchers recently revised it to place creativity -- invention -- as the highest level.

Regurgitating the minute details of *Goldilocks* or *Beowulf* demonstrates far less comprehension than fashioning an original ending that turns the tables or developing a board game from the story. Author Gregory Maguire used the base plot of L. Frank Baum's 1900 book *The Wonderful Wizard of Oz* and the 1939 movie *The Wizard of Oz* to create the smash-hit 2003 Broadway musical *Wicked* that tells the story from the perspective of the Wicked Witch of the West, making her a sympathetic character. This creative approach calls for far more critical and creative thinking than memorizing facts.

> **"Creating new out of old or new out of nothing is how we ended up with manned space flight, cell phones, the Constitution, and rap music."**

Continuing to support creativity in whatever form it takes will be how we cure cancer, establish peace, and manipulate the time-space continuum. Don't shortchange your own creativity.

Generating Original Ideas

Nineteenth-century American writer and humorist Mark Twain may have been partially correct when he said:

> There is no such thing as a new idea. It is impossible. We simply take a lot of old ideas and put them into a sort of mental kaleidoscope. We give them a turn and they make new and curious combinations. We keep on turning and making new combinations indefinitely; but they are the same old pieces of colored glass that have been in use through all the ages.
>
> (*Mark Twain's Own Autobiography* by Mark Twain)

Figure 7.6 You may feel like you cannot come up with new ideas, but even the process of combining and recombining familiar concepts and approaches is a creative act. A kaleidoscope creates a nearly infinite number of new images by repositioning the same pieces of glass.

It is certainly a pretty metaphor of idea generation, but even if old ideas are reworked to create new solutions to existing problems or we embellish a current thought to include new ways of living or working, that renewal is the epitome of the creative process.

It's common to think of creativity as something used mostly by traditional artists—people who paint, draw, or sculpt. Indeed, artists are creative, but think of other fields in which people think just a little differently to approach situations in their discipline. The famous heart surgeon Dr. Denton Cooley didn't have an exact model when he first implanted an artificial heart. Chemist Stephanie Kwoleck discovered life-saving Kevlar when she continued work on a substance that would usually be thrown away. Early US astronauts owed their ability to orbit and return to Earth based on creative uses of mathematics by people like Katherine Johnson. Inventor and actress Hedy Lamarr used diagrams of fish and birds to help aviation pioneer Howard Hughes produce faster airplanes. Indeed, biomimicry, an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies, is now a huge field of study. This list could go on and on.

Figure 7.7 Denton Cooley (Credit: Texas Children's Hospital / Public Domain), Stephanie Kwolek (Credit: Chemical Heritage Foundation / Attribution 3.0), Katherine Johnson (Credit: NASA / Public Domain), and Hedy Lamarr (Credit: MGM / Public Domain). These individuals employed extensive creativity in the fields of science and math, leading to significant discoveries and accomplishments.

ACTIVITY

Work with two or three classmates to determine a product or service you could develop. Think of a situation in your life where a new way of doing something or a not-yet-invented process or device would make your life easier, more convenient, or more purposeful. And this is not limited to the creation of something big. Just looking at something you see all the time with a different lens/perspective is also creative, and we can all do that. What adaptation would you need to make? Let your imagination go wild—driverless cars, wireless communication . . . oh wait, already here. Keep thinking! Each member of your group should write a paragraph that describes the product/service, what you would need to create it, and how it will be received by others. Read each other's paragraphs and discuss the merits of the ideas.

You may actually be very good at coming up with original creative ideas. Some people naturally seem to think more creatively than others, but we all have the capacity to create and devise. Do you enjoy rearranging furniture or organizing your closet? If you already think "I could make that so much better!" as you walk through shops or events, you're on the right track. Do you tinker with wood, paper, yarn, or dirt? Are you a doodler? One way to enhance your creativity is to track your ideas. You can keep a running list on your phone, jot down ideas on index cards you can later sort into categories, or keep ideas flowing in a paper journal. Some creative people design storyboards to visualize goals or projects using pictures from magazines or online for creative inspiration. Play around with ways to keep up with ideas you may be able to incorporate in some various aspects of your life.

Since the 1980s, Roger von Oech, the president of Creative Think, a California consulting firm, has been encouraging employees in corporations, educational institutions, and government agencies to think more creatively. His pithy stories, examples, scenarios, and challenges present either a barrier to creative thinking that needs to be overcome or an example of how to harness seemingly unproductive ideas. Sometimes creative ideas do not initially seem viable or productive compared to a known process or product, but talking out ideas with others and considering new approaches without fear of ridicule or censure can help individuals and groups think beyond the status quo. Von Oech's discussion starters recommend that thinkers *Avoid Arrogance, Fight for It, Get Rid of Excuses,* and *Listen to That Hunch.* You may find some of von Oech's ideas a little out of the ordinary, but great ideas sometimes are, and thinking about them in a different way may be the spark you need to come up with your own version of an idea that will prove effective for you. Stay open to different approaches even if you aren't immediately comfortable with the ideas.

Another creative thinking group you may be interested in investigating is koozai.com, a digital marketing consulting firm based in the United Kingdom with clients worldwide. You may not be in need of help with digital marketing, but the koozai.com website is worth a look to see how creativity can highlight excellent customer service, detail award-winning services, and inject a sense of fun and vitality into a service that may not seem very exciting on the surface, namely helping companies optimize their web presence for increased exposure and profits. The team is a creative mix of engineers, designers, and analysts who use data-based evidence to find the right fit for their clients in a relaxed and productive environment. The actual nuts-and-bolts work involved in web marketing involves a great deal of tedious coding and specialized web design often performed by software engineers working alone, but you don't get a sense of bored, isolated office workers when you peruse the koozai.com site.

Working with Unconventional Ideas

Working with unconventional ideas can produce anxiety because the ideas are unfamiliar and the results of implementing these ideas could be unpredictable. People may not immediately accept your nontraditional ideas. Some may never accept them. If your original creation were to require individuals to give up their

current cell phones, you can imagine the resistance. Even if the new idea is an improvement in communication, some people would hesitate.

To work in this possibly uncomfortable realm, you have to remain open-minded, focus on your organizational skills, and learn to communicate your ideas well. If a coworker at a café where you work suggests serving breakfast in addition to the already-served lunch and dinner, keeping an open mind means thinking through the benefits of this new plan (e.g., potential new customers, increased profits) instead of merely focusing on the possible drawbacks (e.g., possible scheduling problems, added start-up costs, loss of lunch business). Implementing this plan would mean a new structure for buying, workers' schedules and pay, and advertising, so you would have to organize all of these component areas. And finally, you would need to communicate your ideas on how to make this new plan work not only to the staff who will work the new shift, but also to the public who frequent your café and the others you want to encourage to try your new hours.

"Because we've always done it that way" is not a valid reason to not try a new approach. It may very well be that the old process is a very good way to do things, but it also may just be that the old, comfortable routine is not as effective and efficient as a new process could be.

Can you think of any routine task you do now that you've never questioned, such as doing laundry, studying for exams, spending downtime, or preparing food? Consider how you came to learn this routine. Are you following a pattern your parents set for you growing up? Do you ask friends how they perform these tasks and follow their example? How well do these routines work for you? Think of at least one different way you could approach one of these tasks. Would it be a good idea to change the way you do it? How would that benefit you? If not, why is the best approach to keep doing this thing the way you have always done it? Reflect on your thinking behind this routine. How could creative thinking help you identify and assess all of your options?

Another element of working with unconventional ideas is to pay attention to how you organize your thoughts. Organizing includes establishing a clear goal to accomplish, outlining the steps toward that goal, and monitoring progress with specific deadlines. You may be able to add flexibility to this plan since creativity deals in the unknown and that may take longer than you initially expected, but an organized map of your thinking and where you hope to take it can move creative projects forward.

For example, what if you were asked to build a shed for a project or as part of your job? You would need a plan of some sort. It wouldn't be prudent to run to the hardware store and just buy various supplies you see on the spur of the moment. Rather, you would organize your thoughts around this project and determine some specific goals about the size of the shed, its ultimate location and use, the type of materials that would best serve your purposes, and how long the project will take so you can budget time and money toward the accomplishment of the goal. Do you need a building permit in your area for this sort of home improvement project? Will you or others need to sacrifice something (yard space, time, money, a special view) for you to build this shed? Do you have time to complete all the steps? Do you have the skills to put the shed together, or can you learn how to do it? How much are you willing to spend on this? Without an organized plan, you may end up with a good idea, some random supplies, and an incomplete building project that wastes both time and money and does not meet your initial expectations.

Figure 7.8 Thinking through a plan isn't just for school. Household activities and projects require forethought and strategic thinking. (Credit: TWP, Inc. / Flickr / Attribution 2.0 Generic (CC BY 2.0))

In addition to the need to remain open-minded and organized, creative thinking calls for a dissemination plan. Unconventional ideas typically don't get off the ground without the creator of the ideas communicating those thoughts to others. Do you set yourself up to be in the company of other creative thinkers? It's not a bad idea. Creativity is somewhat contagious. You may not think you have a creative way to approach a situation, but if you were to bounce ideas off like-minded friends and also friends who would offer a completely different way of looking at something, you may discover that indeed you do have some good ideas ready to come to fruition. This creative brainstorming doesn't just happen though. You need to set aside specific times to work with others to flesh out ideas and think through obstacles. And then you'll need some more time alone for the ideas to gel. Sometimes the creative answers to problems come to you at odd moments once you have laid the groundwork—be ready to capture the ideas in some form of note when your lightbulb goes off.

Creative thinking isn't just helpful in solving problems. You may want to enhance an otherwise good plan to make it fantastic and memorable, which is when you can bring in creative thinking. If you want to surprise your best friend with a special birthday celebration but are low on funds, you could think of creative ways to make this event one to remember. You could take in a free museum night or window shop at the mall or make a photo collage from pictures on your phone that bring back great memories.

ACTIVITY

What is one of your favorite creative projects that you've recently accomplished? What made it creative? Ask at least one other person that same question and see if his or her answer inspires your own creative thinking on how to handle these situations:

- living with roommates who have different priorities or interests
- breaking away from family and old friends without severing ties all together
- determining if the major you initially chose really fits your personality
- scheduling your time for study, campus activities, work, and personal interests
- ensuring your assignments, presentations, or class artifacts show your best work

Think of ways you may approach these situations.

Creative Process Applied to a Sample Campus Activity

Creative Process Step	Description and Notes
Problem to Solve or Item/Work to Create	**Create a new logo for our Commuter Student Association**
Requirements and Needs	• Will be used on Insta/Twitter, merch, print • Must incorporate school colors but be readable in grayscale • Must be understandable at large and small sizes (computer/phone)
Parameters and Limitations	• Cannot look like other logos on campus • Cannot use photos-illustration only • Timeline: 7 weeks (in time for next year's college catalog) • Budget: $450
Inspiration and Ideas	• Look at Commuter Association logos from other colleges. • Look at city and state transit logos. • Go to library to look at our school's old yearbooks.
Resources/Knowledge	• Graphic design • Copyright info (consult student govt) • Market research
Dissemination and Brainstorming	• Create a survey for all our commuters • Launch a contest for ideas and submissions? • Share drafts with advisor for approval. • Talk to graphic design club?
Implementation Plan	• Samples needed in 3 weeks. From there: • 1 week for survey feedback • 1 week for improvement • 1 week for additional feedback on final candidates • 1 week for finalization and approval
Reflection and Revision	• Ask all new club members in Fall for feedback. • Consider improving logo during Spring semester next year.

Table 7.1 Creative processes should include a plan that considers the goals of the project and provides opportunities for brainstorming and feedback. The steps in this table may not work for everyone, but you can use them to think about what is needed in a process of your own. See the student resources for a blank version you can adapt.

7.3 Analytical Thinking

Estimated completion time: 18 minutes.

Questions to consider:

- How can you best establish component parts in thinking?
- How can you use analysis to improve efficiency?

Thinking helps in many situations, as we've discussed throughout this chapter. When we work out a problem or situation systematically, breaking the whole into its component parts for separate analysis, to come to a solution or a variety of possible solutions, we call that *analytical thinking.* Characteristics of analytical thinking include setting up the parts, using information literacy, and verifying the validity of any sources you reference. While the phrase *analytical thinking* may sound daunting, we actually do this sort of thinking in our everyday lives when we brainstorm, budget, detect patterns, plan, compare, work puzzles, and make decisions based on multiple sources of information. Think of all the thinking that goes into the logistics of a dinner-and-a-movie date—where to eat, what to watch, who to invite, what to wear, popcorn or candy—when choices and decisions are rapid-fire, but we do it relatively successfully all the time.

Employers specifically look for candidates with analytical skills because they need to know employees can use clear and logical thinking to resolve conflicts that cause work to slow down or may even put the company in jeopardy of not complying with state or national requirements. If everything always went smoothly on the shop floor or in the office, we wouldn't need front-line managers, but everything doesn't always go according to plan or company policy. Your ability to think analytically could be the difference between getting a good job and being passed over by others who prove they are stronger thinkers. A mechanic who takes each car apart piece by piece to see what might be wrong instead of investigating the entire car, gathering customer information, assessing the symptoms, and focusing on a narrow set of possible problems is not an effective member of the team. Some career fields even have set, formulaic analyses that professionals in those fields need to know how to conduct and understand, such as a cost analysis, a statistical analysis, or a return on investment (ROI) analysis. You can learn more about these in Chapters 4 and 12.

ACTIVITY

Generate a list of at least two courses you are taking now that you think would routinely practice analytical thinking. Now, think of the profession you are interested in joining. How could the deliberate use of analytical thinking processes be beneficial for that career field? What are you currently learning about in your courses that apply directly to your chosen career path? Think of at least two ways analytical thinking would be used in the career field you are pursuing.

Establishing Component Parts

Component parts refer to the separate elements of a situation or problem. It might include the people involved, the locations of the people, the weather, market fluctuations, or any number of other characteristics of the situation you're examining. If you don't identify all parts of a problem, you run the risk of ignoring a critical element when you offer the solution. For example, if you have a scheduling problem at home and seem to never see your loved ones, the first step in thinking through this problem analytically would be to decide what is contributing to this unfavorable result. To begin, you may examine the family members' individual work, school, and personal schedules, and then create a group calendar to determine if pockets of time exist

that are not taken by outside commitments. Perhaps rather than reading your homework assignments at the college library, you could plan to one day a week read with other members of your family who are doing quiet work. You may also need to determine how time is spent to better understand the family's use of time, perhaps using categories such as work/school, recreation, exercise, sleep, and meals. Once you sort the categories for all the family members, you may see blocks of time spent that would lend themselves to combining with other categories—if you and your significant other both exercise three times a week for an hour each time but at separate locations, one possible solution may be to work out together. You could alternate locations if both people have favorite places to run, or you could compromise and decide on one location for both of you—one week at the park, one week at the campus rec center. This may not ultimately be the solution, but after establishing the component parts and thinking analytically, you have provided at least one viable solution.

What if you look at the situation and decide you have too many component parts? Consider, for instance, how Amazon delivers packages every day. That's a lot of items going to and from seemingly countless locations within a relatively short time—sometimes within just one day. An organization such as Amazon must use a great deal of thinking and organizing to deliver goods and services.

Figure 7.9 Warehouse designers must think through complex problems and allow for a range of package sizes and shapes -- even ones they haven't yet seen -- to work within their systems. (Credit: Scott Lewis / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

One way to maintain clear thinking with so many parts is hyper organization. Proper labeling (for Amazon to ship it uses the foundation of our mailing system, unique ZIP codes that each address must contain to be delivered) as well as a strong sense of categorization (fulfillment warehouses, customer return warehouses, grocery item warehouses, etc.) are necessary for Amazon to do business. If you were faced with a major research paper your freshman composition professor expects to be polished by the end of the semester, where do you start? What are the component parts of a high-quality research paper? What tasks do you need to finish and how quickly to accomplish the overall goals? A partial list might include generating ideas, selecting a topic, researching, reviewing the available literature, outlining, drafting, and reviewing. What if you encounter setbacks in any of the steps? Do you have a contingency plan? In the construction industry, engineers called this *float,* and they deliberately build in extra time and money in case problems arise on the project. This allows them to avoid getting off schedule, for instance if a severe storm makes access to the worksite impossible.

Figure 7.10 Construction planners and engineers allow for a range of contingencies and conditions they cannot control, such as weather, supply problems, safety adjustments, and so on. (Credit: Metropolitan Transportation Authority of New York / Flickr / Attribution Generic 2.0 (CC-BY 2.0))

Forging a Revolution

While most problems require a variety of thinking types, analytical thinking is arguably required in solving all. There was a time when manufacturing was completed by a few people who moved around a workspace to complete their projects. As companies grew, this became more and more inefficient, leading to the need for automation. Henry Ford, the early-20th-century American auto inventor, used analytical thinking to revolutionize the way companies increase production by inventing the assembly line. He perceived the problem in his own factory. When the demand for cars increased but his workers continued their work at the same pace, he analyzed their process to create something more efficient in the assembly line. This invention allowed one person to perform the same role over and over before sending the car chassis to another person who also performed the same role over and over as the evolving car moved down a sort of conveyor-belt system. The workers on Ford's assembly lines still had to think and make sure that the task for which they were responsible was properly constructed, free of defects, and ready to move to the next station; they just did this thinking about their one area of expertise. Instead of various skilled workers wasting time and energy moving themselves and their tools around the factory from one incomplete car to the next, possibly getting in the way of each other's work, the cars came to the workers. Ford vastly improved production rates and decreased manufacturing time by thinking about this then-new way of doing things.

In the 1960s, companies did not have a fast, reliable, and cost-effective way to deliver urgent documents or packages to each other. The standard mail system was slow but inexpensive, and the only alternative was a private courier, which, while faster, was prohibitively expensive. That's when Frederick W. Smith came up with the idea of a national, overnight delivery service as a part of an assignment in his undergraduate economics class at Yale University. As the story goes, Smith received only an average grade because evidently his professor wasn't all that impressed with the concept, but after analyzing the problems with the current system, thinking through his original ideas more fully, and refining his business plan, Smith launched FedEx, the largest, now global, overnight delivery service in the world.[1] This isn't a parable about ignoring your professors, but a testimony to thinking through ideas others may not initially support or even understand; thinking can create change and always has. As with Ford's assembly line and Smith's overnight delivery service, any service we now use and any problem we may still face provides thinkers with opportunities to generate solutions and viable options for improvement. Your thinking may result in a new personal service, a cure for cancer, or a revolutionary way to deliver water to developing countries.

1 "Online Extra: Fred Smith on the BIrth of FedEx." Bloomberg Business Week. 2004. Retrieved 1/28/20. https://www.bloomberg.com/news/articles/2004-09-19/online-extra-fred-smith-on-the-birth-of-fedex

7.4 Critical Thinking

Estimated completion time: 18 minutes.

Questions to consider:

- How can determining the situation help you think critically?
- How do you present informed, unbiased thinking?
- What is the difference between factual arguments and opinions?

Critical thinking has become a buzz phrase in education and corporate environments in recent years. The definitions vary slightly, but most agree that thinking critically includes some form of judgement that thinkers generate after careful analysis of the perspectives, opinions, or experimental results present for a particular problem or situation. Before you wonder if you're even capable of critical thinking, consider that you think critically every day. When you grab an unwashed T-shirt off the top of the pile on the floor of your bedroom to wear into class but then suddenly remember that you may see the person of your dreams on that route, you may change into something a bit less disheveled. That's thinking critically—you used data (the memory that your potential soul mate walks the same route you use on that day on campus) to change a sartorial decision (dirty shirt for clean shirt), and you will validate your thinking if and when you do have a successful encounter with said soul mate.

Likewise, when you decide to make your lunch rather than just grabbing a bag of chips, you're thinking critically. You have to plan ahead, buy the food, possibly prepare it, arrange to and carry the lunch with you, and you may have various reasons for doing that—making healthier eating choices, saving money for an upcoming trip, or wanting more quiet time to unwind instead of waiting in a crowded lunch line. You are constantly weighing options, consulting data, gathering opinions, making choices, and then evaluating those decisions, which is a general definition of critical thinking.

Consider the following situations and how each one demands your thinking attention. Which do you find most demanding of critical thinking? Why?

1. Participating in competitive athletic events
2. Watching competitive athletic events
3. Reading a novel for pleasure
4. Reading a textbook passage in science

Critical thinking forces you to determine the actual situation under question and to determine your thoughts and actions around that situation.

Determining the Problem

One component to keep in mind to guide your critical thinking is to determine the situation. What problem are you solving? When problems become complex and multifaceted, it is easy to be distracted by the simple parts that may not need as much thinking to resolve but also may not contribute as much to the ultimate problem resolution. What aspect of the situation truly needs your attention and your critical thinking?

Imagine you're planning a fantasy vacation as a group assignment in a class you're taking where each person is allowed only $200. The group doles out specific preliminary tasks to each member to decide where to go, what sort of trip to take, and how to keep costs low, all in the name of a fun fantasy vacation. In this scenario, whose plan demonstrates the most effective critical thinking?

a. DeRhonda creates an elaborate invitation for a dinner party she'll coordinate at an exclusive mountain cabin.

b. Patrick researches cruises, cabin rentals, and staycation options, considering costs for various trip lengths.
c. Rodrigio puts down a deposit for a private dining room for 25 at an expensive local restaurant for a date six weeks from the end of the semester.

Write out what each person's thinking reflects about their expectations for this trip and why their actions may or may not help the group at this stage of the planning.

Critical thinking differs according to the subject you're thinking about, and as such it can be difficult to pin down any sort of formula to make sure you are doing a good job of thinking critically in all situations. While you may need to adapt this list of critical thinking components, you can get started if you do the following:

- Question everything
- Conduct legitimate research
- Limit your assumptions
- Recognize your own biases
- Gather and weigh all options

Additionally, you must recognize that changes will occur and may alter your conclusions now and in the future. You may eventually have to revisit an issue you effectively resolved previously and adapt to changing conditions. Knowing when to do that is another example of critical thinking. Informed flexibility, or knowing that parts of the plan may need to change and how those changes can work into the overall goal, is also a recognized element of thinking critically.

For example, early in the 20th century, many people considered cigarette smoking a relaxing social pastime that didn't have many negative consequences. Some people may still consider smoking a way to relax; however, years of medical research have proven with mounting evidence that smoking causes cancer and exacerbates numerous other medical conditions. Researchers asked questions about the impact of smoking on people's overall health, conducted regulated experiments, tracked smokers' reactions, and concluded that smoking did impact health. Over time, attitudes, evidence, and opinions change, and as a critical thinker, you must continue to research, synthesize newly discovered evidence, and adapt to that new information.

Figure 7.11 Information, attitudes, laws, and acceptance of smoking changed dramatically over time. More recently, vaping and related practices have rekindled debates and launched new research into safety. (Credit: Satish Krishnamurthy / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Defending against Bias

Once you have all your information gathered and you have checked your sources for currency and validity, you need to direct your attention to how you're going to present your now well-informed analysis. Be careful on

this step to recognize your own possible biases. Facts are verifiable; opinions are beliefs without supporting evidence. Stating an opinion is just that. You could say "Blue is the best color," and that's your opinion. If you were to conduct research and find evidence to support this claim, you could say, "Researchers at Oxford University recognize that the use of blue paint in mental hospitals reduces heart rates by 25% and contributes to fewer angry outbursts from patients." This would be an informed analysis with credible evidence to support the claim.

Not everyone will accept your analysis, which can be frustrating. Most people resist change and have firm beliefs on both important issues and less significant preferences. With all the competing information surfacing online, on the news, and in general conversation, you can understand how confusing it can be to make any decisions. Look at all the reliable, valid sources that claim different approaches to be the *best* diet for healthy living: ketogenic, low-carb, vegan, vegetarian, high fat, raw foods, paleo, Mediterranean, etc. All you can do in this sort of situation is conduct your own serious research, check your sources, and write clearly and concisely to provide your analysis of the information for consideration. You cannot force others to accept your stance, but you can show your evidence in support of your thinking, being as persuasive as possible without lapsing into your own personal biases. Then the rest is up to the person reading or viewing your analysis.

Factual Arguments vs. Opinions

Thinking and constructing analyses based on your thinking will bring you in contact with a great deal of information. Some of that information will be factual, and some will not be. You need to be able to distinguish between facts and opinions so you know how to support your arguments. Begin with basic definitions:

- **Fact:** a statement that is true and backed up with evidence; facts can be verified through observation or research
- **Opinion:** a statement someone holds to be true without supporting evidence; opinions express beliefs, assumptions, perceptions, or judgements

Of course, the tricky part is that most people do not label statements as fact and opinion, so you need to be aware and recognize the difference as you go about honing your critical thinking skills.

You probably have heard the old saying "Everyone is entitled to their own opinions," which may be true, but conversely, not everyone is entitled to their own facts. Facts are true for everyone, not just those who want to believe in them. For example, *mice are animals* is a fact; *mice make the best pets* is an opinion.

ACTIVITY

Determine if the following statements are facts or opinions based on just the information provided here, referring to the basic definitions above. Some people consider scientific findings to be opinions even when they are convincingly backed by reputable evidence and experimentation. However, remember the definition of *fact*—verifiable by research or observation. Think about what other research you may have to conduct to make an informed decision.

- Oregon is a state in the United States. (How would this be proven?)
- Beef is made from cattle. (See current legislation concerning vegetarian "burgers.")
- Increased street lighting decreases criminal behavior. (What information would you need to validate this claim?)
- In 1952, Elizabeth became Queen of England. (What documents could validate this?)
- Oatmeal tastes plain. (What factors might play into this claim?)
- Acne is an embarrassing skin condition. (Who might verify this claim?)
- Kindergarten decreases student dropout rates. (Think of different interest groups that may take sides

on this issue.)
- Carbohydrates promote weight gain. (Can you determine if this is a valid statement?)
- Cell phones cause brain tumors. (What research considers this claim?)
- Immigration is good for the US economy. (What research would help you make an informed decision on this topic?)

Many people become very attached to their opinions, even stating them as facts despite the lack of verifiable evidence. Think about political campaigns, sporting rivalries, musical preferences, and religious or philosophical beliefs. When you are reading, writing, and thinking critically, you must be on the lookout for sophisticated opinions others may present as factual information. While it's possible to be polite when questioning another person's opinions when engaging in intellectual debate, thinking critically requires that you do conduct this questioning.

For instance, someone may say or write that a particular political party should move its offices to different cities every year—that's an opinion regardless of whether you side with one party or the other. If, on the other hand, the same person said that one political party is headquartered in a specific city, that is a fact you can verify. You could find sources that can validate or discredit the statement. Even if the city the person lists as the party headquarters is incorrect, the statement itself is still a fact—just an erroneous one. If you use biased and opinionated information or even incorrect facts as your evidence to support your factual arguments, then you have not validated your sources or checked your facts well enough. At this point, you would need to keep researching.

7.5 Problem-Solving

Estimated completion time: 12 minutes.

Questions to consider:

- How can determining the best approach to solve a problem help you generate solutions?
- Why do thinkers create multiple solutions to problems?

When we're solving a problem, whether at work, school, or home, we are being asked to perform multiple, often complex, tasks. The most effective problem-solving approach includes some variation of the following steps:

- Determine the issue(s)
- Recognize other perspectives
- Think of multiple possible results
- Research and evaluate the possibilities
- Select the best result(s)
- Communicate your findings
- Establish logical action items based on your analysis

Determining the best approach to any given problem and generating more than one possible solution to the problem constitutes the complicated process of problem-solving. People who are good at these skills are highly marketable because many jobs consist of a series of problems that need to be solved for production, services, goods, and sales to continue smoothly. Think about what happens when a worker at your favorite coffee shop slips on a wet spot behind the counter, dropping several drinks she just prepared. One problem is the employee may be hurt, in need of attention, and probably embarrassed; another problem is that several customers do not have the drinks they were waiting for; and another problem is that stopping production of

drinks (to care for the hurt worker, to clean up her spilled drinks, to make new drinks) causes the line at the cash register to back up. A good manager has to juggle all of these elements to resolve the situation as quickly and efficiently as possible. That resolution and return to standard operations doesn't happen without a great deal of thinking: prioritizing needs, shifting other workers off one station onto another temporarily, and dealing with all the people involved, from the injured worker to the impatient patrons.

Determining the Best Approach

Faced with a problem-solving opportunity, you must assess the skills you will need to create solutions. Problem-solving can involve many different types of thinking. You may have to call on your creative, analytical, or critical thinking skills—or more frequently, a combination of several different types of thinking—to solve a problem satisfactorily. When you approach a situation, how can you decide what is the best type of thinking to employ? Sometimes the answer is obvious; if you are working a scientific challenge, you likely will use analytical thinking; if you are a design student considering the atmosphere of a home, you may need to tap into creative thinking skills; and if you are an early childhood education major outlining the logistics involved in establishing a summer day camp for children, you may need a combination of critical, analytical, and creative thinking to solve this challenge.

ACTIVITY

What sort of thinking do you imagine initially helped in the following scenarios? How would the other types of thinking come into resolving these problems?

1. Mission Control reacting to the Apollo 13 emergency
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking
2. Automakers coordinating the switch from fuel-based to electric cars
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking
3. The construction of the New York subway system
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking

Write a one- to two-sentence rationale for why you chose the answers you did on the above survey.

Generating Multiple Solutions

Why do you think it is important to provide multiple solutions when you're going through the steps to solve problems? Typically, you'll end up only using one solution at a time, so why expend the extra energy to create alternatives? If you planned a wonderful trip to Europe and had all the sites you want to see planned out and reservations made, you would think that your problem-solving and organizational skills had quite a workout. But what if when you arrived, the country you're visiting is enmeshed in a public transportation strike experts predict will last several weeks if not longer? A back-up plan would have helped you contemplate alternatives you could substitute for the original plans. You certainly cannot predict every possible contingency—sick children, weather delays, economic downfalls—but you can be prepared for unexpected issues to come up and adapt more easily if you plan for multiple solutions.

Write out at least two possible solutions to these dilemmas:

- Your significant other wants a birthday present—you have no cash.
- You have three exams scheduled on a day when you also need to work.
- Your car needs new tires, an oil change, and gas—you have no cash. (Is there a trend here?)
- You have to pass a running test for your physical education class, but you're out of shape.

Providing more than one solution to a problem gives people options. You may not need several options, but having more than one solution will allow you to feel more in control and part of the problem-solving process.

7.6 Metacognition

Estimated completion time: 19 minutes.

Questions to consider:

- How can you become more aware of your own thinking?
- What is the benefit of thinkers using their thoughts deliberately?

For many of us, it was in kindergarten or first grade when our teacher asked our class to "put on our thinking caps." That may partially have been a clever way for a harried teacher to get young scholars to calm down and focus, but the idea is an apt depiction of how we think. Depending on the situation, we may have to don several very different caps to do our best thinking. Knowing which cap to wear in which situation so we are most prepared, effective, and efficient becomes the work of a lifetime. When you can handle more than one complex thought at a time or when you need to direct all your focus on one crucial task is highly individual. Some people study well with music on in the background while others need absolute silence and see any noise as a distraction. Many chefs delight in creating dinners for hundreds of people in a chaotic kitchen but don't care for making a meal for two at home.

When an individual thinks about how they think, this practice is called *metacognition*. Developmental psychiatrist John Flavell coined the term metacognition and divided the theory into three processes of planning, tracking, and assessing your own understanding.[2]

> **"Becoming aware of your thought processes and using this awareness deliberately is a sign of mature thinking."**

For example, you may be reading a difficult passage in a textbook on chemistry and recognize that you are not fully understanding the meaning of the section you just read or its connection to the rest of the chapter. Students use metacognition when they practice self-awareness and self-assessment. You are the best judge of how well you know a topic or a skill. In college especially, thinking about your thinking is crucial so you know what you don't know and how to fix this problem, i.e., what you need to study, how you need to organize your calendar, and so on.

If you stop and recognize this challenge with the aim of improving your comprehension, you are practicing metacognition. You may decide to highlight difficult terms to look up, write a summary of each paragraph in as few sentences as you can, or join a peer study group to work on your comprehension. If you know you retain material better if you hear it, you may read out loud or watch video tutorials covering the material. These are all examples of thinking about how you think and adapting your behavior based on this metacognition. Likewise, if you periodically assess your progress toward a goal, such as when you check your grades in a course every few weeks during a long semester so you know how well you are doing, this too is metacognition.

Beyond just being a good idea, thinking about your own thinking process allows you to reap great benefits

2 Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp. 231–236). Hillsdale, NJ: Erlbaum

from becoming more aware of and deliberate with your thoughts. If you know how you react in a specific thinking or learning situation, you have a better chance to improve how well you think or to change your thoughts altogether by tuning into your reaction and your thinking. You can plan how to move forward because you recognize that the way you think about a task or idea makes a difference in what you do with that thought. The famous Greek philosopher Socrates allegedly said, "The unexamined life isn't worth living." Examine your thoughts and be aware of them.

Becoming Aware of Your Thinking

Just as elite athletes watch game footage and work with coaches to improve specific aspects of their athletic performance, students can improve their mindset and performance reliant upon their thinking by starting to be aware of what they think. If a baseball pitcher recognizes that the curveball that once was so successful in producing strikeouts has not worked as well recently, the pitcher may break down every step of the physical movement required for the once-successful pitch. He and his coaches may notice a slight difference they can remedy during practice to improve the pitche

Figure 7.12 Baseball pitchers and coaches analyze every component of their motion using video and other technology. (Credit: West Point, The US Military Academy / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Likewise, if Shamika, for instance, wants to be more generally optimistic and not dwell on negative thoughts, she may ask her friends to mention every time she adds a negative post on social media. Shamika may go even further by stopping herself when she says something that is not in line with her new, optimistic mindset. She could jot down the instance in a journal and capture her feelings at the time so that later she could analyze or think through why she was negative at that time. If you procrastinate on assignments, you may ask a friend to be your accountability buddy to help keep you on track. Thinking about how to focus on the positive, in Shamika's case, or avoid procrastination doesn't magically change the situation. It does, however, allow the owner of the thought to contemplate alternatives instead of becoming frustrated or mindlessly continuing to sabotage sincere goals. Think now of a personal example of a habit you may want to change, such as smoking, or an attribute such as patience or perseverance you may want to improve in yourself. Can you determine what steps you may need to undertake to change this habit or to develop a stronger awareness of the need to change?

Using Thought Deliberately

If you need to plan, track, and assess your understanding to engage in metacognition, what strategies do you need to employ? Students can use metacognition strategies before, during, and after reading, lectures, assignments, and group work.

Planning

Students can plan and get ready to learn by asking questions such as:

- What am I supposed to learn in this situation?
- What do I already know that might help me learn this information?

- How should I start to get the most out of this situation?
- What should I be looking for and anticipating as I read or study or listen?

As part of this planning stage, students may want to jot down the answers to some of the questions they considered while preparing to study. If the task is a writing assignment, prewriting is particularly helpful just to get your ideas down on paper. You may want to start an outline of ideas you think you may encounter in the upcoming session; it probably won't be complete until you learn more, but it can be a place to start.

Tracking

Students can keep up with their learning or track their progress by asking themselves:

- How am I doing so far?
- What information is important in each section?
- Should I slow down my pace to understand the difficult parts more fully?
- What information should I review now or mark for later review?

In this part of metacognition, students may want to step away from a reading selection and write a summary paragraph on what the passage was about without looking at the text. Another way to track your learning progress is to review lecture or lab notes within a few hours of the initial note-taking session. This allows you to have a fresh memory of the information and fill in gaps you may need to research more fully.

Assessing

Students can assess their learning by asking themselves:

- How well do I understand this material?
- What else can I do to understand the information better?
- Is there any element of the task I don't get yet?
- What do I need to do now to understand the information more fully?
- How can I adjust how I study (or read or listen or perform) to get better results moving forward?

Looking back at how you did on assignments, tests, and reading selections isn't just a means to getting a better grade the next time, even if that does sometimes happen as a result of this sort of reflection. If you rework the math problems you missed on a quiz and figure out what went wrong the first time, you will understand that mathematical concept better than if you ignore the opportunity to learn from your errors. Learning is not a linear process; you will bring knowledge from other parts of your life and from your reading to understand something new in your academic or personal learning for the rest of your life. Using these planning, tracking, and assessing strategies will help you progress as a learner in all subjects.

Have you ever been in a situation where a series of events transpired that on reflection you wish you had handled differently? For instance, what if you were tired after a long day at work or school and snapped at your roommates over an insignificant problem and that heated exchange ruined your weekend plans? You'd been anticipating a fun outing with a large group, but now several people don't want to go because of the increased tension. Afterwards, you come up with several other ways you wish you had acted—you might have explained how tired you were, ignored the irritation, or even asked if you could continue your discussion of the problem at another time when you were less tired. You could call that wish metacognition after the fact. How much more effective could you be in general if instead of *reacting* to events and then contemplating better alternatives later, you were able to do the thinking *proactively* before the situation arises? Just the act of pausing to think through the potential consequences is a good first step to accomplishing the goal of using metacognition to reduce negative results. Can you think of a situation in which you reacted to events around you with less than ideal results? How about a time when you thought through a situation beforehand and reaped the benefits of this proactive approach?

Let's look at two seemingly ordinary examples of this concept. Think about your reaction and the eventual long- and short-term results of you walking into your math class on Tuesday afternoon to recall only then that

you have a major closed-book exam that class session. You look around to see nervous classmates reading notecards or working practice problems. You choose to stay and take the exam wholly unprepared. You end up with a low D on the exam and now must contemplate the consequences of that result.

Figure 7.13 Self-awareness and self-assessment are critical in preparing for tests. (Credit: Magharebia / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Scoring such a low exam grade may not be the end of the world, certainly, but you may not maintain the GPA you had hoped to post, you may need to repeat the course, or you may get further behind in this subject because you didn't master the skills on this test. This is quite a bit of awareness about your thinking. Now you need to decide what actions to take as a result of your self-awareness thinking. Contemplating this negative consequence may lead you to make an appointment with your instructor to discuss your situation, which is always a good idea. Could you take an alternate exam to replace this atypical low score? Even if the answer is no, you have still made a connection and shown your instructor that you are seriously thinking about your coursework.

Now consider the opposite scenario. What if you had entered your exam schedule onto your calendar beforehand and devised a viable plan to be prepared? You likely would have prepared in advance of exam days, studied the required materials, worked through similar problems, and come to the exam session more prepared than you did in the first example. Because you know you need a set amount of time to prepare for exams, you would have blocked that time on your calendar, possibly changing your work schedule for the week, declining social invitations, and otherwise altering your daily routine to accommodate this significant event. Consider how much better your results would be with this amount of preparation and how this would improve your overall performance in the course. You can take advantage of thinking about consequences before they happen so you can employ specific strategies to improve your learning.

7.7 Information Literacy

Estimated completion time: 23 minutes.

Questions to consider:

- How do you go about verifying source validity, and why is this important?
- How do you use resources to improve your thinking?
- Where do you go to find print and online resources?

What type of system best helps you to manage your resources?

When conducting any type of thinking, you need to have a firm grasp on *information literacy*, or knowing how

to access the sources you may need. Practicing good information literacy skills involves more than simply using a search engine such as Google, although that could be a starting point. You also engage in creative thinking (i.e., generating topics to research), analytical thinking (i.e., reading and examining the parts of sources), and critical thinking (i.e., evaluating sources for accuracy, authority, etc.). Then there is synthesis that is used when incorporating multiple sources into a research project. Information literacy utilizes all of the necessary thinking skills. If you saw the name of a person on the cover of a magazine, for instance, you might assume the person did something important to merit the attention. If you were to google the person's name, you would instantly need to use context clues to determine if the information your search produced is actually about your person and not someone else with the same or a similar name, whether the information is accurate, and if it is current. If it is not, you would need to continue your research with other sources.

Verifying Source Validity

The American Library Association defines information literacy as a set of skills that allow you to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."[3] We need information almost all the time, and with practice, you'll become more and more efficient at knowing where to look for answers on certain topics. As information is increasingly available in multiple formats, not only in print and online versions but also through audio and visual means, users of this information must employ critical thinking skills to sift through it all.

In today's information environment, what would be the best way to find valid information about climate change? Would it be Wikipedia, NASA, a printed encyclopedia from 1985, or a report from a political campaign?

If you chose any answer except the NASA website, can you see how the other answers may have a vested interest in encouraging readers to believe a particular theory? The encyclopedia may not intentionally attempt to mislead readers; however, the write-up is not current. And Wikipedia, being an open-source site where anyone may upload information, is not reliable enough to lend full credence to the articles. A professional, government organization that does not sell items related to the topic and provides its ethics policy for review is worthy of more consideration and research. This level of critical thinking and examined consideration is the only way to ensure you have all the information you need to make decisions.

You likely know how to find some sources when you conduct research. And remember—we think and research all the time, not just in school or on the job. If you're out with friends and someone asks where to find the best Italian food, someone will probably consult a phone app to present choices. This quick phone search may suffice to provide an address, hours, and possibly even menu choices, but you'll have to dig more deeply if you want to evaluate the restaurant by finding reviews, negative press, or personal testimonies.

Why is it important to verify sources? The words we write (or speak) and the sources we use to back up our ideas need to be true and honest, or we would not have any basis for distinguishing facts from opinions that may be, at the least damaging level, only uninformed musings but, at the worst level, intentionally misleading and distorted versions of the truth. Maintaining a strict adherence to verifiable facts is a hallmark of a strong thinker.

You probably see information presented as fact on social media daily, but as a critical thinker, you must practice validating facts, especially if something you see or read in a post conveniently fits your perception. You may be familiar with the Facebook and Instagram hoaxes requiring users to copy and paste a statement that they will not grant permission for these social media sites to make public the content from their private pages. Maybe you've seen any number of posts and memes that inaccurately associate famous people with memorable quotations. We may even allow ourselves to believe inaccurate claims as truth when we experience different emotions including anger, fear, or loneliness; we want to believe a claim is true because it aligns with how we are feeling, regardless of any verifiable source. Be diligent in your critical thinking to avoid misinformation!

3 "Information Literacy." American Library Association. Accessed February 1, 2020. https://literacy.ala.org/information-literacy/

Determining how valid a source is typically includes looking into the author's credentials, experience, and status in the discipline; the actual content of the source material; any evidence the source presents as support; and whether any biases exist that may make the source questionable. Once you know who controls the content of the source you've chosen, you need to determine what biases or special interests the site or article may exhibit.

ACTIVITY

Reflect on what bias the following sites may have. Without consulting the Internet, write one to two sentences on what ideas the following organizations may present. After you consider these on your own, conduct a search and see if you were accurate in your assumptions about the entities.

a. National Dairy Council
b. Yoga Society
c. People for the Ethical Treatment of Animals (PETA)
d. The American Medical Association

Whatever you write or declare based on sources should be correct and truthful. Reliable sources present current and honest information backed up with evidence you can check. Any source that essentially says you should believe this "because I said so" isn't a valid source for critically thinking, information-literate individuals.

Evaluating books, articles, and websites for validity presents different challenges. For books and scholarly articles, in print or online, you can typically establish if the source is current and from a reputable publisher or organization with information on the copyright page or journal publication information.

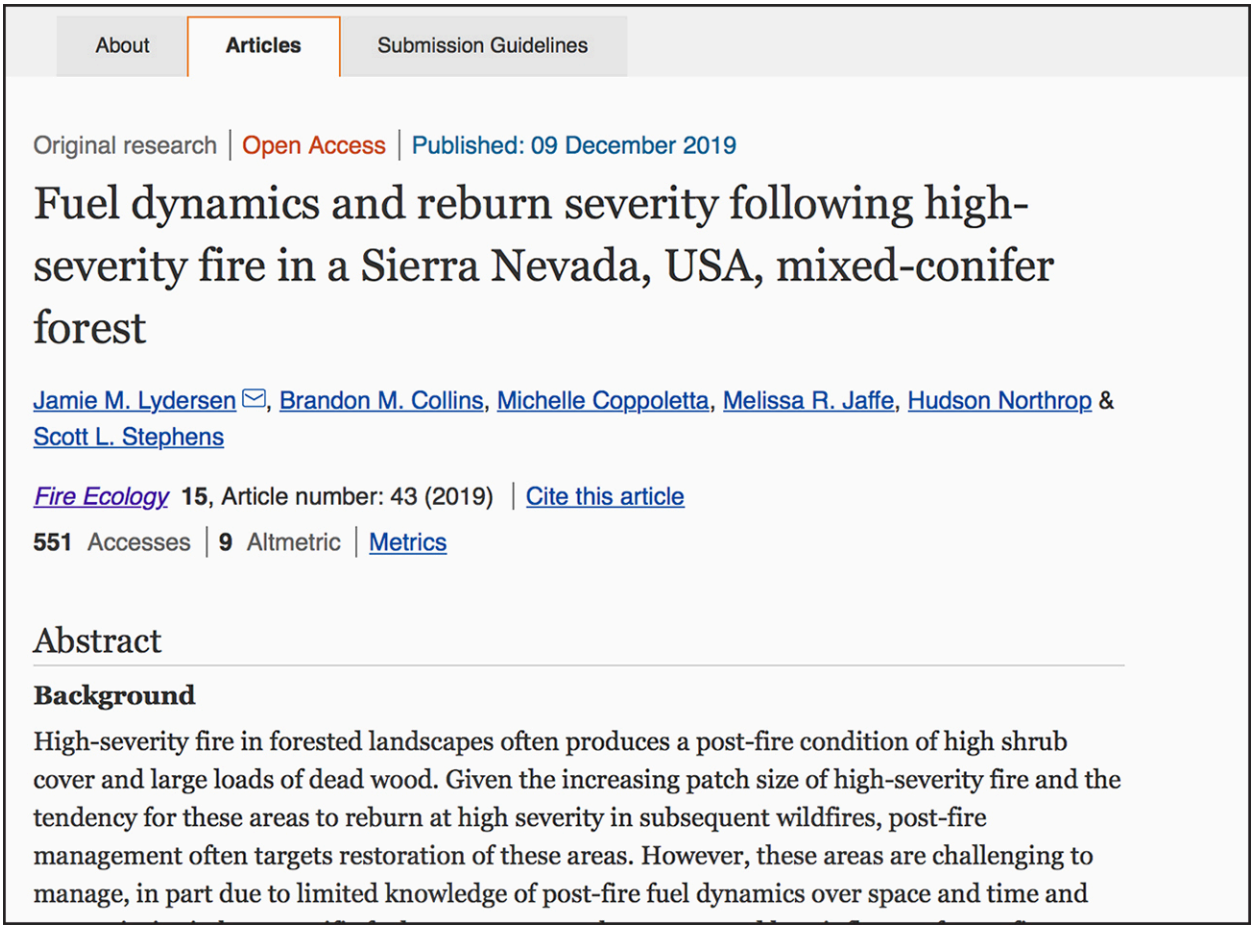

Figure 7.14 The most reliable sources of online information may be journals or related research-oriented websites, which include the author names, their credentials, and other data. However, unless they are "peer-reviewed," meaning independent experts have read and verified the quality of the information, even credible-looking sites may be more opinion- than fact-oriented. (Credit: Springer Open. https://fireecology.springeropen.com)

For a website, you should determine who owns this site. Is it a professional organization such as the American Medical Association? You can usually find this info in the *About* section of the site or in a copyright designation near the end of the landing page. Domain names can help you determine the purpose of the site, but you shouldn't rely solely on this website marker.

Domain	User
.edu	Used by **edu**cational institutions (i.e., colleges, universities, school districts); usually reliable sources of information, but individual members of these institutions may be able to create web pages on the site under the official domain that do not reflect the values of the school
.com/.biz	Used by **com**mercial or business groups; may be valid, but also may be used to sell products, services, or ideas
.gov	Used by **gov**ernment agencies; typically valid
.org	Used by **org**anizations, such as nonprofit groups or religious entities; may present information slanted toward a specific denomination or cause. You'll need to conduct additional research to verify validity.

Domain	User
.net	Originally created for networks or groups of people working on the same problem, .net is still a viable option for noncommercial sites such as personal blogs or family websites. You'll need to conduct additional research to verify validity.
Many other domains exist	Research the validity of domain names outside these most common ones.

Resources for Thinking

When you look into books, articles, and documentaries on thinking, you will find plenty of choices. Some books or articles on thinking may seem to apply only to a narrow group of readers, such as entrepreneurs or artists. For example, the audiences for these two books about thinking seem highly selective: Carl Sagan's *The Demon-Haunted World: Science as a Candle in the Dark* may be mostly directed to the science community, and James Lohan's *Lies My Teacher Told Me: Everything Your American History Textbook Taught Wrong* is likely of interest primarily to historians. And some chapters may focus specifically on those groups; however, most texts on thinking are also applicable to other disciplines. You may have to work a bit harder to find a common ground or generate your own examples that explain the concepts from the book, but you can still reap benefits from understanding different perspectives. Don't immediately disregard a book or article just because it doesn't seem to fit your thinking perspective on the surface; dig a bit more deeply to see what you can learn. Remember, being open-minded and considering as many alternate approaches as possible are two hallmarks of critical thinking.

Finding Print and Online Resources

When you need to research a topic, you probably start with a search engine. That can be helpful, but can easily lead you down incorrect paths and waste time. Use advanced searches, filters, and other means to target your results more specifically. However, don't limit yourself to just Internet sources; print journals, books, and articles are still significant sources of information.

Your college may have access to extensive stores of subscription-based site content, photos, videos, and other media through its library, providing more than enough information to start researching and analyzing any topic. Depending on the specific database and school, you may be able to access some of these resources remotely; others may require you to visit the library in person. Remember, when you are gathering and arranging pieces of information, keep track of the source and the URL so that you can both cite it correctly and return to learn more if needed.

Some other more general places to explore educational, inspirational, and thought-provoking material follow:

- Exploring the TED website (http://www.ted.com) is worth a few minutes of time. There you'll find short videos (limited to 18 minutes) of speaking demonstrations by diverse experts in fields covering all disciplines. If you are in an exploratory phase of your thinking and researching, you can scan the TED Talk topics related to your interest area.
- You may be familiar with the Khan Academy, created in 2008 by Salman Khan, as an online learning resource for students and teachers containing tutorials, videos, and practice sets in a variety of subjects from science and mathematics to grammar lessons.
- Massive Open Online Courses (MOOCs) provided by Coursera, Udemy, and Udacity, provide learners and thinkers the chance to take courses, attend webinars and discussions, and learn about a large number of

subjects, often free of charge. Much of the content is provided by major universities, and the courses are often facilitated by faculty.
- For-profit companies and nonprofit groups such as the Foundation for Critical Thinking (FCT) can also help you hone your thinking. The FCT presents materials, seminars, and conferences to help people think with "clarity, relevance, logic, accuracy, depth, significance, precision, breadth, and fairness."

Creating a System for Managing Resources

You could have all the money (or time or cars or great ideas) in the world, but that won't do you any good if you haven't also created a system for managing all your resources. In the same way you might feel overwhelmed with all the choices when a waiter gives you a book-sized menu with hundreds of options, you can stall your thinking if you don't have an effective and efficient way to access all the great articles, websites, books, podcasts, webinars, and other idea resources you can amass for the life of a project or during a college course or for a life event.

Systems to manage your ideas and thoughts don't need to be elaborate. The best idea-management system is the one that gets used, so you need to be comfortable with what all is involved in managing these thoughts. Keep in mind, once you get into the swing of researching for and keeping good ideas, you're going to end up with resources in many different formats. Gone are the days when one shelf of an oak bookcase near your desk could contain all your thinking resources on a topic. You may still find books, so you don't need to discard the bookcase just yet, but very likely, you'll also have online resources including search results, document files, websites, blogs, audio files, videos, and more. You can use filing folders, binders, online folders, boxes, or computer systems to organize your ideas.

A word about stacking papers and clutter: don't. Clutter impedes creativity, steals focus, and represents procrastination. Fight the temptation to allow clutter to overwhelm your projects and workspace. File or trash anything you are not using right at the moment; this daily practice will save you a tremendous amount of time that you could waste looking for papers or articles you saved for later review.

Like physical clutter, a messy online environment can stall productivity and clear thinking. One key to effective information and idea management is a simple, consistent labeling system. Some companies call this a *naming protocol or naming convention,* a standard way all online files, folders, and drives are labeled for easier retrieval and long-term storage. If you don't think through a file name with this forward-looking approach and then you don't access that file for several months, you aren't likely to remember which file is which, and you may end up wasting valuable time opening random files in an attempt to find the one you need. This isn't a very efficient way to operate, and in some work environments would not be acceptable on large-scale and important projects. For example, if you were taking an upper-level literature course studying poetry, and remember you filed an excellent summary of one of the poems a few years earlier in your freshman composition class, you won't be too happy when you have 78 documents called *Notes.* Great idea—lousy document/idea management system.

If your searches will take place on multiple devices--a laptop and a smartphone, for example, you could use a notetaking app such as Evernote, which contains a wealth of organizational tools and has various levels of access. You can access the same note regardless of where you're searching. In the same way, you could even use a series of Google Docs or Sheets, as long as you consider the file naming and organizational conventions mentioned above. For example, if you needed to put together a research paper requiring 20 data sources, you could use a spreadsheet to keep track of the source article name, author, topics, potential data points you plan to use, the source, and the URL. Even if you didn't incorporate everything into the final paper, such a method would save you a lot of time trying to track down small pieces of information. (The sheet would also be a great reference when you write your bibliography.)

Finding print and online sources demands a great deal of time and effort. Understanding how different approaches to thinking are appropriate for various situations as you research will help you be more creative

and critical as you identify and verify your sources.

ACTIVITY

Quite literally, all careers need thinkers. Many jobs today expect employees to come up with original ways of doing routine tasks. Nurses may consider a more effective way to convey necessary information about patient care to other members of the medical team. Teachers must reconcile individual student learning needs with the reality of large classrooms. Attorneys think about all the consequences of presenting a client's case in a certain manner. And chefs balance the cost of using the finest ingredients with customer preferences and profit margins.

Any career you can imagine has some amount of thinking involved. The most successful workers in any industry are the ones who think beyond the ordinary limits or expectations established in that profession and create new and improved ways to do ordinary jobs.

Consider the types of thinking required for the jobs in the table below.

Industry	Job Title	Job Descriptions	Thinking type Required
Transportation	Air traffic controller	Regulates air traffic for outgoing and incoming aircraft; responds to emergencies; schedules planes to specific gates to minimize delays	
Healthcare	Pediatric oncology nurse	Cares for critically ill children; assists doctors in diagnoses, treatment, and examinations; communicates with patients and care providers	
Internet technology	Computer analyst	Maintains computer hardware and software systems; troubleshoots user problems; suggests modifications for improved productivity	
Education	College professor	Teaches, evaluates, and guides post-secondary students through various academic subjects working toward various degrees and certificates	

Career Connection

All professions need thinkers to take good ideas and make them better and to tackle problems that seem unresolvable and make sense of them. No job or career area is exempt from this crucial human resource. Your critical thinking in college will help you succeed in the work you do after your academic journey. Make a list of your top three ideal careers. What types of thinking are required of each? How will your time in college better prepare you for this type of work?

Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

How do you feel about the ways you think? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning “least like me” and 4 meaning “most like me.”

1. I understand how to approach problem-solving.
2. I have creative potential.
3. I often think about how I’m learning
4. I know how to find and evaluate valid information.

Where do you go from here?

Thinking isn’t something we can turn on and off when we enter or leave a classroom—we think about everything. We may have different strategies and processes for thinking in different environments, but all thinking starts with our own ideas coming into contact with new information and experiences. What would you like to learn more about? Choose topics from the list below, or create your own ideas relative to thinking and research them.

- learning to be a creative thinker
- technological advances in the study of the brain
- thinking and brain trauma
- thinking in leadership roles
- theories of nontraditional learning methods