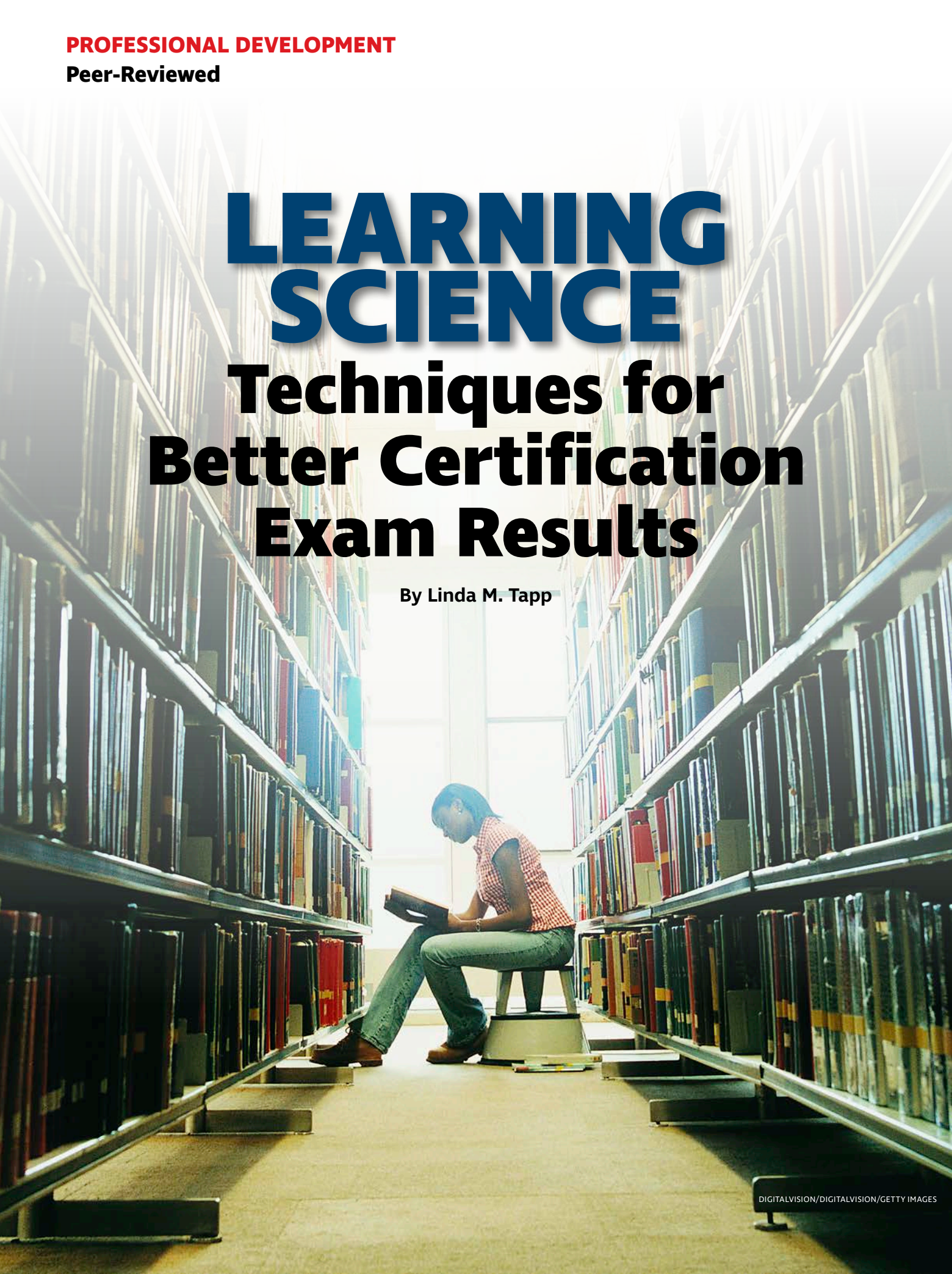
LEARNING SCIENCE

Techniques for Better Certification Exam Results

By Linda M. Tapp



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LEARNING SCIENCE IS AN INTERDISCIPLINARY FIELD of study that includes the neuroscience of learning, educational technology and cognitive science. It is often discussed among talent development professionals such as trainers, facilitators, instructional designers and teachers at every level, from grade school through university. The research that supports established learning science principles has shown that there are techniques to help individuals learn information better and retain it longer.

Several of these techniques, such as repetition, reinforcement, spacing, retrieval practice, realistic examples, microlearning and testing, can be used by anyone studying for certification exams such as those offered by BCSP and the Board for Global EHS Credentialing to make it easier to remember and recall information when needed and long after the examination is completed.

Learning science has been studied for many years, but it is likely not commonly used by OSH professionals studying for certification exams. Many people take certification exams long after they have completed formal education, so study techniques that may have been successful while in school may have been forgotten or are simply outdated. While many professionals understand the value of achieving one or more certifications, they may struggle with how to prepare for these exams. Especially when a potential test taker has been away from formal schooling for many years, getting back into the studying and test-taking habit can seem daunting (Klein-Collins, 2018). Using research-based techniques from learning science can help make study efforts more successful regardless of the test and can help safety and health professionals become more knowledgeable.

Value of Certification

The value of professional certification has been studied and documented. A recent study by BCSP and the National Safety Council (NSC, 2020) found that certified safety, health and environmental professionals typically earn $17,700 more per year than those with no licenses or certifications, and that those with the CSP certification earn $27,700 more per year (Figure 1). Also, many employers posting vacancies for OSH professionals often include a safety, health or environmental certification as either required or preferred for applicants.

This article is not about what materials to study, where to find those materials, or even about test-taking strategies. All those things can be found in study group discussion forums and on the certification provider websites. This article offers suggestions for approaching certification study plans in a way that helps an individual learn and retain exam content so that the information can be recalled not only when presented with related questions on an exam, but also long after the initial certification has been achieved.

KEY TAKEAWAYS

- **Principles of learning science can be applied to certification exam study efforts to increase retention of exam study material.**
- **There are nontangible benefits to learning and retaining material covered in professional safety and health certification exam blueprints including the application of newly learned knowledge to everyday responsibilities.**
- **Learning science techniques used by those studying for exams can also be used for creating and delivering information in safety training classes, which can result in greater attention and retention by trainees.**

Techniques

Cramming

Cramming refers to the process of trying to learn as much information as possible in a short time only to regurgitate it shortly after. While many people have used this technique to study for and pass an exam, this method will not likely be successful when preparing for certification exams due to the vast amount of information that must be studied and recalled. Cramming is generally not a pleasant experience, but it can be effective. However, it is effective only when the information needs to be recalled shortly after the time spent "cramming" it into the brain (Glenn, 2007; Sarma & Yoquinto, 2020; Young, 2019). For example, if a person could take a certification exam one section at a time, spending an hour or two right before the test cramming the information covered in that section into short-term memory would likely result in at least a passing grade. In this scenario, cramming was a successful strategy; but if that same information must be recalled in a month or two, the individual would likely not remember the crammed information and would need to restudy it.

With exams such as comprehensive certification tests, the quantity of material is so vast and broad that it is highly

FIGURE 1

HOW CERTIFICATION AFFECTS OSH PROFESSIONAL EARNINGS

Note. Data from "2020 SH&E Industry Salary Survey," by BCSP and National Safety Council, 2020, https://bit.ly/3EvDXLZ.

unlikely a test taker would be able to successfully memorize that much knowledge before the exam. Additionally, many certification exam questions are written to determine whether the test taker can apply the covered information, not just restate it. Learning to apply principles cannot be easily done through sheer memorization. To truly learn the materials being studied so that one can successfully pass a certification exam, as well as store that same information for future use, an individual can apply the principles of learning science to increase the odds of success.

Repetition, Spacing & Reinforcement

One of the first ways many students learn is through repetition. Sousa (2011) states that "rote rehearsal is valuable for certain limited learning objectives" but that "it doesn't mean we understand the information or can apply it to new situations" (p. 93). With respect to safety information, few areas can benefit from sheer rote rehearsal (repetition), such as what to do in case of fire (stop, drop and roll) and steps for using a fire extinguisher (pull, aim, squeeze and sweep). With respect to certification exams, topics that lend themselves to memorization may include classes of chemicals, different flash points and their classifications, or procedures with a distinct set of correct steps.

Repetition as a certification exam study technique can be improved by repeated sessions and in conjunction with spacing out the repetition events. To learn through repetition with spacing when studying for certification exams, the information should be revisited frequently, since "every time we recall information from long-term storage into working memory, we relearn it" (Sousa, 2011, p. 134). Simply reviewing notes or highlights in a study guide over a given period will help to remember the information being studied. Looking at something once will likely not commit it to long-term memory. Every time the information is reviewed, it becomes easier to retrieve subsequently (Pollock & Jefferson, 2012).

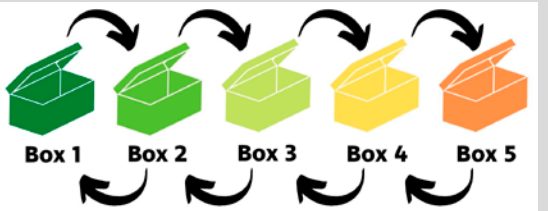
Spacing can successfully increase retention because after information has been given attention, it is put into short-term/working memory where it stays while the brain tries to determine whether it is worth moving to long-term memory. If it is, the information is encoded and stored until needed later. When the brain experiences the right trigger later, it will recall the information from long-term memory, and adapt and apply it (Pollock & Jefferson, 2012). If study sessions are spread out, at least some forgetting will have taken place between each session. Each study session will require more work to retrieve the information from memory, which leads to mastery and stronger memories (Lang, 2016). "The increased effort to retrieve the learning after a little forgetting has the effect of retriggering consolidation, further strengthening memory" (Brown et al., 2014, p. 49).

Reinforcement aligns closely with repetition. Reinforcement is simply experiencing ideas, concepts and information more than one time. A key to effective reinforcement and learning is to change the way the information is presented. If a person always looks at a particular set of study questions or one study guide, material is being reinforced in the same way every time. If a person uses multiple study sources and formats, the same information is covered but the different perspectives and various formats will lead to a more effective type of reinforcement. According to Bjork and Bjork (2011):

> When instruction occurs under conditions that are constrained and predictable, learning tends to become contextualized. Material is easily retrieved in that context, but the learning does not support later performance if tested at a delay, in a different context, or both. In contrast, varying conditions of practice—even varying the environmental setting in which study sessions take place—can enhance recall on a later test. (p. 58)

FIGURE 2
LEITNER BOX SYSTEM

In the Leitner box system, when starting, all flash cards are in Box 1. When a card is answered correctly, it moves to the next box down. When a card is answered incorrectly, it moves to the next box up. Cards in Box 1 should be reviewed the most often, and cards in Box 5 should be reviewed the least often.



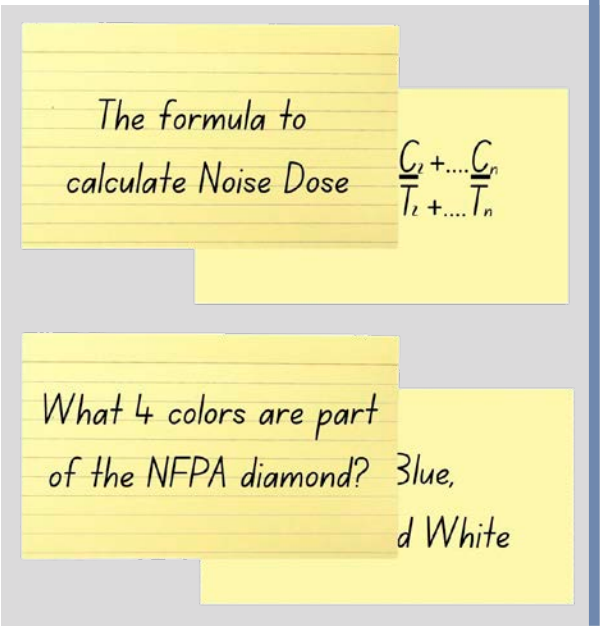
Retrieval Practice

Retrieval practice is a way of testing what was remembered by actively trying to retrieve specific information from memory. Retrieval practice often includes repetition and may involve spacing. Many people have used retrieval practice alongside repetition by using flash cards to study. All levels of students still use these today, including adults studying for certification exams. Online flash card websites and mobile applications are filled with higher-level study materials, including question sets for most popular certification exams. Retrieval practice works because "every time we extract a piece of information or an experience from our memory, we are strengthening neural pathways that lead from our long-term memory into our working memory, where we can use our memories to think and take actions" (Lang, 2016, p. 28).

Flash Cards

Flash cards have long been a popular way of remembering information through retrieval practice. Sebastian Leitner, a German scientist, developed his own flash card system in the 1970s that became known as the Leitner box system. This system was a series of boxes with the first box containing the study materials that needed to be frequently reviewed because mistakes were often made with these materials. The other boxes contained flash cards that were more easily recalled. If attempting to follow the Leitner box system, practice exam questions that are frequently missed would be placed in the first box. A second box would contain flash cards that are generally answered correctly, and other boxes would contain cards reviewed the least often because they are the easiest to

FIGURE 3
FLASH CARDS EXAMPLE



recall. When using a system such as the Leitner box, flash cards selected and not answered correctly are moved to the next box up so that they will have to be reviewed more often (Figure 2). For example, if a card was drawn from Box 2 and the answer was not known, it would be moved to Box 1. The idea behind the Leitner box system is that the better something is known, the less often it must be practiced, and although a piece of information is known extremely well, it will never completely disappear from the review (Brown et al., 2014). It can be a confidence builder to attempt and successfully practice questions that are easily answered, but time is better spent on those questions that are challenging. The description of a box here is only symbolic, and although the activity could be done with numbered boxes, separate piles representing boxes can work equally well.

The way flash cards are created and structured can also help determine their effectiveness. Flash cards usually have one side that shows a question, and the reverse side includes the answer (Figure 3). Studying using flash cards can be more effective if they are written in a way that requires more retrieval than recognition. For example, it is best not to write a multiple-choice question on the front of a flash card with the one correct answer shown on the back even though that is often the format on actual certification exams. This format is simply a recognition test. A question written in a fill-in-the-blank format is better for testing retention because it is more difficult. As Young (2019) says, "Cued recall tests, in turn, are better than recognition tests, such as multiple-choice answers, where the correct answer needs to be recognized but not generated" (p. 125).

To use flash cards correctly, self-discipline is required to not turn it over to see the correct answer until sufficient time has been spent to come up with the correct response. If questions and correct answers are simply reviewed, flash cards as a study method will not be as effective as a process where the answer is first retrieved from memory before confirming it by flipping over the card (Wissman et al., 2012). If the temptation is too great to peek at the back of the card, one solution would be to leave the reverse side blank and require the correct answer to be verified later. As Brown et al. (2014) note:

> Trying to come up with an answer rather than having it presented to you or trying to solve a problem before being shown the solution leads to better learning and longer retention of the correct answer or solution, even when your attempted response is wrong, so long as corrective feedback is provided. (p. 101)

As noted, varying study materials and methods are beneficial to reinforcement activities. An easy way to do this with flash cards is to review the cards the opposite way they were likely intended. To do this, the answers (on the back) serve as the prompts and are reviewed first, and the question is what must be recalled from memory. (Think of the way the *Jeopardy!* television game show contestants must phrase their answers in the form of a question.) If flash cards are reviewed the same way or in the same way often enough, even if they are written as scenario prompts or as fill-in-the-blank questions, the answers may become rote, and the flash card system will be less effective.

Realistic Applications & Examples

In addition to fill-in-the-blank formats, a question that requires a scenario to be described is also effective in increasing retention of training material. For example, instead of a flash card question asking for a definition of a safety procedure such as confined space entry, the front of the card would include prompts to describe a location and situation where confined space safety procedures would be necessary and why. This not only forces retrieval of key facts but also aids in retention by including the value of storytelling and real-world application.

When creating stories or when answering flash card scenario questions, making the story personally relatable will help it be memorable. For example, if an exam topic is closely related to a specific workplace application, working through the details of how that study topic works in real life will help that information be more easily recalled when needed. As Young (2019) notes, "vivid, meaningful things are more easily recalled than banal or arbitrary information" (p. 161).

Feynman Technique

Creating stories as a learning technique is also an important function in the Feynman technique, a system for learning created by Nobel-Prize-winning physicist Richard Feynman (Hollins, 2017). The Feynman technique includes four basics steps:

1. Pick a concept and write it out as if explaining it to a child (no technical words or jargon).
2. Identify areas where the concept was difficult to explain. This is where gaps in knowledge exist. Then go back and find the missing information, study it, and try to explain that information as if to an 8-year-old.
3. Organize notes into a story that is simple and easy to understand. If confusing parts remain, the summary story should be rewritten.

4. Tell someone else about it. A good way to determine whether the material is understood is to try to explain it to someone else.

When studying for a certification exam, the same steps Feynman used to ensure that he clearly understood something he was trying to learn can be used as a reality check on perceived comprehension.

First, the concept being studied should be written out as if explaining it to a child. Imagine speaking to a class of fifth graders and trying to explain a complex idea in a way they will easily understand.

Exam questions involving mathematical calculations may be difficult for exam takers depending on their background and expertise. One such exam topic is ventilation, provided on the publicly available exam blueprint for BCSP's CSP exam. Imagine someone studying the formula for air changes per hour (ACH). The formula (ACH = CFM · 60/area · height of ceiling) could be memorized, but that would not ensure that the concept was understood. The Feynman technique could be used to determine whether the concept of ACH is understood, as well as the formula associated with it. Is it possible to describe the ACH calculation so that a child would understand it?

> Once a learner becomes familiar with the various methods of increasing retention, the individual can apply these methods to other areas.

If an attempt to explain a study to a child fails, the second step of Feynman's technique comes into play. Review resources and research documents that will help fill in the gaps and information needed to better explain the idea on the next attempt.

Once the idea can be easily explained, Feynman's third step dictates that the notes created when working to understand the concept be turned into a story. A short story explaining the concept will be an excellent summary of key information and helps test takers remember it. In the previous ACH example, thinking of a real-life situation (e.g., the need to decide which size air conditioner to purchase for a specific room) and working through it using the information learned and understood about ventilation would meet the requirements of Feynman's third step.

It can be difficult to remember specific measurements required by standards-setting organizations such as OSHA. One such example is 29 CFR 1926.451, which is related to scaffold safety. This scaffold safety standard has many specific measurements that must be followed, and these may be tested on a certification exam. A planned effort to identify where these requirements apply by consciously stopping and reviewing all scaffolding encountered with an attempt to tie in study material will help make the study information more concrete. If a non-safety professional is present, explain the hazards and associated safety measures in place and why they are important. If experiencing difficulty explaining these concepts, this may indicate that the concepts are not as well understood as originally thought, and more study time is needed on that subject.

Teach Others

Feynman's last step is to tell others about the topic being learned. Safety professionals often do this when providing safety training. Before delivering a complex or technical topic, many professionals make certain they have their facts straight and can easily explain the concept to others. If a safety professional cannot clearly and simply deliver an explanation to trainees, the trainer may lose credibility and the trainees may not learn key safety information. One of the best ways to learn new information is to present it to others (Fiorella & Mayer, 2013).

Study groups can also benefit those preparing for certification exams by adding in accountability and collaborative learning, but they can be even more effective if the last Feynman step is integrated into the group's way of operating. Each week, a different member of the study group can take responsibility for doing a deep dive into a specific topic, then teaching that topic to the others in the group. Preparing to present information clearly to a group of others, particularly if those in the group ask questions and can help illuminate gaps in knowledge, is a great way to not only learn new information but help increase retention as well.

Microlearning

Cognitive load refers to the amount of information the brain must process. With too much cognitive load, the brain will be overloaded, and less long-term learning will take place. John Sweller introduced cognitive load theory in 1988. This theory states that content needs to be broken down into more manageable chunks, which allows the brain to convert information from short-term memory into long-term memory and application (Sweller, 1988). By tackling study material in shorter sessions, cognitive load is lessened and the material will be more easily moved into long-term memory.

Once information is in short-term memory, it must be processed so that the brain can make sense of it. When too much new information enters short-term memory too quickly, the brain cannot handle it. As with the delivery of safety training, too much content decreases the amount learned (Pollock & Jefferson, 2012).

Instead of studying for a certification exam all weekend for 8 hours or more a day, the same content could be studied in shorter increments over time. Instead of 16 hours in a weekend, an hour every night or perhaps 15 minutes before work in the morning and 15 minutes during lunch can make it easier to learn and remember information (Young, 2019).

The Benefits of Difficulty

Greater effort to retrieve what was learned after some of the information has been forgotten has been shown to strengthen memory (Brown et al., 2014). Much of learning is failing, and when we fail, we often (or at least should) learn from that experience. Failure often results in greater determination to improve on future attempts. Building in difficulty, and therefore a greater chance of failure, is one way to trick oneself into more focused learning and retention.

Failure might not seem to be beneficial when studying but, as discussed, the idea of productive failure would indicate otherwise. Psychologists have identified an inverse

relationship between retrieval practice and the ability of that practice to ingrain learning: The easier knowledge or skills are to retrieve, the less effect retrieval practice will have on retaining the information. Conversely, the more effort one must make to retrieve knowledge or skills, the more effective retrieval practice will be at strengthening it (Brown et al., 2014).

Pre- & Post-Testing

Another concept from learning science that can be applied when studying for certification exams is the practice of pre- and post-testing. When studying for a certification exam, it may be common practice to study material, take a practice exam to see how well one learned the material, then go back to study those areas where knowledge gaps existed. While this is a great idea, it is also beneficial to take a practice test before beginning to study. While results may not be impressive, it will help provide focus on key information, as the brain will be trained to look for specific gaps in knowledge. As Carey (2015) notes, "taking a practice test and getting answers wrong seems to improve subsequent study because the test is directing the learner in some way to the kind of material that is needed to know."

Confidence Ratings

Pre- and post-testing can be even more effective by adding confidence ratings to each answer. A confidence rating can be written next to each question after the test taker has answered. For example, if the first question of a practice test is relatively easy to answer, a 100% confidence rating could be written next to that question. If the answer to the next question is not known, a 10% confidence rating might be written. By simply applying a confidence rating to each question, the chance of failure increases. If a question is answered incorrectly, the learner will experience one type of failure. If a confidence level is wrong, it can show the learner that they are overconfident in a particular area, which is another kind of failure.

Value of Learning Science for Safety & Health Professionals Other Than Certification Preparation

Once a learner becomes familiar with the various methods of increasing retention, the individual can apply these methods to other areas. Safety professionals responsible for creating or providing training materials can use techniques such as repetition, reinforcement, spacing, retrieval practice, realistic examples, microlearning and testing to help trainees learn and remember content as well. Using these methods in training can help lead to greater transfer of newly learned skills on the job by the individuals participating in those training classes.

Continuous learning is an important part of maintaining a high level of professionalism within the safety and health community. Instead of simply reading articles and attending educational sessions, taking additional steps to dive deeper into new material will not only provide greater return on professional development efforts, but also can be key to linking newly learned information to what is already known, as well as increasing the application of the new information to day-to-day responsibilities.

One key aspect of well-designed certification exams is that they require the test taker to be able to apply knowledge and not simply restate information. Memorizing facts and statements is not necessarily useful when safety information is needed in the field, nor should it lead to a passing score on certification exams. Understanding the concept well enough so that the principles can be used to solve related (and sometimes unrelated) problems is key to successfully passing not just certification exams, but any type of test. Additionally, approaching certification exams in this way will help the time commitment given to passing a test have longer and more valuable benefit if the newly learned information can be applied on the job in a way that keeps workers safe. **PSJ**

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