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ACTIVATING PRIOR KNOWLEDGE

Barr and Tagg (1995) noted the importance of shifting the focus of education from teaching to learning. Understanding the learning process helps us identify teaching strategies that will assist students with learning and applying new information. Knowledge is cumulative, and learning new information is heavily influenced by what is already known. For more than 100 years psychologists have held that prior information is extremely important in the learning process (e.g., Baldwin, 1898; James, 1890). With recent advances in cognitive neuroscience, prior knowledge has been shown to be even more important than previously thought (Willingham, 2009). For many decades, the strongest psychological models proposed a relatively simple three-step process (Atkinson & Shiffrin, 1968). According to this information processing model, new information arrived through your senses (sensory memory), and if attended to, the information made its way to short-term memory. If the information was not attended to, it was lost. The attended to information was thought to be held in short-term memory for roughly 20 seconds, long enough to process the information in some way. Here, content would either be immediately put to use in some way or lost. If the student actively worked with the content, then it was believed the content would have a good chance of making it into long-term memory where it could stay forever. A generation of learners were taught this relatively simple one-directional model of memory. This model has evolved over time because of our increased understanding of the interactive nature of how memory works (Willingham, 2009). Thus, although many of the core elements of Atkinson and Shiffrin (1968) model still serve as a useful framework, it is important that our understanding of memory reflects current research.

Research has shown that learning is incremental (Goswami, 2008) and that our experiences and knowledge influence what we perceive to be important or not important (Willingham, 2009). The original Atkinson and Shiffrin (1968) memory model focused on how information moved from one stage to the next, not why it was attended to in the first place. As we encounter new stimuli, our brain quickly scans and searches our long-term memory to help decide whether this new information is worthwhile and needed. Thus, new content coming in through our senses is not all treated the same; some information will get preferential treatment because of our past experiences (Snyder, Holder, Weintraub, Carter, & Alain, 2009). Researchers have found that we are indeed influenced by our prior experiences and knowledge as we learn new content (Heit, 1994).

Another significant change in our understanding of memory relates to what Atkinson and Shiffrin (1968) called *short-term memory*, which began to be referred to as *working memory* (Baddeley & Hitch, 1974). Working memory has been determined to be a more accurate descriptor of what happens during this stage because we are working with new content in hopes of retaining it. Baddeley and Hitch (1974) argued that working memory is complex, with subsystems working together in an interactive manner to help us learn new content. However, much of the short-term language is still accurate and meaningful. For example, we are limited in how much content we can work with at a time. In classic studies by Miller (1956), it was demonstrated that we are only able to hold on to and work with about seven chunks of information at a time. In addition, we quickly lose the new content coming in if we do not actively use it in some way. Thus, our working memory is limited, meaning we can only work with a few new concepts at once. It is also important to note that we do not have long to hold on to information in working memory, often less than 30 seconds, unless we are actively using the information. Using effective memory strategies such as imagery and elaboration in this part of the process is therefore necessary (Unsworth, 2016). This also demonstrates why it is important to periodically have students in class apply the information just learned.

The primary challenge in learning is moving information from working memory to long-term memory. One of the most important factors in getting information into long-term memory, and there are many, is our prior or related knowledge. It is much easier to learn new information that is related to content we already know than to learn something totally new. During the working memory part of the memory process, we search our

If we discover that we do know information about the topic, we make connections with our previous knowledge, building neural networks through a process called *elaboration* (Schwartz, Son, Kornell, & Finn, 2011). These connections to previously established neural pathways increase learning, as they allow us to build on what we already know. If, however, we search our long-term memory and do not find any related content or experiences, neural pathways must be built from scratch, a more time-consuming and cumbersome process (Cameron, 1993). This explains why experts are able to take in and learn new information faster and with less effort than novices; they have many more prior experiences and significantly more knowledge that allows additional connections to be made to new information and skills being learned. Their long-term memory is a gold mine of information, making it very easy to attach new content to previously learned content. Novices, in contrast, do not have already established neural pathways, so they need to work hard at creating new neural pathways and building connections as they learn new content. Sometimes novice learners may have relevant information in their long-term memory, but the connection between the new content and the previously learned content may not always be obvious (Goswami, 2008). Experts not only have more information to work with, but also are able to more easily identify the possible connections between new and old information. This is why it is so helpful when faculty, who are the experts, explicitly point out connections that may not be immediately apparent to students. Thus, prior knowledge on a subject matter directly affects how we take in and learn new information. Sterner and Wedman (1996) demonstrated that prior experience with solving problems also influenced the learning process. Thus, what we have learned previously helps us learn new information.

If information is successfully moved to our long-term memory, there is no limit to the length of time the information or skill may be retained. Individuals who are 80 or more years of age may well recall events or information from their childhood with amazing accuracy. Long-term memory is limitless with respect to capacity, meaning we can store as much information as we want or need. It is impossible to fill our long-term memory. However, it may be difficult to find or retrieve information when needed, especially if we have not stored it in a way that promotes easy access. Storing the content in an organized fashion will help us retrieve the information when we need it. Think about how much easier it is to find your document files on your computer if you have clearly titled folders and sub-

to find a specific file. The categories used to mentally organize information we encode are often referred to as *schemas*. Piaget, a developmental psychologist, coined the term *schema* and talked about how schemas change based on our learning experiences (Woolfolk, 2013). When we learn, we modify existing schemas to accommodate the new information or create additional schemas to house the new content. Our schemas therefore increase and grow in complexity as we learn.

The more frequently we access or use specific content, the easier it will be to retrieve it when needed at a later time. By retrieving information over and over again, we're building strong, efficient neural pathways that make the information easily accessible. In addition, prior knowledge increases the likelihood of our using more efficient parts of the brain for learning. In a fascinating study, van Kesteren and colleagues (2014) examined brain activities during learning. In this study, second-year undergraduate students underwent fMRIs (functional magnetic resonance imaging) while they were learning new content. Some of the content was based on previously learned content (prior knowledge), whereas other content was unrelated to material previously covered. Participants in the study with prior knowledge about the new content being learned were more likely to process this information using efficient brain functions, which led to increased learning (van Kesteren, Rijpkema, Ruiter, Morris, & Fernàndez, 2014).

Having adequate background knowledge not only is important during lectures but also can significantly affect other academic tasks. Reading, one of the primary avenues for learning, is an important example. The role of prior knowledge in reading comprehension was investigated in a classic study by Recht and Leslie (1988). In this study, students were placed into groups based on whether they were poor or good readers and whether they had high or low content knowledge about baseball. The students were asked to read a passage on baseball, answer questions about the passage, and re-create the story nonverbally. Not surprisingly, overall, the good readers who had high baseball knowledge performed the best, and poor readers who had low baseball knowledge performed the worst on a comprehension test. The fascinating finding, however, was that the poor readers with high baseball knowledge performed almost as well as the good readers with high baseball knowledge, and the good readers with low baseball knowledge performed almost as poorly as the poor readers with low baseball knowledge. Knowledge of baseball was more important than reading proficiency when reading a passage and then answering questions about that information (Recht & Leslie, 1988). Thus, this finding highlights the importance of

able to take in and comprehend new information via reading. In fact, this research demonstrates that prior knowledge matters more than reading skills. The importance of prior knowledge has also been found in other academic tasks such as improved note-taking skills (Wetzels, Kester, van Merrienboer, & Broers, 2011).

Given this understanding of how memory works, activating students' prior knowledge on the subject being taught will help students take in the content in a way that is more efficient and effective. Often students will have some background knowledge on a topic, but for a variety of reasons, this information doesn't jump out at students as they are searching their long-term memory for help with learning new content. It may be that the needed content has not been retrieved often so the neural pathway isn't as accessible, or it could be that as novice learners, students do not immediately recognize how the prior knowledge may be connected or related to the new content. This is where your assistance as the professor is needed to help students to process information presented during lectures.

As the expert in the subject matter, you play a key role in helping students identify what type of information might prove helpful in learning the new information. For example, if students don't have much prior knowledge on how memory works but do have a basic understanding of computers, professors can help students access their knowledge on how information is stored using a computer as an example. This knowledge can then be used to help facilitate new learning. For instance, students will likely be able to understand how the computer temporarily stores what is written in a document, but it is not stored permanently until it is officially saved. This analogy can be used to help students understand the difference between working and long-term memory. Although analogies such as this one can be incredibly helpful to some students, they can also negatively affect the learning experience for students who are not familiar with the related concept. We must always be mindful that examples used in our lectures may not resonate with students who are significantly younger than we are, come from different cultures, or for whom English is not their first language (Littlemore, 2001). Knowing what your students know will help you identify relevant information that will assist students with taking in new information. As the professor, you also have the opportunity to build knowledge as the course progresses. Thus, students at the end of a course will be able to use information learned at the beginning of the course to help them take in the new content. This will also be the case with courses that

will serve them well as they continue learning throughout their college experience and in life.

LECTURE ENHANCEMENT STRATEGIES

Activating prior knowledge is a key consideration in helping students learn new information, and there are several ways to promote this activation during a lecture. The following strategies are designed to assist you in helping students activate their prior knowledge. If you already use some of these lecture enhancement strategies, think of ways to adapt them for future use.

Pretest

A pretest is an effective method to assess what students already know about the subject for two primary reasons. First, it provides you with a good overview of what the students in the class know and don't know about the subject, including whether students have previously learned inaccurate information. If students have an inaccurate knowledge base, this can make new learning very difficult. Although it is certainly possible to unlearn the content, this is more difficult than simply learning new content. Challenging faulty thinking takes much time and effort. The information you discover about accurate and inaccurate prior knowledge, or the absence of prior knowledge, can be used to develop effective lectures and lecture activities. The second primary reason for this technique is that engaging students in the retrieval practice of previously learned content brings immediate attention to this content. In essence, you have activated relevant prior knowledge so that it is more readily accessible to the student and will aid the student in learning new content in the future. This type of activity might be particularly important if you are teaching a course with a prerequisite. If the content learned in previous courses is essential to the new content you'll be presenting, it will be important for you to know how well your students understand the prerequisite material. A pretest can guide how you proceed. It may be necessary to provide students with online support materials to help them refresh their memory for this content, or you may even need to devote some class time to review previously covered material.

throughout the semester prior to starting a given type of lecture for the day is an effective way to continually activate prior knowledge and monitor students' learning progress. It also provides an excellent opportunity for students to retrieve previously stored information so that it is very accessible as they strive to learn the new material. It puts the previous content front and center, so when you introduce new concepts in the lecture students won't have to look too far to make connections to material recently covered. Quizzes could occur before class using online tools, at the beginning of class, or at any point within the class period. Although formal quizzes are valuable, informal quizzing can also be quite helpful. Informal quizzes are typically brief and are often not graded. Polling software, such as Poll Everywhere and Kahoot!, or classroom clickers allow students to take brief quizzes using technology tools, and the responses from the class can then be displayed on the board and integrated into your lecture. These tools make it very easy for you to assess how well students are learning your course content and activate this prior knowledge so they are ready to take in the new course content you are about to present. If you or your students don't have access to technology or are in a space where technology is limited, you can use no-tech options for polling or quick quizzes. For example, you can ask students to raise their hand to respond to a true-or-false or multiple-choice quiz question or ask students to raise colored index cards representing the different answer choices. Regardless of the method you select, quick quizzes activate prior knowledge and provide you with incredibly useful information as you continue to lecture on a topic.

Dusting Off the Cobwebs

Sometimes you'll discover that students' background knowledge is so limited or even nonexistent it makes activating prior knowledge almost impossible. Although this may be the case on the very first day of class, it is a short-lived problem. Once you've had the opportunity to build some background knowledge through your lessons, you can help students activate content you have taught them. The dusting-off-the-cobwebs exercise is a great way to activate prior knowledge at the start of class prior to starting the lecture strategy for the day. For this exercise, you can assign partners or students can self-select their partners; however, changing partners every time you do the activity is recommended. In the starting step of the exercise, ask students to discuss what they learned during the pre-

missed. In essence, they are filling in the information gaps. Give them another two minutes for this step. The final step is a large-group review where you randomly call on students to briefly share a concept from the prior class or from the reading assignment. Randomly calling on students helps keep students on task during this activity. Most students, even those who may not be frequent participants, are comfortable sharing their ideas after this activity because they had four minutes to think about and discuss the content. It is therefore a relatively safe strategy to use with students who may not typically contribute to class discussions. If you are going to randomly call on students, inform them prior to beginning the exercise so students will expect to be called on. This large-group review typically takes about five minutes, depending on the complexity of the concepts, the level of student understanding, and the depth of the review. Because this activity takes about 10 minutes in its entirety, you might use it once per week rather than during every class period. In addition to activating their prior knowledge, this dusting-off-the-cobwebs activity also provides you with quick assessment data about how well students understand the concepts previously presented. If you discover information gaps or inaccuracies, you can review material in more depth before addressing the new content in the upcoming lesson. It is a powerful way to begin a class. You can also use this strategy at the beginning of a course that has prerequisite requirements. You can make a list of the most important concepts or theories they should have been previously exposed to in the prerequisite course, then ask students to discuss with a partner what they remember about these concepts. Finally, you can have a large-group review of the material.

This activity is called *dusting off the cobwebs* because it shows students that with a little cognitive cleaning, the information can be found in long-term memory. It is common for students to start off not remembering much, especially when using prior course material, but they can very quickly shift to remembering when others start to discuss the content. The discussion of the content triggers the retrieval process, and information previously learned has now been activated.

What Do I Know? Turn and Talk

The turn-and-talk activity is focused on helping students identify potentially useful experiences that may aid the learning process. For this activity, ask students to turn to a nearby classmate and talk about what the

relate to the content or serve as examples of concepts. The purpose is to give students an opportunity to activate prior knowledge that might assist with learning the new content. This activity can be brief; even allowing only two to three minutes for this task can have positive results. While they are engaged in this activity, walk around the classroom to hear the connections they are making and then assist students who are having difficulty identifying possible connections. After students have had the opportunity to discuss what prior experiences might connect to the new content, you can ask for volunteers to share the connections they found and then expand on these concepts. You can also use this information to guide you as you lecture on this new content. Referring to the content they already know during the lecture can help them make connections and increase their learning. In other words, take notes on the examples they discuss and refer to these examples at appropriate times during the lecture.

Explicit Links

One very simple yet effective strategy is to remind students of previous content that is related to the new content you are about to present. For example, when discussing a new theory, you can make references to a theory they learned the previous week. Explicitly explaining how the theories are similar or different can help students learn the content. Although many of us do this naturally during lectures, it is important to also formally incorporate this strategy into the planning process. In other words, when developing a lecture, think about explicit connections that will help your students master the content. Remember, what seems like an obvious connection between concepts to you as an expert may not be so obvious to your students. It is much more difficult for novice learners to find connections that experts easily see because we often take what we know for granted and think that others share our knowledge base. We need to remind ourselves often that new learners do not yet possess a robust knowledge base. When you remind students of related content and draw attention to connections between concepts, it's a great opportunity to put the previously learned content front and center. This makes it easier for students to take in the new material.

Mini Lesson on Reading Strategies

Teaching students how to build some background knowledge prior to reading is another effective strategy. Reading is one of the primary ways

This is in part because of a lack of prior knowledge on the subject matter. Two incredibly simple yet powerful tools in textbooks are the table of contents and chapter summaries. Unfortunately, these features are often overlooked by students. Reading the table of contents provides students with a basic overview of the content addressed in the chapters. The organizational structure of information in the table of contents will undoubtedly help students take in and store information more efficiently. It provides students with the organizational schema for the content. Reading the chapter summary before starting to read the chapter will also assist students with building a base of knowledge on the subject matter. This is particularly important in introductory courses or courses where students often do not have much content knowledge about the subject. The brief chapter summary is a great way to begin to learn the content before diving into the details of the chapter. If the information in the summary is familiar, reading it activates prior knowledge. If the chapter summary information is completely new, this activity serves to create a basic knowledge base, thus making it easier for students to take in and process the chapter content. To help students understand the value of this activity, tell them how they are more likely to understand a movie if they saw the trailer before watching the movie. In other words, the trailer provides some background information on the movie plot that makes it easier to understand the plot when watching the movie.

Mini Lessons Prior to Assigning a Reading

As faculty, we often ask students to read something before we lecture on the content because we want students to come to class with some background knowledge so they can actively participate in discussions and answer questions. This is particularly true for those who are using the discussion-based lecture format. Unfortunately, students often don't do the reading before class (Burchfield & Sappington, 2000). This failure to complete assigned readings may be caused by factors such as poor time management or motivation. Also, previously students may have not found reading to be a good investment of their time. In other words, students may have spent hours reading only to be frustrated with how little they understand afterward, most likely when taking courses on material that is brand new to them. As we learned from the Recht and Leslie (1988) study, the lack of prior knowledge makes it difficult to learn from reading. A very simple strategy we can use as faculty to combat this is to provide students with some background information before asking them to read a chapter. Giving a brief preview lecture, highlighting some of the important points in the chapter, and then

assigning the reading can help students gain more from the time they spend reading. These mini lectures can be during the last 5 to 10 minutes of class. This approach serves as a preview of the content for the next chapter. Again, this strategy is designed to develop or build background knowledge so that it will be easier for students to make connections and take in the new content when reading. The combination of the mini lecture and the increased likelihood that they will be learning more from reading the chapter increases the likelihood that they will have some background knowledge before you begin your main lecture on that content. This approach requires us to rethink the way we lecture. A mini lecture preview of the chapter is followed by the reading assignment, which is followed by the in-depth lecture. It's a win-win for all.

SUMMARY

There are many effective strategies to help students use prior knowledge to more effectively and efficiently learn new information presented during a lecture. These strategies assist with learning new information and also allow students to practice recalling the information, which as we will see in Chapter 8, is also beneficial to the learning process. Finally, it is critical to note that many of the strategies noted need not take a great deal of class time.

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