THE LEARNWELL PROJECTS

The STEM Students'
ACADEMIC PLAYBOOK

INTRODUCTION TO THE LEARNWELL PROJECTS

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INTRODUCTION

Seeing the World through a STEM Lens

In the distant past, one of our ancestors had a problem. The exact nature and size of the problem isn't important. It probably wasn't even a new situation. A generation or more may have faced the same challenge. But then one day, our intrepid ancestor looked at this problem and devised a tool to solve it.

Behold the first STEM professional.

Our ancestor shared this amazing invention with their brothers and sisters. And at first, they may have viewed this tool with skepticism and fear. It may have simply been a stick used at a particular angle to achieve a particular outcome—but it was bold! It was radical! It gave them an evolutionary advantage.

This growing family was hungry for more. They invented agriculture and alphabets, wheels and roads, science and math, machines and medicine. They built civilization with their unique ability to transform observation into creation.

While that tale was a simplistic view of our human origins, it shares a few key themes of your education at Florida Polytechnic University. Regardless of the STEM field you ultimately choose, all Florida Poly students should view the world through this lens. This education isn't simply about learning; it's about transforming and problem-solving.

The word *engineer* is derived from the Latin word *ingenium*, which means someone with advanced mental powers. In today's context, STEM professionals use their knowledge of science and mathematical methods to develop creative solutions to practical problems.

As future STEM professionals, you must continue developing your mental qualities and capabilities. Your professors will expose you to concepts from science and math, and they will show you how this knowledge plays out in a variety of fields. You should absorb as much of this information as you possibly can. However, you should know that obtaining the information your professors express during class or that you obtain from resources, such as books, articles, and case studies, is only part of the labor you must invest in your academic work.

In the spirit of ingenium, the most essential labor you must do involves using your mental skills to transform the content you encounter into conceptual knowledge that you control. This type of academic work will facilitate high academic performance in college and equip you for a successful professional career.

As a new college student, you bring tons of experience doing academic work to your new environment. However, the volume of information, the pace of learning, and the complexity of academic outcomes you must produce can be difficult to manage. This booklet provides you critical guidelines that will help make you a more effective learner.

SECTION I

Academic Work

What is academic work? While you have been doing academic work for many years, you probably haven't fully contemplated this question. Academic work in college is much more complex. Having a working definition of what academic work entails is imperative to ensure you are doing it well.

Academic work requires students to use their minds to put abstract material, such as concepts, theories, rules, and formulas, into action. This is a cognitive endeavor that requires you to use your thinking skills strategically.

In each class, you will be exposed to high volumes of information. Even if you are familiar with the content, you will likely be required to learn it at much deeper levels than previous academic experiences. This type of deep learning demands that you use a more sophisticated set of thinking skills than you may be accustomed to using.

You have a hidden superpower called *metacognition* at your disposal. Metacognition involves your knowledge and awareness of your internal processes, states, and conditions as you process information and navigate tasks throughout your learning environments.[1]

This means that you must continue with familiar school activities, such as attending classes, taking notes, studying, working through problems, and so forth. You must also become acutely aware of the interplay between the external content you are exposed to and the internal changes occurring in your mind.

Using this resource, you will be able to:

- **Frame your academic courses to focus on learning material that matters most to your immediate academic success and your professional career.**
- **Save time and control your performance.**
- **Develop habits of thinking that match those of STEM professionals.**

(Don't let this notion intimidate you! Humans engage in metacognitive activity from the toddler years.)

This booklet will help you take advantage of this activity by breaking down the elements of academic work and helping you develop Metacognitive Action Plans (MAPs) that will help you navigate each course you take. MAPs will not only make you a more effective student, but also help you hone skills that will land you a better job. These skills will push you further and faster in your profession. They will connect you to your academic power source, so you can learn better, faster, and with greater personal and professional reward.

Using this resource, you will be able to:

- Frame your academic courses to focus on learning material that matters most to your immediate academic success and your professional career.
- Save time and control your performance.
- Develop habits of thinking that match those of STEM professionals.

1 Hennessey, M. (1999). Probing the Dimensions of Metacognition: Implications for Conceptual Change in Teaching-Learning. *National Association for Research in Science Teaching*. Boston; Kuhn, D. &. (2004). A Bridge Between Cognitive Psychology and Educational Practice. *Theory into Practice*, 268-273; Martinez, M. E. (2006). What Is Metacognition? *Phi Delta Kappan*, 696-699.

The Elements of Academic Work

STEM professionals, such as computer scientists and engineers, use science and mathematical concepts to manipulate the natural world to create solutions that benefit mankind. For example, to build an underground tunnel, engineers must understand each element that makes up the terrain. They also must fully understand the complexity of what the tunnel project entails. From this knowledge, they can use science, math, and materials to manipulate the elements to create the tunnel. This is the essence of ingenium.

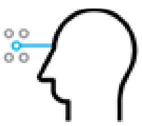
Academic work has its own form of ingenium. As students, you must understand three key elements that are ever present in academic work: content, cognition, and concepts. Then you must know how to manipulate these elements to produce the answers and assignments that your educators are assessing. When you understand each of these three elements and fully grasp the outcomes your professors are seeking, you can use your mental powers to transform the elements into the outcomes. This is where ingenium and metacognition align. In the next section, you will learn how to separate these elements and then manipulate them to produce the knowledge your professors will be assessing.

> **You have a hidden superpower called *metacognition* at your disposal. Metacognition involves your knowledge and awareness of your internal processes, states, and conditions as you process information and navigate tasks throughout your learning environments.**

SECTION II

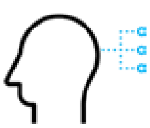
The Three Cs

Academic work consists of three elements: content, cognition, and concepts. Much of your academic success hinges on your ability to (1) distinguish these three elements within academic work and (2) properly coordinate these three elements to generate knowledge.



Content consists of the information presented during class and material students consume while reading academic material. You can think of content as the building blocks of academic work.

Cognition consists of the mental processing powers students use to transform content into conceptual knowledge. Cognition provides direction to students' academic work.



Concepts are the core ideas of a subject or discipline. They are the abstract notions that the content is expressing. Concepts are the destination for academic work.

The following analogy will help you see the distinct value and contribution of each element. If you were building a house, the content would be the raw materials used to build the home, such as the wood planks, nails, bricks, and so forth. The cognition would be the various tools, such as nail guns, cement trucks, and saws used to transform the raw materials into the specific pieces of the home. The concepts would be the idea of the home, which is usually expressed in a building plan. This is a conceptualization of what the finished product should look like. Think about the distinct roles that each element plays in the building process. A similar interaction plays out in academic work.

Your professors will communicate concepts or ideas to the class. These are high-level concepts that they know deeply. For example, related rates, velocity, and derivatives are concepts you may encounter. Your professors want you to learn the concepts, as they are the essential to the discipline. However, they are abstract. So they will use content, such as words, numbers, symbols, formulas, and so forth, to communicate the abstract ideas.

Part of your work involves capturing the content during class. But you should know that your most valuable contributions will be made away from class. Your primary perpetual task will be converting the daily content you extract from class into conceptual knowledge.

Learning the content is relatively easy because content is the most visible aspect of academic work. As successful high school graduates, you likely have a range of tactics for capturing and retrieving content. These tactics are useful tools for academic work, but they have limits. They, alone, cannot produce the conceptual knowledge that educators will ultimately assess.

The real struggle of academic work in college involves learning the concepts that the content expresses. To develop the conceptual understanding that your professors seek and that your profession demands, you must skillfully use your cognitive skills to convert the content into conceptual knowledge.

How the Three Cs Interact

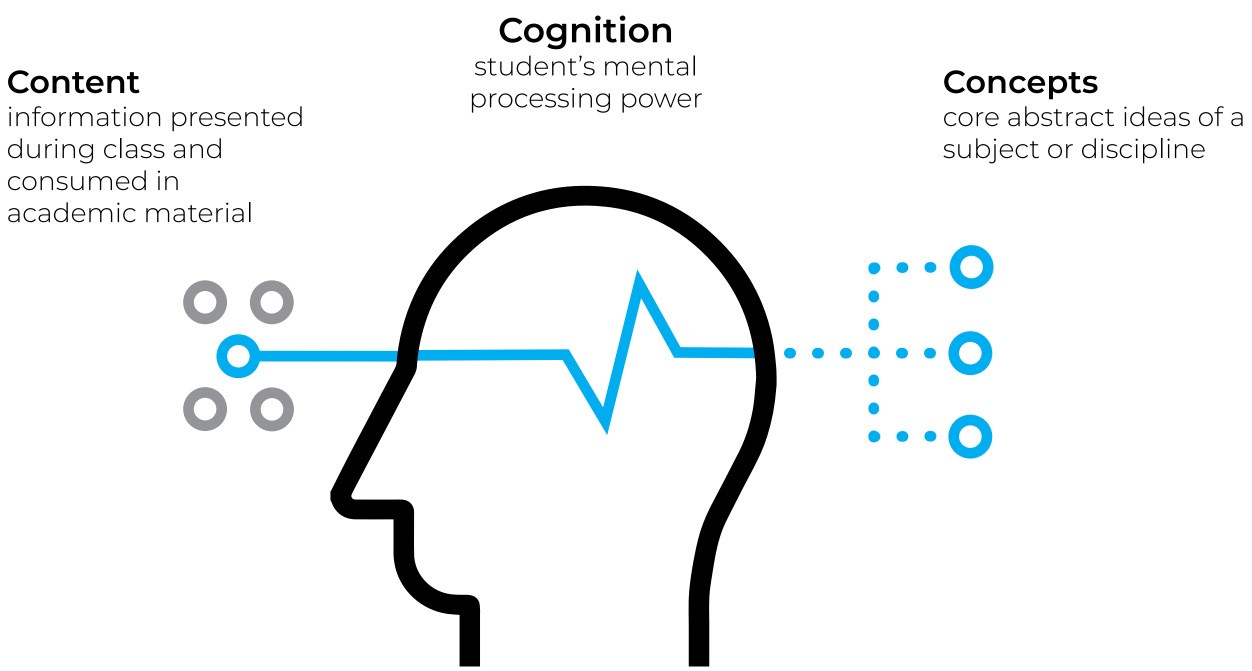
> **Your most valuable contributions will be made away from class. Your primary perpetual task will be converting the daily content you extract from class into conceptual knowledge.**

Let's say you're in an electrical engineering course learning about electrical circuits. Throughout the course, your professor exposes you to a diverse range of concepts (such as Ohm's Law, Kirchhoff's Laws, and Thevenin's Theorem) and terms (such as voltage, current, and resistance).

If you approach academic work like many students do, you may study your notes to the point that you can accurately recall the content that was used to express the concept. This outcome would suggest you know the content well. However, this does not indicate that you have done the cognitive work to produce the type of conceptual knowledge your professor will assess.

For example, your professor may assess whether you can use the laws or terms to diagnose and solve problems involving electrical circuits. Or perhaps she will assess whether you can explain how to build an electrical circuit. The point is that merely knowing the content doesn't mean you have learned the ultimate concept.

The path to learning concepts requires you to strategically use your cognition to interact with the content in specific ways. This quality of academic work requires you to be able to differentiate your thinking skills, which is the focus of the next section.



SECTION III

Differentiating Thinking Skills

Around second or third grade, you learned to distinguish different monetary values. During this tender age you learned, for example, that a dime is worth ten cents, a quarter is worth twenty-five cents, and a dollar bill is worth one hundred cents. After nailing down the basics, you then learned that if you stack a ten-dollar bill, a five-dollar bill, and four nickels together, you get fifteen dollars and twenty cents.

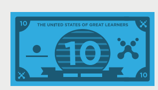
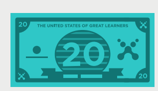
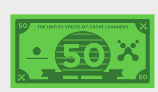
Intriguingly, you learned to differentiate units of money well before you possessed money. Why did you learn this skill so early? Because the skill of differentiating between monetary units is so essential that kids must learn it before participating in the economic world.

Unfortunately, such forethought was not put into the academic world. The ability to differentiate among thinking skills is a threshold skill. Students must possess this skill to do cognitively complex work. It is as indispensable to academics as differentiating among monetary units is to finances. Yet this skill is not taught. Here's an orientation to this vital skill.

ThinkWell-LearnWell™ Diagram

Lower-Order Thinking Skills → Higher-Order Thinking Skills

Surface Approach to Learning → Deep Approach to Learning

Metacognitive Learning Goals	Bloom's Higher-Order Thinking Skills	Corresponding Learning Outcomes	Outcome Valuation
To Identify or Define Information Students seek to answer some form of this what-based question: can I list and/or define the key terms?	**Remembering** Students work to recall/recognize information, ideas, and principles in the approximate form in which they were learned.	**Able to Recall or Duplicate Information** Students will be able to reproduce information in similar form as the original source. Corresponds to tasks in which cues are embedded.	
To Explain Information Students seek to answer some form of this why-based question: can I explain the reasoning behind the ideas/concepts?	**Understanding** Students work to explain and provide rationales to support concepts and/or principles.	**Able to Provide Rationales for Information** Students will be able to explain why concepts are essential to understanding the topic, subject, story, etc. Corresponds to tasks that require explanations or elaborations.	
To Apply Information to New Situations Students seek to answer some form of this how-based question: can I apply this information to a new or different situation, problem, or context?	**Applying** Students work to transfer principles and/or concepts to a different problem or task with minimal cues or direction.	**Able to Apply Information to Different Situations** Students will be able to use information to complete a problem or task with minimal direction or cues. Corresponds to tasks that require application of knowledge to a situation.	
To Compare and Contrast Information Student's seek to answer some form of this analytical question: can I distinguish processes, procedures, or principles from seemingly identical processes, procedures, or principles?	**Analyzing** Demands that students be able to distinguish and differentiate between comparable processes, functions, methods, etc.	**Able to Discern Nuances of Information** Students will be able to discern patterns, differences and similarities within information. Corresponds to tasks that require students to distinguish between similar sets of information, processes, or outcomes.	
To Make Judgments About Information Student's seek to answer some form of this evaluative question: can I determine the best rationale, plan, solution, course of action, etc., given the information?	**Evaluating** Demands that students be able to make judgments with information.	**Able to Reach Conclusions with Information** Students will be able to make judgments about information they've analyzed. Corresponds to tasks that require students to decide which course of action, solution, or option is best.	
To Introduce, Develop a Viewpoint Students seek to answer some form of this generative question: can I synthesize the information in an original way?	**Creating** Demands that students be able to construct new information from existing information.	**Able to Produce New Information** Students will be able to present new meaning or generate new knowledge. Corresponds to tasks that require students to produce authentic work.	

The **ThinkWell-LearnWell™ Diagram** is an essential tool for developing metacognitive skills and improving academic performance. This lesson starts the process of differentiating thinking skills. You will need to continue developing this skill on your own. Here are a few links to animated videos that will help you hone this vital threshold skill:

- Differentiating Thinking Skills Part 1: youtu.be/cuB_4jImrZk
- Differentiating Thinking Skills Part 2: youtu.be/eaTGkBLGsu0

Knowing how to differentiate your thinking skills is important for two reasons: (1) it is a fundamental skill needed to control your interactions with content, and (2) it enables you to use the Learner's Formula (more on that in the Making the Magical Leap section) to productively generate the conceptual knowledge your professors are seeking.

Differentiating among thinking skills is challenging because thinking is invisible. And since we can't see thinking skills, we must separate them by their functions. This means we must know the type of labor that respective thinking skills perform in academic work. Another way of saying this is that we must know what each thinking skill looks, sounds, and feels like. And while you use your thinking skills ubiquitously, you likely don't know them as intimately as you should. Using this diagram will help you figure out the thinking requirements for your academic work and help you think and learn more effectively.

The following pages in this section work vertically down the diagram to separate a set of core thinking skills you will frequently use. This exercise will help you appreciate each thinking skill's unique contribution to academic work. At the conclusion of each skill, complete the reflective activity to increase your awareness of how you have already used each skill.

The First Row: “Remember Me, Baby”

To Identify or Define Information Students seek to answer some form of this what-based question: can I list and/ or define the key terms?	**Remembering** Students work to recall/ recognize information, ideas, and principles in the approximate form in which they were learned.	**Able to Recall or Duplicate Information** Students will be able to reproduce information in similar form as the original source. Corresponds to tasks in which cues are embedded.	

On this level, the mind works to store information in a similar form as it was received. Triggered by “what based” metacognitive conditions, the work concludes with a definition or some form of information duplication, regurgitation, or recall. This type of interaction does have value, but it is the lowest form of cognitive product students can develop.

After operating at this level of interaction for your courses, you would be able to:

- Rely upon your photographic memory to recall exhaustive lists of definitions.
- Store and retrieve complex concepts.
- Solve mathematical problems that are in a convention identical to the way the problems were presented in class or in the book.
- Write papers with a spectacular recollection of events.

Identify an instance when you had to use the *remembering* thinking skill in your college academic work and share how you determined you had successfully used this skill.

The Second Row: "Tell Me Why"

To Explain Information Students seek to answer some form of this why-based question: can I explain the reasoning behind the concepts?	**Understanding** Students work to explain and provide rationales to support concepts and/or principles.	**Able to Provide Rationales for Information** Students will be able to explain why concepts are essential to understanding the topic, subject, story, etc. Corresponds to tasks that require explanations or elaborations.	

The work performed at this level seeks to support (or "stand under") information. Instigated by a slightly deeper "why-based" metacognitive trigger, the mental work accomplished with this level of thinking leaves students with an ability to explain information and provide rationales. Academic products produced with this level of interaction have greater value than products generated on the first row.

Operating at this level, you would be able to:

- Elaborate on the lists of definitions you worked so hard to remember and retrieve.
- Explain the significance of the concepts you stored in your memory.
- Logically support your mathematical solutions.
- Write longer papers by elaborating on the events you recall.

Identify an instance when you had to use the *understanding* thinking skill in your college academic work and share how you determined you had successfully used this skill.

The Third Row: “Show Me How”

To Apply Information to New Situations Students seek to answer some form of this how-based question: can I apply this information to a new or different situation, problem, or context?	**Applying** Students work to transfer principles and/or concepts to a different problem or task with minimal cues or direction.	**Able to Apply Information to Different Situations** Students will be able to use information to complete a problem or task with minimal direct or cues. Corresponds to tasks that require application of knowledge to a situation.	

This level of interaction seeks to apply information. Initiated by a “how-based” metacognitive trigger, mental work performed with this mode of thinking continues until students can apply their newly acquired information to new, dissimilar situations. Academic products created with this way of thinking are worth even more value than the previous level.

Operating at this level, you would be beyond storing definitions. You would be able to:

- Provide examples of concepts you learned in class or from reading materials that are different from those that were used in class.
- Apply your mathematical understanding to different types of problems.
- Extend your papers’ lengths and quality by providing personal examples of concepts.

Identify an instance when you had to use the *applying* thinking skill in your college academic work and share how you determined you had successfully used this skill.

SECTION IV

Metacognitive Homework

Academic work is a cognitive endeavor, and metacognition is the key to gaining control over your cognitive abilities. Recall that metacognition involves your knowledge and awareness of your internal processes, states, and conditions as you process information and navigate tasks throughout your learning environments. As you become more sensitive to your metacognitive activity, you will possess greater awareness and control of the impact your thinking has on your work.

Investing time away from class to think about and note the relationships among the content you encounter, the thinking skills you use to process the content, and the knowledge that flows from those interactions is one of the most valuable contributions you can make to your metacognitive development. The **Conceptual Knowledge Log** can help you track how your knowledge enhances over time.

Conceptual Knowledge Log

Instructions

1. *Date:* write the date you create this entry.
2. *Concept:* write down the concept you are learning.
3. *What I Now Know:* briefly summarize what you know about the concept as of this date.
4. Review the log after a week and note how your knowledge has changed.

Date	Concept	What I Now Know

SECTION V

More Thinking about Thinking

STEM professionals use various tools and processes to do their jobs, for example, using devices to transform raw materials into other useful devices, materials, and so forth. As a student in the STEM field, you must use your cognition (your thinking skills and processes) to transform content. Each thinking skill you use will transform content in distinct ways.

To illustrate the transformative power of your thinking skills, consider the following. Let's say you are given five different ten-digit phone numbers (i.e., 555-555-5555) from different areas throughout the country. The numbers represent content. The table below shows how your cognitive work can transform into outcomes.

The key takeaway points from this example are:

1. While the example used phone numbers, the content could be anything from cake baking to quantum physics.
2. Cognition matters. The types of cognitive skills you use will produce very different knowledge products.
3. You must learn how to skillfully use your cognitive powers to produce the outcomes that are required.

Cognitive Work	Outcome/Knowledge Product
You tap your **remembering** thinking skill and processes to store the numbers in your mind and establish ways to retrieve the numbers upon cue.	You can accurately recall each telephone number.
Then let's say you tap your **understanding** thinking skill and processes to learn what the community of each respective number is like.	You can explain why there is or is not a connection between the community and the phone numbers' prefixes.
Next, you tap your **applying** thinking skill and processes to learn how each prefix was chosen.	You can express the origin story of how the prefixes came to be.
Next, you tap your **analyzing** thinking skills and processes to learn how the community of each phone number differs.	You can create an illustration that shows the dominant industries, racial or ethnic backgrounds, weather patterns, and so forth in each community.
Next, you tap your **evaluating** thinking skills and processes to establish a value to each community.	You attach a rating system to your previous illustration and rank the zip codes in order based on your criteria.
Finally, you tap your **creating** thinking skills and processes to develop a real estate guide based on the numbers and the information you've ascertained thus far.	You create a real estate listing.

Thinking about thinking can be abstract and difficult to grasp. Metaphors and similes are mental handlebars we can use to process abstract information. Contemplate the following cooking simile to appreciate the transformative effect thinking skills have on content.

Each respective thinking skill transforms content in specific ways. Switch one skill for another, and you end up with a qualitatively different end product. This transformational process is similar to the way respective cooking methods transform raw food into different finished products.

Think on this: if you take a piece of meat or some vegetables, depending on your preference, the finished product will be qualitatively different if you fry the ingredients compared to baking them or grilling them or boiling them. The key point is that whichever method you use will transform the ingredient in ways that make the finished product different than the other methods could make it. Likewise, the thinking skills you use as you encounter academic content matter. So be aware of the finished product your professors expect and be intentional about the skills you use.

SECTION VI

Making the Magical Leap

The information in this booklet thus far has primed you for "the magical leap." So what is the magical leap? Academic work in high school and in college are similar in many ways. However, college work requires students to do additional mental labor to leap from the given content to the needed knowledge. The magical leap is the process of using your mind to transform the information you encounter into knowledge you possess.

As you accumulate information from the classes you attend, this information will rarely make sense to you. This information is content you hear in class, glean from online sources, have in your notes, obtain from books, and so forth, whereas knowledge is something you possess; you own it. It is a product that you can use in some meaningful way.

For example, let's say you accumulate a complex engineering concept, several terms that relate to the concept, a couple of rules that apply to the concept, and a couple of examples of these elements in use. Merely accumulating this content is not enough. You must make a magical leap to produce knowledge that is qualitatively different from the content to which you were exposed. Thankfully, there's a formula to help you make this leap.

In the Three Cs section, we distinguished the invisible concepts of a course from the "visible" content that educators use to teach the course, and the internal cognition you use to process information throughout the course.

As students, you will need to use your cognitive powers to constantly make magical leaps from the content to the conceptual knowledge. Since STEM students rely on formulas to solve problems, here is the Learner's Formula to help you make the magical leap: conceptual knowledge equals correct content plus appropriate cognition plus time.

In order to produce conceptual knowledge, you must study the correct content with the appropriate thinking skills for as long as it takes to produce the quality of knowledge your professors require. We've already discussed content, so the next components to consider are the cognition and time.

Time is the least important factor in the equation because the amount of time you will need to study depends on your cognition. If you think about the content well (with the appropriate thinking skills), then you will learn well and ultimately perform well. Unfortunately, many students and educators focus on how much time students spend studying. However, the key metric is how well you think when you study. Use the **Metacognitive Conceptual Understanding Log** to track your thinking skills.

The Learner's Formula

conceptual knowledge = correct content + appropriate cognition + time

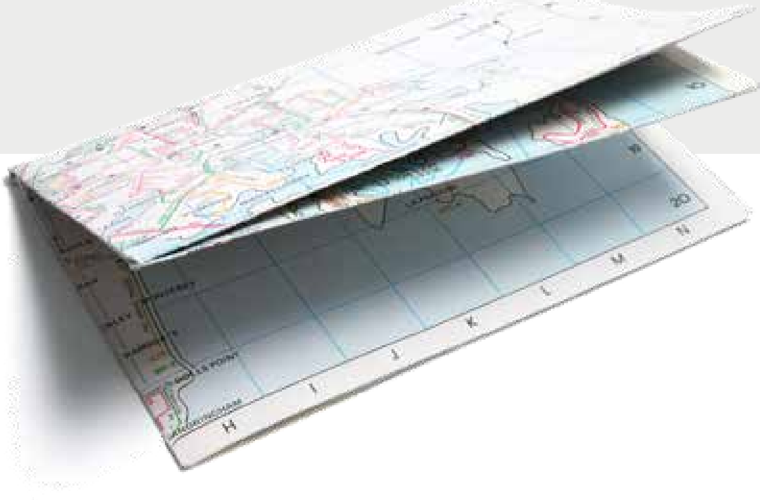
Metacognitive Conceptual Understanding Log

Instructions

1. *Date:* write the date you create this entry.
2. *Concept:* write down the concept you are learning.
3. *Cognition:* write down the thinking skill(s) you are using.
4. *What I Now Know:* briefly summarize what you know about the concept as of this date.
5. Review the log after a week and note how your knowledge has changed. Note how a change in thinking skills produces a change in knowledge.

Date	Concept	Cognition	What I Now Know

Create Your Own MAPs



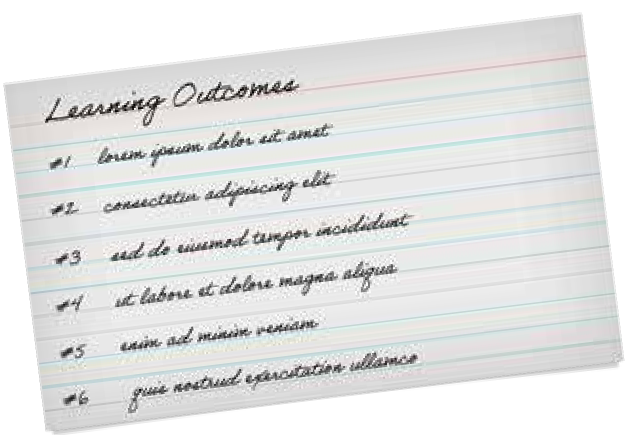
Many hard-working students wind up doing pseudowork in college. Pseudowork consists of activities that look good and feel good but do not produce the proper level of knowledge that will be assessed. Pseudowork wastes students' time. But you can avoid pseudowork by creating your own academic work metacognitive action plans (MAPs).

MAPs are actions you can take to ensure you efficiently make the magical leaps necessary in your courses. MAPs empower your learning by enabling you to *plan*, *monitor*, and *evaluate* the quality of your academic work.

STEP 1: Plan

Academic success starts with proper preparation. Set yourself on a path of success by taking the following actions before your first day of class!

Purchase a notebook with a clear pocket on the front for each class. You can use the inside of the notebook to store class materials. But the most critical point may be how you use the front pocket. Write down your course learning outcomes on a sheet of paper, preferably card stock because you will refer to them throughout the course.



The course learning outcomes are the learning targets for the course. Your success will largely depend on how well you generate these outcomes. Your professors will cover content during class and expose you to content through other resources. However, it is your responsibility to use your thinking skills to transform the content into the outcomes. By grounding yourself in your course learning outcomes, you make the content you encounter more meaningful.

STEP 2: Monitor

With the learning outcomes as conceptual guides, you must continually weigh the content you encounter each day against the learning outcomes of the course. Many students spend lots of time trying to learn content in isolation. However, you must understand the relationships between the micro-content that is presented and the macro course outcomes. If you do not see clear connections between the daily content and the course outcomes, then consider this an indicator that you have more work to do. Use the Learner's Formula to make the magical leap and the **Key Relationships Map** to clarify the relationships between the outcomes, concepts, and content.

Key Relationships Map

course name

date

term

term

term

concept

concept

term

term

learning outcome

concept

term

concept

term

term

concept

term

course name

date

term

concept

term

term

concept

term

learning outcome

concept

term

term

concept

term

concept

term

term

Step 3: Evaluate

Ensure that the knowledge you have produced matches the outcomes of the course. If what you know aligns with what your professor will be assessing, then you can be confident in your learning. Use the **Knowledge Evaluator Grid** to verify your knowledge.

Academic work, like any other form of work, depends on how well the work is managed. By planning, monitoring, and evaluating your thinking, you engage in a process that enables you to manage your learning.

As you use your course learning outcomes as goals, you create guideposts to aim toward. Then, as you do your academic work, you can actively monitor your thinking and learning. Finally, as you conclude your study sessions or as assessment dates approach, you can evaluate your learning to ensure you produced the appropriate types of knowledge. Once you internalize the process, academic success becomes routine.

Knowledge Evaluator Grid

Learning Outcome	Can I produce the outcome?	If not, what do I need to produce the outcome?

SECTION VIII

Problem-Solving Steps

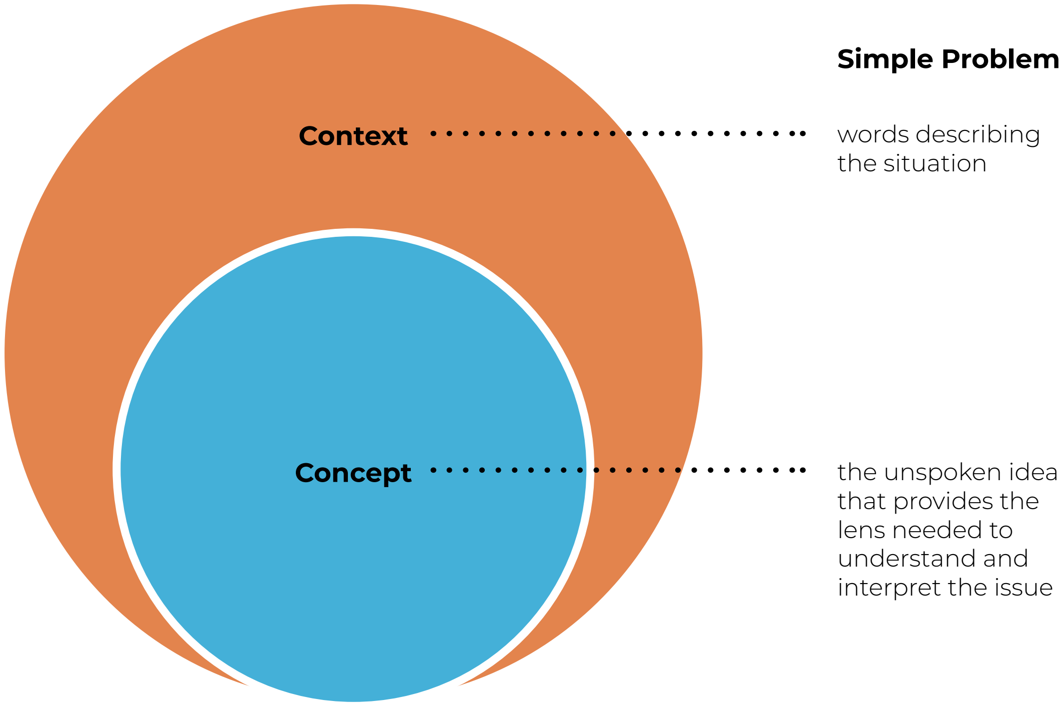
STEM professionals are problem-solvers. Therefore, much of your academic work will involve solving problems. So let's make sure you understand what problems entail.

A problem is a concept(s) wrapped in a context. To solve a problem, one must first use their understanding of the concept(s) (ideas of the field) to understand the context. Once you have identified the concepts, then you can conjure applicable methods (e.g., formulas, rules, procedures, and so forth) that are related to the concepts.

You will encounter two types of problems: simple problems and complex problems. Simple problems have one concept embedded in the problem's context. These problems are relatively easy because they require less cognitive work. Here are the steps that are typically followed when solving simple problems:

1. Read the problem context.
2. Identify the concept that is embedded within the context.
3. Recall methods associated with the concept (e.g., formulas, rules, etc.).
4. Apply computations.

Since there is only one concept involved in the problem, recalling the correct method (step 3) that is needed to solve the problem is easy. Once you get step 3 right, the only work that remains is working through the computation.



SECTION IX

Math Conceptual Knowledge Note-Taking Method

Use the **Math Conceptual Knowledge Note-Taking Worksheet** during, after, and between classes to activate the analytical and evaluative thinking processes that you will need to solve complex problems. By doing the mental work that the worksheet prompts, you will replicate the thinking processes you will need on assessments.

Using this note-taking method will help you learn mathematical concepts, their associated methods, and computations in a manner that makes them accessible and manageable on exams. Additionally, this method will facilitate the type of enduring knowledge you will need throughout your educational pursuits and in your profession.

Math Conceptual Knowledge Note-Taking Worksheet

In this exercise, make sure you grasp the essential concepts that are explicitly or implicitly relevant to this type of problem.

Note-Taking Goals

- Analyze the problem context to discover the relevant concept(s).
- Identify the computations that are related to the concept(s).

What concepts are applicable to this problem?

What computations are related to this concept?

Concept #1	Computation for concept #1

What computations are related to this concept?

Concept #2	Computation for concept #2

What computations are related to this concept?

Concept #3	Computation for concept #3

SECTION X

Key Learning Indicators

Students often use grades as a measure of their performance. However, grades are lagging indicators. They tell students whether the work they have already done was sufficient. Grades tell us the story of the past.

Students must learn to use leading indicators to assess their learning. Leading indicators tell students whether they are learning effectively on the front end. The benefit of these metrics is that they give students time to adjust before they are assessed. Leading indicators predict future performance.

Use the **Leading Indicators Checklist** to establish the proper leading indicators.

Leading Indicators Checklist

By August 23 (Classes Begin)

- ☐ My course outcomes for this course are easily visible on the front of a notebook.
- ☐ I have reviewed the learning outcomes for each course.

By September 4

- ☐ I see clear connections among the daily course content and the course outcomes.
- ☐ I have a personal copy of the ThinkWell-LearnWell Diagram.
- ☐ I have a personal copy of the Outcome Decoder Tool.
- ☐ I have used the ThinkWell-LearnWell Diagram to differentiate my thinking skills.
- ☐ I have used the Outcome Decoder Tool and ThinkWell-LearnWell Diagram to figure out the thinking skills for the outcomes for this course.

By September 11

- ☐ I can articulate the relationships between the course concepts, methods, and computations.
- ☐ I am deliberately using thinking skills that match those required for this course.
- ☐ The thinking skills in my notes align with the thinking skills required for this course.

By September 25

- ☐ I use the textbook to expand my conceptual knowledge.
- ☐ I can logically express my knowledge of the course concepts.
- ☐ I am deliberately making "magical leaps" during my work away from class.

By October 9

- ☐ I am beginning to predict potential questions/problems that will appear on the upcoming tests.
- ☐ I can produce the learning outcomes that are applicable for the concepts related to the first half of this course.

By October 23 (Midterms)

- ☐ I see clear relationships between my thinking and test performance.
- ☐ I see clear connections between the course learning outcomes and the course assessments.

By November 13

- ☐ I have produced all of the course learning outcomes.

APPENDIX

Exercise Pages

THE LEARNWELL PROJECTS

Making Learning More Visible, Manageable, and Effective

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