EMPOWERING YOUR STAFF TO SOLVE PROBLEMS

Evidence-Based Training for Strategic Thinking

https://tinyurl.com/ProblemSolvingVLA   October 25, 2019 Virginia Library Association Annual Conference

Jennifer: Welcome. Availability of presentation and handout online at the tinyurl. That tinyurl is also on the handout.

Introductions

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Jennifer
Brief context about JMU Libraries:
- approximately 150 faculty and staff
- located in Harrisonburg in the Shenandoah Valley
I'm Jennifer Keach and the Coordinator of Organizational Learning & Development at JMU Libraries

Rebecca:
I'm Rebecca French, and I'm the Metadata Analyst Librarian. Over the past few years I've been involved in training some of my JMU Libraries colleagues, specifically in e-resource metadata and batch loads. I found that my typical approach of teaching people how to use software tools and follow procedures didn't cover the complex problem solving skills that are needed to be really successful at this type of work. In trying to become a more effective trainer and supervisor, I teamed up with Jennifer for her experience in training and instructional design. Together we dug into the research and the result is the presentation we're sharing with you today.

Agenda

- Why teach problem solving?
- Two problem solving scenarios
- Gagné's five categories of learning
- Four tips for teaching problem solving

Jennifer

So, today we plan to

- Share why we believe you should be teaching problem solving
- Share two scenarios from our own library in which employees need to solve problems.
- Talk about the instructional theory of a man named Robert Gagne
- followed by tips that are inspired by that theory.

We'll pause a few times throughout the presentation for you to reflect on your own challenges related to teaching problem solving skills—and how you might apply what we talk about.

Why Teach Problem Solving?

- Staff, students, and volunteers increasingly performing more complex tasks
- Outsourcing and/or automation of routine work
- Retirements and loss of institutional memory

Gremmels, G. S. (2013). Staffing trends in college and university libraries. *Reference Services Review, 41*(2), 233-252. https://doi.org/10.1108/00907321311326165

Rebecca

I'm going to start by quickly highlighting a few trends you all have likely heard about and maybe have even experienced in your own libraries. We're seeing that work that used to be done only by professional librarians, things like answering reference questions or performing original cataloging, these types of tasks are increasingly being done by library staff, students, or volunteers. Another trend is that routine work is increasingly being outsourced or automated, which often means that staff become responsible for overseeing and troubleshooting the automated workflows. In these kinds of work, there's not one easy answer that can be memorized or a step-by-step procedure that can be followed. Because the tasks are more complex, they require problem solving skills.

Many of you probably learned how to solve problems through years of learning on the job. This relates to another trend - library workers are retiring in large numbers, and with that comes the loss of all the historical knowledge and experience these long-time employees have. We believe it's possible to help newer library employees build problem solving skills more quickly if you're intentional about training problem solving.

Problem Solving

- A process by which the learner
  - *discovers a combination of previously learned rules*
  - *plans their application*
  - *to achieve a solution for a novel problem situation.*

Adapted from Gagné, R. M. (1985). *The conditions of learning and theory of instruction*. Fort Worth: Holt, Rinehart and Winston. p. 178

Rebecca

I've already started talking about problem solving, but what exactly do I mean by that? We think of problem solving as a process in which three things happen:

First, the learner draws on previously learned knowledge and rules, finding a combination that they

then figure out how to apply to their problem,

which allows them to achieve a solution to their novel problem situation.

So we start with some existing knowledge and figure out how to put it to use to solve a new problem.

Next we're going to share two examples of problem solving scenarios from our own library and then invite you to come up with one of your own.

Loading Bib Records   Providing User Service
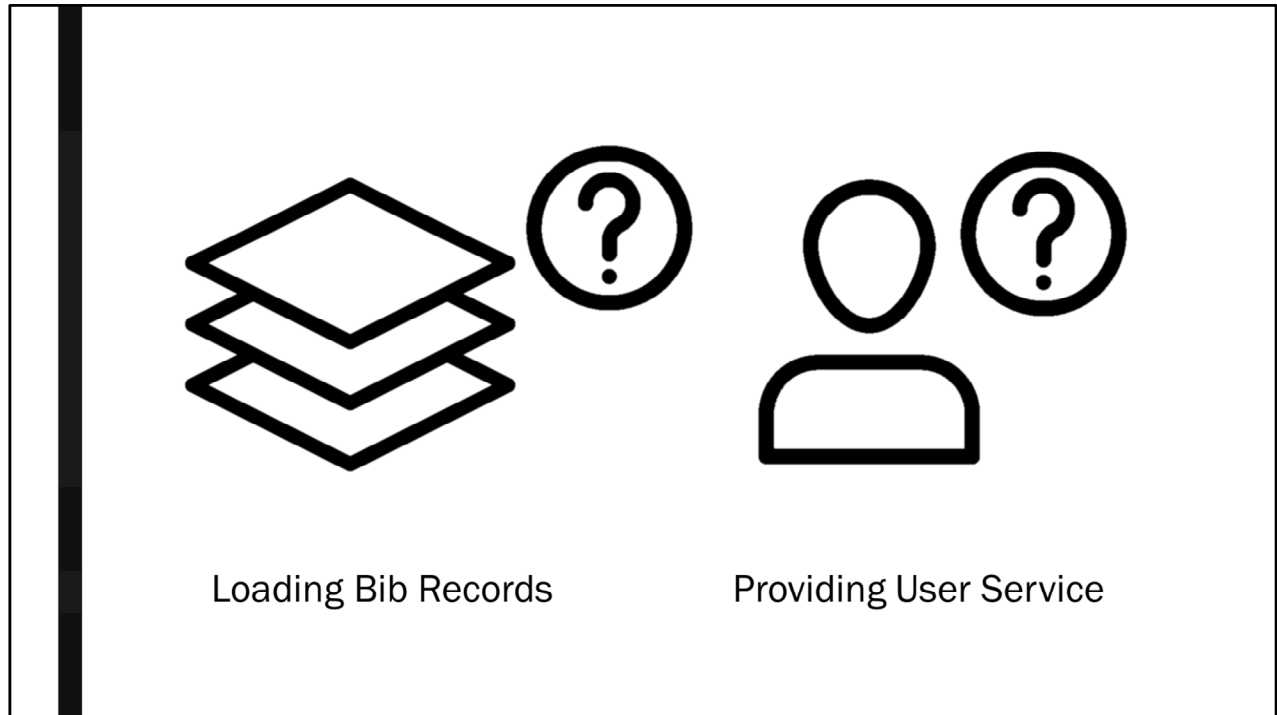
Rebecca: The scenario I'm going to talk about comes from tech services. Say I'm teaching a new cataloger how to load bibliographic records into the library catalog. This is usually a routine procedure, but sometimes unexpected things happen. In this case, we know we're trying to load a new record that should not be replacing anything in the catalog, but the test load shows that it is going to overlay an existing record. The cataloger needs to figure out what's going on and how they can get the new record loaded correctly.

Jennifer: Rebecca's scenario comes from her own experience, but for mine, I learned about a scenario from my colleague, Andrew Evans, who trains front desk staff at JMU Libraries. In our library, we have public workstations with a fairly long list of software. Plus, we have printers and wifi that our library users can connect to with their own laptops, tablets, and phones. Printing is paid for by swiping a student ID through a card swipe. So, when a user has a technology problem, there are multiple possible points of failure—and the front desk is where panicked students go for help. How do you teach the employees who work at the main information desk how to troubleshoot the many different technology questions that might come to them?
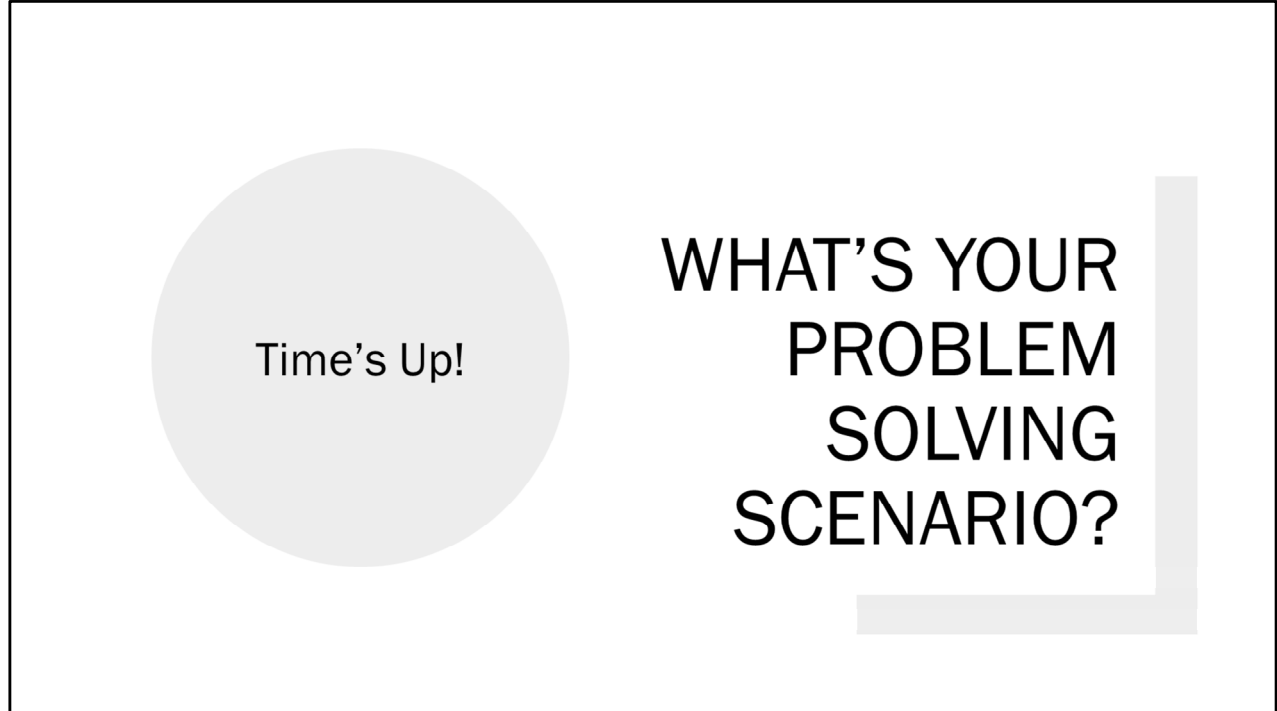
Jennifer
We'd like for you to play along with our scenarios by thinking of your own example, so let's stop for a minute or two to give you time to think of a scenario in your own library where your employees need to have problem solving skills. Some scenario in which you would like to train other employees to do the problem solving.

You'll find a spot on your worksheet to briefly describe your problem solving scenario. Write that down on your sheet. [Offer pens.]

If you are wondering how much time you have, you'll notice a timer on this slide.

Next, we are going to talk about a foundational instructional design theory and how it applies to training your employees to solve these problems.

Gagné's Theory of Instruction:
Five Categories of Learning

Motor Skills

Attitudes

Verbal Knowledge

Procedural Knowledge

Thinking Strategies

Gagné, R. M. (1965). *The conditions of learning and theory of instruction*. New York: Holt, Rinehart and Winston.
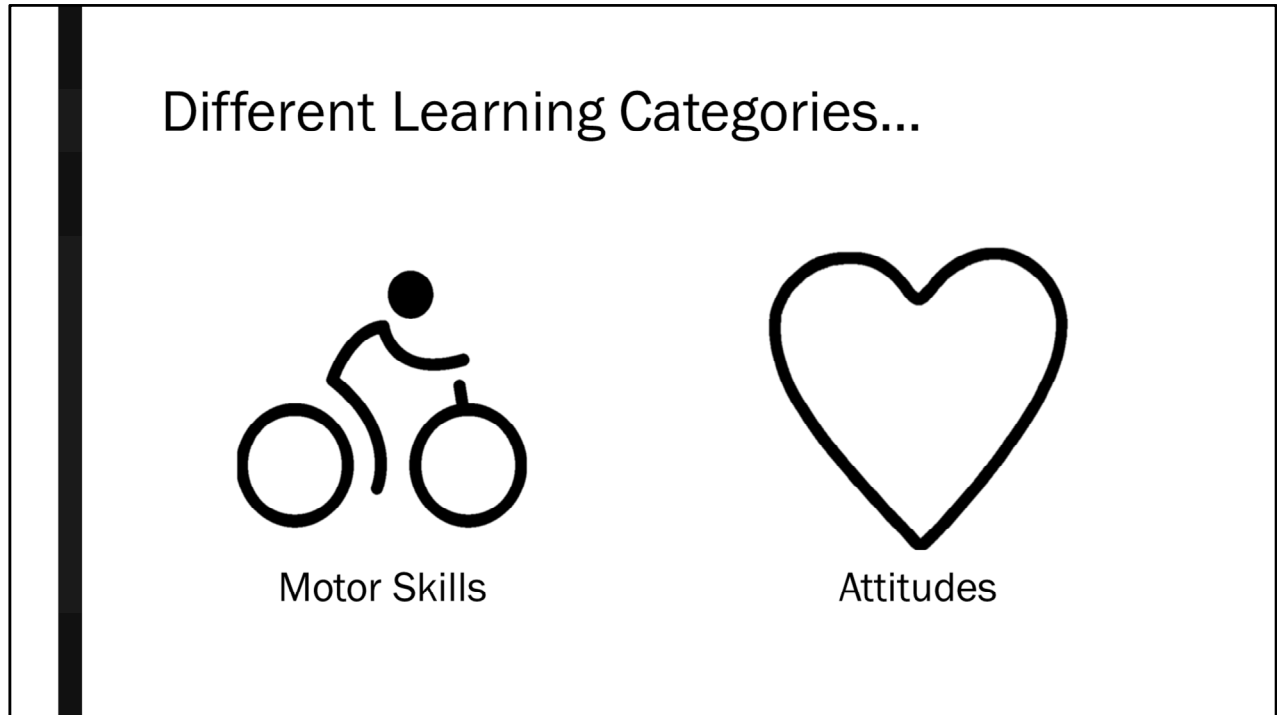
Jennifer

An educational psychologist named Robert Gagne proposed a way to think about learning and teaching which includes the idea that all learning can be categorized into 5 different areas.

- Motor Skills
- Attitudes
- Verbal Knowledge—which Gagne also refers to as Verbal Information
- Procedural Knowledge—which Gagne also refers to as Intellectual Skills
- Thinking Strategies—which Gagne refers to as Cognitive Strategies

Throughout this presentation, we'll use the phrases you see on this slide instead of the phrases that Gagne used because we think that these are a bit easier to understand.

Gagne published his theory of instruction, of which this is a part, back in 1965. Although his ideas have been around for awhile now, his ideas continue to inform instructional design and workplace learning today.

Different Learning Categories...

Motor Skills   Attitudes

Jennifer

Two of perhaps the most intuitive learning categories proposed by Gagne are Motor Skills and Attitudes. As I'm describing these, think about your scenario because I'm going to ask you to write down how you see motor skills and attitudes applying in your example, if you do.

The classic example of learning a motor skill is learning to ride a bike. This category involves the coordination of muscles. Within the library, we might think of motor skills that need to be taught such as repairing a book, applying shelf labels or inserting security strips, removing jammed paper from a printer. These all require some sort of physical coordination and are all considered motor skills.

Attitudes, on the other hand, are mental states which influence an individual's behavior. At work, you might hope to teach an employee to accept diverse perspectives, to embrace an upcoming change, or to believe in their own ability to run a meeting. These are all attitudes.
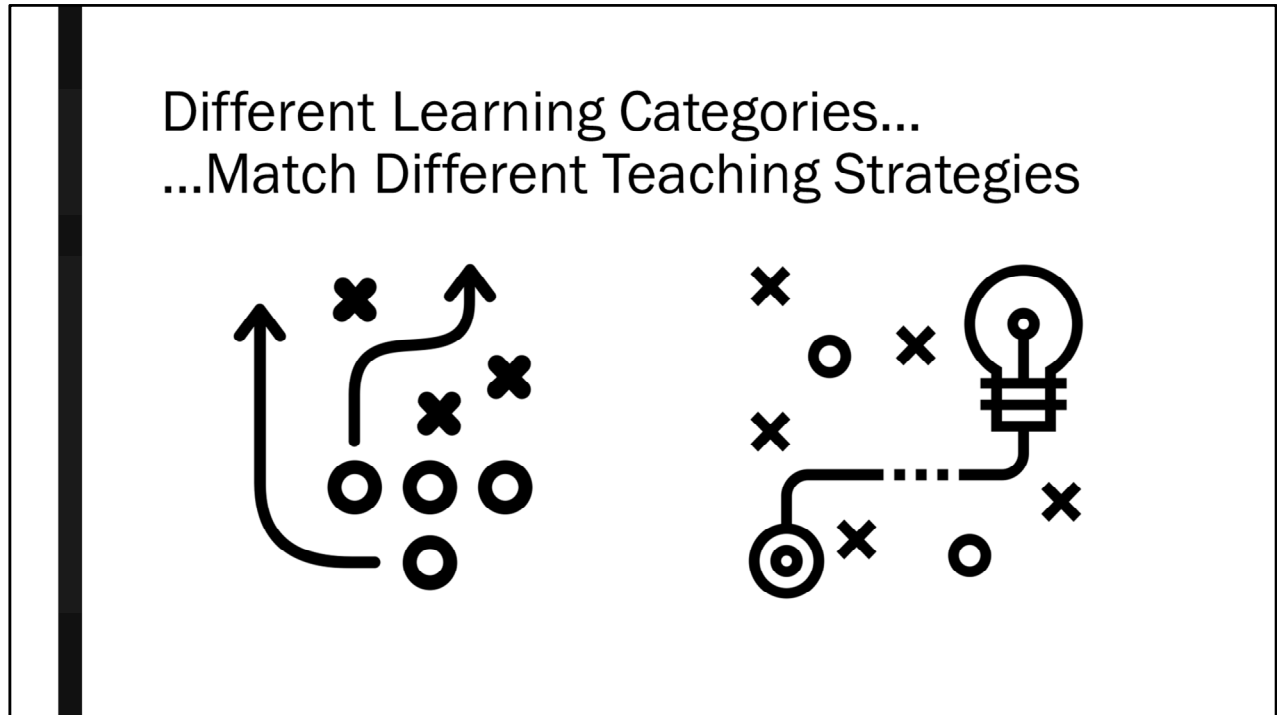
Jennifer

It turns out that the strategy you might take to teach someone to say, repair a book, will be very different from the strategy you might use to embrace change at work. We may know this intuitively, but Gagne went further and suggested different specific strategies for each category of learning. You can use his suggestions as a guide when you are deciding how to train or teach others.

For motor skills. According to Gagne, nothing beats the learning that happens for motor skills as when the learner practices the new skill. For a person to really learn how to do a new motor skill, you should ask them to perform that skill and provide feedback on their performance. This may sound intuitive, but I know that I've made the mistake more than once of demonstrating a motor skills to someone—unjamming a printer, for instance—and then thinking that I've successfully "taught" a new skill.

To teach someone a new attitude, on the other hand, Gagne says that the most dependable approach is for learners to observe someone they admire who advocates for and models the behaviors associated with the attitude. Even just watching a video of someone can serve as a model. You still want to help the learner practice any new behaviors associated with that attitude, but the role model is really a key component to the learning.

Before we move on to the next three learning categories, I'd like for you to think about your problem solving scenario for a moment. Do you notice that your scenario includes a new motor skill or a new attitude that your employees need to learn in order to solve the problem? If you do, jot that skill or attitude down on your handout. Don't worry too much if you don't, though.

Rebecca
If we recall the definition of problem solving I shared earlier, where the problem solver applies rules and knowledge to find a solution, we can see that problem solving primarily relies on three of Gagne's categories of learning. He mentions recalling verbal knowledge and applying rules and procedures, and then using thinking strategies to apply that knowledge to find a solution.

We're going to discuss each of these three categories in more detail. As we go through each one, think about where it might show up in your own scenario, and we'll give you a few moments to write your ideas down on your handout.

Verbal Knowledge

- Being able to state or describe something
- Examples
  - *Names or labels*
  - *Facts*
  - *Body of knowledge*

Rebecca
The first category of learning used in problem solving is verbal knowledge. It's also known as declarative knowledge because it involves being able to state or describe something. That something can be names, facts, or a body of knowledge.

- Names are exactly what you might think they are: the terms or labels we give to various things. For example, a new library employee would need to learn the names of different locations in the library where materials are stored.

- Facts are another type of verbal knowledge. They include statements like "The library closes at 8pm" and "Bibliographic records are stored in a database."

- The most complex type of verbal knowledge occurs when many facts are meaningfully organized into a body of knowledge. Someone who possesses a body of knowledge on a subject is able to use facts to support more general themes. For example, a librarian with knowledge of cataloging would be able to describe how the production of bibliographic records as surrogates supports discovery of materials.

Loading Bib Records   Providing User Service

Rebecca: In the problem solving scenario I described earlier, the cataloger would need to know the names of parts of a bibliographic record – fixed fields, variable MARC fields, statement of responsibility, authorized access points – and names of the various parts of the cataloging software. They would need to have a body of knowledge around cataloging, made up of many facts like knowing that each physical item on the shelf is represented by a record in the catalog. Most of this would likely have already been learned through earlier cataloging training, but it's important to think through what verbal knowledge is required for a given problem solving scenario to ensure that the learner has the necessary prerequisite knowledge.

Jennifer: When I look at my scenario troubleshooting user technology, I immediately notice all kinds of new labels, facts, and even bodies of knowledge that our new employees may not yet have. If the employee at the front desk doesn't know the names of the software programs—Access, SPSS, InDesign—they aren't going to get very far at all in even understanding what the user is asking. There are also a few facts that help the employee to solve a problem they've never seen before related to the public computers. Our public workstations use software called VeriLab which requires the user to login and wipes the machine clean between users—you probably have something similar. That's a fact about the computers. The front desk employees may also need to a set of organized knowledge— generally about how hardware works (i.e. that it needs to be plugged in and connected),

how software works (i.e. that most have menus and help files), even generally how magnetic strips and card readers work. All of these bodies of knowledge can also help solve thorny problems that arise.

Before we move on to the next learning category, think for a moment about your scenario. Do you notice verbal knowledge that is needed in order to solve the problem? Any names of things that your learner might not yet know? Any facts? Entire or portions of a body of knowledge? If so, jot it down on your handout.

Procedural Knowledge

- Learning to distinguish between things
- Learning how to do something
- Examples
  - *Books versus bound journals*
  - *Professors and students are users*
  - *We allow professors to renew books as often as they'd like*
  - *Procedure for renewing a book*

Jennifer

The next category of learning that is often involved in problem solving is procedural knowledge. Within this category are two different kinds of procedural knowledge.

- Learning to distinguish between things and put them into categories. An example in a library might be the ability to identify that a book is different from a bound journal, and both are printed materials and so different from DVDs and CDs. Or, that a professor and a sophomore are both users, and each belongs to their own subset of users—faculty member or student.

- Learning how to do something through rules and procedures are another way. A rule in a library might be that we allow faculty to renew books as often as they'd like, while a student can't renew their check-outs at all. Procedures are a sequence of rules—how to actually renew that book, for instance.

Loading Bib Records   Providing User Service

Rebecca: In my record loading example, it's important that the cataloger is able to distinguish between a record *overlaying* and a record *inserting* as a new record. The cataloger would need to know the procedure or steps to take to load records. And in addition to standard cataloging rules, there may also be local rules that should be followed. At JMU Libraries, we have some local rules about structuring unique identifiers for e-books from different providers.

Jennifer: So, if I think about problem solving related to technology problems at the front desk, I find quite a few procedural skills that need to be taught. The printer manufacturer has a procedure for opening all the different doors and drawers to find and remove jammed paper. There is a rule, too, which we teach to our front desk employees: you must get consent from the user before touching their personal laptop or phone.

Before we move on to the last category of learning, think for a moment about your scenario. Do you notice procedural knowledge that is needed in order to solve the problem? If so, jot it down on your handout.
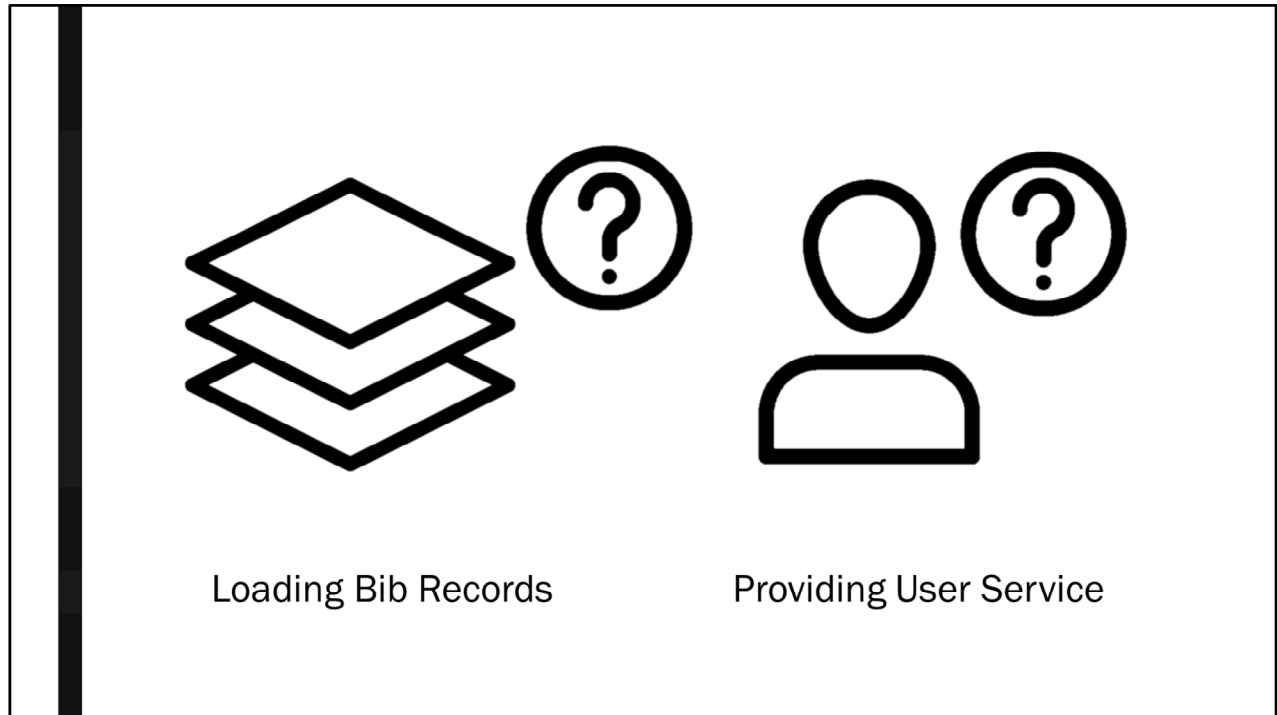
Thinking Strategies

- Ways learners manage their own thinking and learning
- Examples
  - *Highlighting*
  - *Rehearsal*
  - *Mnemonic devices*
  - *Selecting the best strategy for a particular situation*
  - *Rubber duck debugging*

Rebecca

The final category of learning is thinking strategies, also called cognitive strategies. These are ways learners manage and control their own thinking and learning.

Highlighting is a strategy that helps the learner pay attention to important information. Other examples of thinking strategies are rehearsal, which helps store new information in memory, and rhymes and mnemonic devices, which help recall information. Other strategies called metacognitive strategies help the learner think about their thinking. Many of us know that metadata means data about data, so metacognition is thinking about thinking. One example of this type of thinking strategy is when a learner selects the best strategy to use in a particular situation.
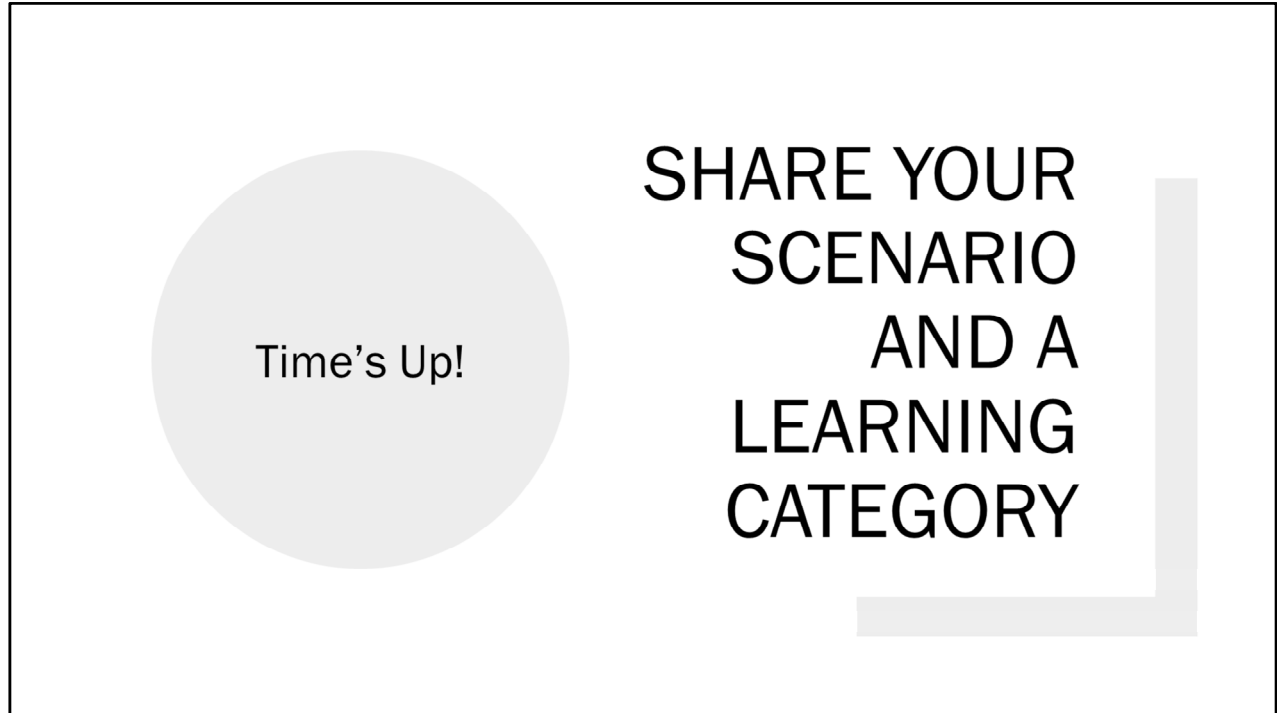
I suspect many of you have probably had the experience of explaining a problem to a colleague and realizing the answer in the course of your explanation. In computer science this is known as rubber duck debugging. If you get stuck, you explain your code, line by line, in very simple terms that even a rubber duck could understand. Slowing down and explaining the problem in simple terms like this is another thinking strategy that can be used in a variety of problem solving situations.

Rebecca: One thinking strategy that could assist in troubleshooting issues with record loads is to follow a standard troubleshooting checklist that outlines likely trouble spots that should be checked. This is an attending strategy because it guides the learner through what they should focus on. Evaluating the effectiveness of different attempted solutions is another thinking strategy that would be useful here.

Jennifer: When it comes to thinking strategies, there are quite a few that help when trying to solve a technology problem for a user. The employee needs to narrow down where they think the problem may lie, a type of thinking strategy called "attending." Another example of a thinking strategy is to know how far you should go with one hypothesis before you switch your approach and try a different hypothesis. Yet another example thinking strategy is to broaden your focus to think about anything you know about the particular technology at hand, or even something similar to it in a different environment, to see if that inspires something you haven't yet tried.

Think for a moment about your scenario. Do you notice a thinking strategy that is needed in order to solve the problem? Examples of ways to think?

Jennifer

If you thought of a thinking strategy to teach, jot it down on your handout. And when you are done, we would like you to turn to your neighbor and share your scenario and how at least one category of learning appears in what you will need to teach. We plan to give you about 3 minutes to accomplish this! If you are wondering how much time you have, you'll notice a timer on this slide.

Challenges in Learning Verbal Knowledge

- Experts have greater body of knowledge than beginners
- Cognitive load of trying to recall relevant information (names, facts, and how those are connected in a body of knowledge)

Rebecca

Now we're going to look at why teaching and learning in these three categories can be challenging, and give you practical tips for overcoming these challenges when teaching problem solving. Feel free to jot down notes and ideas on your handout as we go through each one.

When solving problems, beginners tend to start at the end and work backwards because they're not aware of the various paths they could take towards a solution. Research shows that experts, on the other hand, are able to start at the beginning and work toward the solution because they have more experience and a greater knowledge of the whole domain they're working in. In other words, the experts possess verbal knowledge that the beginners don't, specifically the body of knowledge relevant to the problem.

Another challenge of gaining verbal knowledge is the cognitive load the learner experiences when trying to recall names and facts. Working backwards, as beginners tend to do, also increases the cognitive load.

So how can we help beginners develop their knowledge of the problem domain in a way that doesn't add to their cognitive load?

Tip #1: Use Goal-Free Problems

- Learner is given information and asked to discover whatever they can
- Reduces cognitive load by removing the goal and preventing working backwards

Rebecca

A great way to do that is to use what are called goal-free problems. A goal-free problem is one where the learner is given some information and then asked to simply find out whatever they can, rather than working toward a specific goal.

Using a goal-free problem in my record loading scenario might look like asking the cataloger to play around in the cataloging software. We have a training version of our catalog set up for exactly this purpose, so there are no consequences for making mistakes or messing up data. Given some records to load, the cataloger could experiment with different things. What happens when they overlay records? What happens if they change a certain MARC field before loading a record? What if they use a different load table?

Even though we have an end goal in our problem solving scenario (which is to get the record loaded correctly), in this goal-free exploration we've removed that goal. This reduces cognitive load because the cataloger no longer needs to keep the goal in mind, and they can focus their cognitive resources on building their knowledge of the domain through exploration.

Our next tip is also going to help reduce cognitive load.

Challenges in Learning Procedural Knowledge

- Cognitive load of trying to recall concepts, rules, and procedures
- Trainer won't always be there to assist

Jennifer
Challenges in learning procedural knowledge

Just like with verbal information, it can be extra challenging to solve problems when the learner has to simultaneously recall concepts, rules or procedures. Also, you as the teacher won't always be there to help the employee—so then the learner can get stuck.

Tip #2: Use Job Aids

- Benefits
  - *Reduces learner's cognitive load*
  - *Provides concepts/rules/procedures at point of need*
  - *Helps automate application of rules and procedures*
  - *Creation helps trainer make implicit knowledge explicit*
- Can include verbal and procedural knowledge

Jennifer

A solution to that challenge is to provide job aids. A job aid might also be called a cheat sheet or a tip sheet. It's something that is quickly available exactly when you need it to help jog the employee's memory at a glance.

Look for a moment at the handout that is in front of you now. It includes a description and examples of each of the categories of learning. That's by design so that you don't have to recall that info AND also apply it. We were trying to reduce your cognitive load. A job aid is similar to that, but found in the workplace.

Inside the printer itself, you'll often find what is essentially a job aid when you see prompts of what to try and in what order.

An additional example in my problem solving scenario could include some small signs reminding employees of rules like: Get consent from the user before touching their personal laptop.

All of these things work to reduce the learner's cognitive load so that they aren't trying to recall procedures or rules that aren't quite routine yet while simultaneously trying to solve a problem.

Also, there is a side benefit of creating a job aid for you. Doing so forces you as the trainer to make implicit knowledge—things that you "just know"—more explicit so that you can then share it with others.

Challenges in Learning Thinking Strategies

- Many are implicit
- Take time to develop
- Different people may prefer different thinking strategies

Rebecca

One reason thinking strategies can be difficult to teach is that they're often implicit. As Jennifer just mentioned, with implicit knowledge we're not consciously aware that we know these strategies or when we're using them. They also take time to develop and refine through repeated use. Finally, thinking strategies can be very individual. A strategy that works well for me may not be very effective for someone else.

Tip #3: Use Cognitive Apprenticeship

- Expert thinks out loud while solving a problem
- Works with both prepared and real world situations
- Also good for teaching attitudes

Rebecca

Our tip to help learners develop thinking strategies is to use what's called cognitive apprenticeship. When teaching someone how to troubleshoot issues with loading bib records, I would have them observe me while I'm doing the troubleshooting and explain my thought process out loud – saying what information I'm looking for, what I learn from that, and the options I'm considering for different actions I could take. Having an experienced problem solver think out loud like this while solving a problem helps the learner see where different thinking strategies are used.

You can use cognitive apprenticeship with practice problem solving scenarios that you've created and thought through ahead of time, and it's also a great method for turning real world situations into teaching opportunities. When someone I'm training comes to me with a problem they've encountered, I'll think out loud as they watch me try to solve the problem. Doing this off the cuff lets the learner see that I don't always know the answer immediately, and that even experienced problem solvers encounter dead ends and have employ a variety of strategies to reach a solution.

I also want to briefly mention here that cognitive apprenticeship is a good method to use for teaching attitudes.

Challenges in Learning How to Solve Problems

- Pulls together:
  - *Recall of facts and knowledge (i.e. verbal knowledge)*
  - *Competence with applying rules and following procedures (i.e. procedural knowledge)*
  - *Ability in activating different strategies (i.e. thinking strategies)*
- Takes experience to learn how to solve problems

Jennifer

So, we have one more tip for you and it's based on just how difficult it is to learn how to solve problems.

As we've explained, problem solving isn't just a simple skill. It's a combination of skills: recall of facts and knowledge, applying rules and procedures, activating different strategies

It just simply takes experience to learn how to do each of those things—and then to combine it all into one fluid practice. And since problem solving involves novel problems, it takes experience where each example is different.

Tip #4: Provide Practice

- Incorporate practice in formal instruction, informal coaching, and/or on-the-job experience
- Provide practice problems that relate specifically to the job
- Provide guidance which focuses on the process

Jennifer

Rather than allowing an employee to gradually accumulate that experience on the job, a proven method of teaching problem solving skills is to give the learner practice problems when you can provide feedback when they get stuck.

We all have had this experience. With practice, you start to find that you don't need to think about the names of things, rules, procedures, or even ways of thinking—those things just become automated. The ideal is when you don't need to think about those things, when you just "know" it—and the way to get there is practice.

Some guidance for providing practice for teaching problem solving:

- Incorporate practice wherever you can: in a classroom, during informal coaching, and on-the-job by pairing new employees with more experienced employees.

- The practice problems should be related to the job. Research has not found that generic problem-solving skill training is effective, but it has found that domain-specific training is.

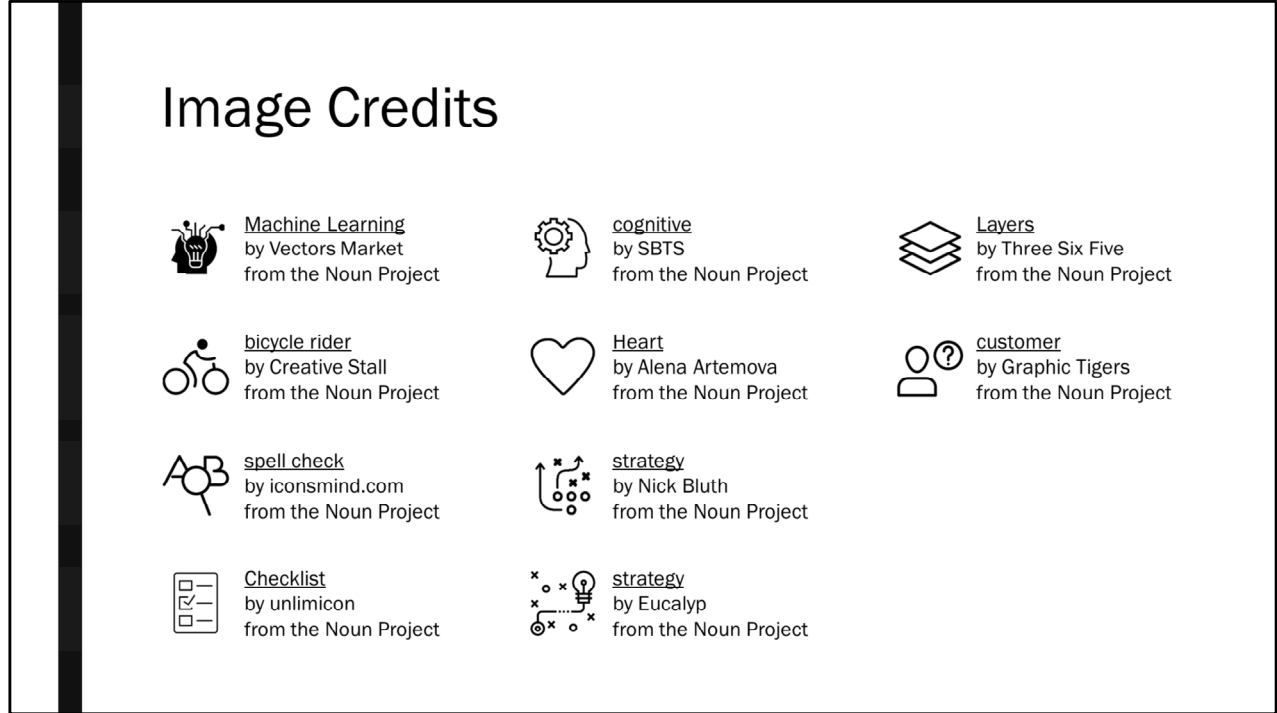- Finally, the feedback you provide during practice should focus on when and how to

apply rules and knowledge and new ways to think like the cognitive apprenticeship that Rebecca just described—not on getting the right answer.
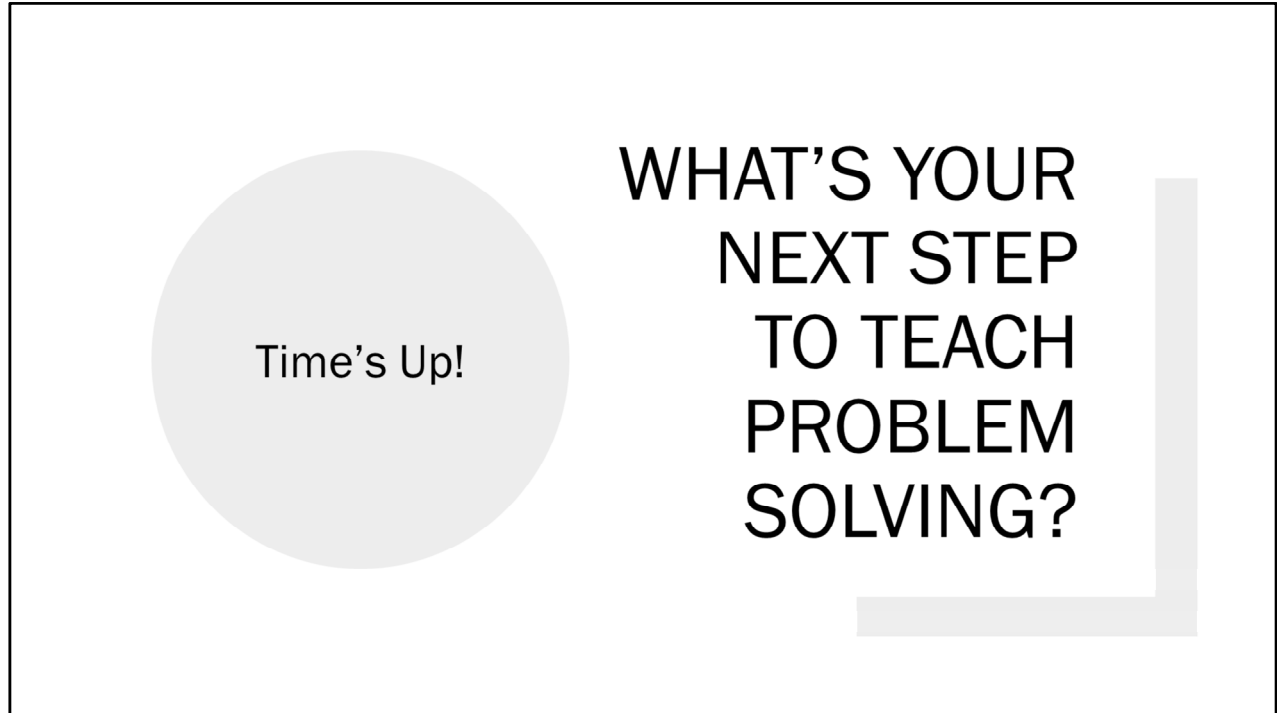
Jennifer

On the back of your handout, you will see that we listed the tips that we shared today for each of category of learning. Now, we want to give you a chance to think about your next step in teaching someone to solve problems. Will you develop a goal-free problem for your employee to explore? Will you create a tip sheet? Think through your own cognitive strategies so that you can describe them to someone else? Create practice problems?

Jot down some ideas and when you are ready, discuss your "next step" with your neighbor. We have about 3 minutes for this activity.

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Rebecca

As we wrap up, I'd like to quickly give credit for the images we used in this presentation.

What Questions Do You Have For Us?

- Gagné's five categories of learning
  - *Motor skills*
  - *Attitudes*
  - *Verbal knowledge*
  - *Procedural knowledge*
  - *Thinking strategies*

- Four tips for teaching problem solving
  - *Use goal-free problems*
  - *Use job aids*
  - *Use cognitive apprenticeship*
  - *Provide practice*

Rebecca

Gagné's 9 Instructional Events

1. Gaining attention (reception)
2. Informing learners of the objective (expectancy)
3. Stimulating recall of prior learning (retrieval)
4. Presenting the stimulus (selective perception)
5. Providing learning guidance (semantic encoding)
6. Eliciting performance (responding)
7. Providing feedback (reinforcement)
8. Assessing performance (retrieval)
9. Enhancing retention and transfer (generalization)

Werner, J. M. & DeSimone, R. L. (2012). *Human resource development* (6th Ed.). Mason, OH: South-Western.

This is a hidden slide in case someone asks about this part of Gagne's theory.