MAGNA ONLINE SEMINARS

Transcript

Using Brief Interventions to Maximize Student Learning

A Magna Online Seminar was presented on August 19, 2014 by James Lang, Ph.D.

Using Brief Interventions to Maximize Student Learning teaches participants to:

- Understand five fundamental principles of human learning (predicting, self-explaining, retrieving, generating, and connecting) and recognize their implications for college teaching
- Know how to create brief learning interventions that stem from each of these five principles and incorporate the interventions into your current courses
- Be able to design new or redesign existing lesson plans that create organic opportunities for cognitive-based interventions

Editor's note:

This is a written transcript of an audio recording. Our policy is to edit only the occasional unintelligible phrase. Everything else appears exactly as it was spoken.

Rob Kelly: Hello, and welcome to Magna's online seminar Using Brief Interventions to Maximize Student Learning, co-sponsored by Magna Publications and *The Teaching Professor*. I'm Rob Kelly, editor of *The Teaching Professor*. And I'll be the moderator today. I'm pleased you could join us.

If you haven't already printed the handouts, select the file you wish to print from the file share box on the left of your screen and then click the Save to My Computer button to download, open, and print it. You may listen to the seminar through your computer. Or you may choose to listen through your telephone. To listen through your phone, dial the number and use the access code shown in the box at the bottom left of your screen.

And now, I'm pleased to introduce Jim Lang. Jim Lang is an associate professor of English and the director of the Center for Teaching Excellence at Assumption College. He is the author of *Cheating Lessons: Learning from Academic Dishonesty*, *On Course: Week-by-Week Guide to Your First Semester of College Teaching*, and *Life on the Tenure Track: Lessons from the First Year*.

Welcome, Jim Lang.

James Lang, Ph.D.: Thank you. So I would like to begin with . . . by, first of all, I'm inviting you to make sure that if you have questions that you type those into the chat room. And I will try to respond to questions along the way. There will be a couple opportunities for you to interact in other ways. And I would encourage you to do so.

As we all know, the landscape of higher education has sort of erupted recently in new ways to think about teaching and learning. Every morning in my twitter feed, I see links to resources and articles and experiments and new ideas about how to construct my classroom, how to engage in different kinds of classroom practice, or how to evaluate my students.

And yet, as we also know, faculty have extraordinary demands on their time. So faculty members aren't often able to take a new approach that they read about and immediately test it out in their classroom or to sort of revamp their teaching from the ground up every time they hear about an interesting new experiment, however effective it might seem to be.

So the confluence of these two things has led me to develop the approach that you'll hear about today, namely using brief interventions to maximize student learning in any type of classroom. And the goal here is twofold. First of all, I wanted to be able to see if I could identify concepts from the learning sciences that would seem to apply in almost any type of teaching environment, from the flipped classroom to a traditional lecture. Are there

core concepts or learning activities that seem to be helpful in any of these types of environments?

The second thing I wanted to be able to do was identify concepts that could be translated into brief interventions. And this is sort of to respond to the idea that faculty often are pressed for time and might find it difficult to sort of go back and sort of really rethink their teaching from scratch. So if we can find these kinds of brief interventions that stem from what we know about how human beings learn, and we'll have the power to maximize student learning, these are things we can figure out how to seed into almost any type of learning environment.

So that explains the sort of brief interventions idea here. Now I found some support for this on a recent book on teaching and learning that I think is one of the best books I've read in this area. And it's called, *Make It Stick* by Roediger, McDaniel, and Brown. And you'll see a reference to this book in the handouts for this seminar.

Roediger, McDaniel, and Brown argue that much of what we have been doing as teachers and students isn't serving us well, but some comparatively simple changes could make a big difference. And so that's what I looked for. And that's what we're going to talk about today. What are some of these relatively simple changes that can make a big difference in student learning? So that's the major premise of our seminar.

But there's a minor premise that I want to talk to you about as well. Namely, oftentimes faculty think about learning as being sort of Bloom's Taxonomy, and so going from sort of fundamental things like having students learn and remember knowledge up to these higher order skills of synthesis and evaluation, and that's a great and useful way for us to think about learning. But oftentimes I think faculty think about the first stages of knowledge acquisition and comprehension as being ones that they can skip over very quickly and get to these higher order skills.

But what learning scientists seem to be telling us now is that that knowledge, comprehension, acquisition, and memory seem to be important. Annie Murphy Paul, who writes the Brilliant Blog wrote recently about this idea of splitting memory into E memory and O memory, E memory being electronic memory, and O memory being organic memory. And she wrote about doctors who use sort of, who are able to sort of quickly use their phones or computers to look up symptoms and make quick diagnoses.

But when they sort of started looking at that, they recognized that electronic memory can be useful for some things. It can be useful to help sort of remind you about things. It can be useful when you know exactly

what you're looking for. But we also need a really strong foundation of organic memory in order to be able to get up to those higher order skills.

So I don't want us to think here that lower order thinking skills like memory, acquisition, recall, all that stuff, are things that we should neglect. We want to be able to do both. So what you're going to hear about today are both these kinds of knowledge, crystallized knowledge, which is what we normally think about knowledge that we have learned and is sort of solidly in our long-term memory. And that might include facts and information, but it also might include procedures and skills.

And then we also want to think about fluid knowledge. So that means what we normally think about when we're talking about things like synthesis and application and evaluation. These are the kind of higher order skills. What do we do with the knowledge once we have obtained it?

In our time today, we're going to focus on talking about both of these ideas. How do we help students obtain crystallized knowledge? And then also, how do we help them begin to work with that knowledge through the higher order thinking skills? So we're going to focus ourselves on five activities that I think can help generate interesting and brief interventions that will maximize learning in classrooms.

The first is predicting. And that is to ask students to make predictions about course content before you have exposed them to it. The second is retrieving. And retrieving is just another word for remembering, being able to produce things from your memory when you need them. So how do we help students learn to practice retrieval and be able to retrieve ideas and crystallize knowledge when they need it?

Generating, by that, I just mean students generating their own responses to the learning material. So instead of just sort of absorbing what the faculty member says is important or, you know, the meaning or significance of the material, being able to generate their own examples, illustrations, ideas, ways that the course material might connect to things outside the classroom. Four, self-explaining, and self-explaining is self-explanatory. It just means when people sort of talk out loud about what they are learning and the process of learning it.

And five is connecting. And this is probably the most sort of complicated higher order thinking skill we'll talk about. And that is, how do we help students build up a framework of knowledge in which all the sort of disparate facts and discrete ideas are connected into a larger knowledge network? And so that's what we'll finish up with.

Okay. So let's begin with predicting. And to talk about predicting, I want to tell you about a study. And you'll see this study actually referenced in one of your handouts by Kornell, Hays, and Bjork. And in this study, the researchers, in the article, researchers talked about four different experiments in which they asked their subjects to memorize word pairs. And what they did was try and see about the role that prediction would have in helping people to learn to memorize these word pairs.

Now as you can see from the example on the screen, these word pairs are loosely connected, right? So you would think about whale. You wouldn't automatically think mammal necessarily, right? But there might be a lot of other things that you might think about as whale, as connected to whale. So there is a connection. But it's not one that you would automatically guess. And there's not a pattern in the list of words that they gave, so the students wouldn't be able to read a few of them and then be able to automatically guess the correct answer.

So what they did in one of these experiments was they exposed the students to word pair whale/mammal for 13 seconds. And then in another group, they exposed them to the first word whale for 8 seconds, asked them to speculate or predict what they thought the second part of the pair would be. And then for only five seconds, they showed them that second pair, that second half of the pair.

So as you can see here, there's something important to notice about that. In the first instance, the students were given the full 13 seconds of exposure to the correct answer. In the second instance, they were only given that exposure for five seconds. And part of the time they spent predicting what they thought the pair would be. Now if you look at the results, you see that prediction seems to have a powerful ability to help the students ultimately remember when they took a subsequent exam on the word pairs.

So in that study condition, student, the subjects were able to remember 55% of the word pairs correctly when they had been exposed to them for the full 13 seconds. But when they were asked to make a prediction about that word pair, they were ultimately able to remember 67% of the word pairs correctly. So this was a really interesting phenomenon, which suggests to us that when we are exposing a learner to new contact, if we ask that learner to make a prediction about it, it seems to be that it will help them learn and remember that material more effectively.

Now there's a potential caveat here though. And this is going to be our first poll for the session. Some learning theories would suggest that if a student makes a prediction about something and makes a wrong prediction, is that ultimately going to influence their ability to remember the correct answer?

So for an easy sort of example about this, say you meet someone. And you remember their name. You're introduced to them by name. And shortly after, you forget it. And you can't remember their name again. So you call them by the wrong name. Now you've made that sort of prediction about what the person's name is the second time you met them. In subsequent meetings with that person, you might think to yourself, now which name am I remembering, right, the correct name or the incorrect name?

And so you might think that asking students to remember, to predict information and get it wrong would potentially influence them in a negative way. So what do you think? Do you think some theories would suggest that this is a potential problem with this theory and that maybe there's a way we have to think a little bit differently about prediction? Do we have any results, Rob?

Rob Kelly: Yeah, 88% or so said no.

James Lang, Ph.D.: Okay. So that's correct. In this particular set of studies, what happened was that incorrect predictions actually had no impact on the student's learning. So it turns out that even when students get the answer wrong when they're making their predictions, it doesn't seem to have a negative effect ultimately on their learning.

Now the question we want to ask ourselves is, why does this happen? And in the initial article and then subsequently, this also was described in *Make it Stick* as well, the explanation that's offered is this. The attempt to retrieve the answer may enhance the activation of related concepts, which may in turn create a fertile context for encoding the answer when it is presented. And by encoding the answer, we just mean sort of processing and the brain sort of determining where it's going to go.

So what seems to be happening here is when you're asked to make a prediction about the subject, you sort of marshal your resources to think about, okay, what do I know that might help me to answer that question? And so you're activating connected knowledge in your brain that might help you kind of come up with an answer. Now even if you get the answer wrong, ultimately, when the answer is presented to you correctly, you have a better chance of sort of putting that information into a place where it's going to be connected to other things. And that's going to help you remember it.

The more connections that we have between a new piece of information and other things that we already know, the more likely we are to understand it and remember it. So the active prediction helps sort of, you

know, activate all these related concepts that are going to make it easier for us to remember the information when we get it.

So what are the practical implications of this in terms of making an intervention in our class? We want to think about predictive questions that we can ask our students to make that it can be done very quickly at the beginning or the end of the class period. So one of the things that you'll see also that you'll see in your handouts is an example of how student interventions can be done at the beginning of the period, at the end of the period, or at the midway mark of the period.

And I think predictive questions are really good ones to ask prior to exposure, to first exposure to content. And the beginning and end of a class can be a really great time to do that. So the question examples that you see here, when we get to the end of, you know, I teach English literature, and so oftentimes, we're reading sections of novels. And as we get to the end of a class, and we've, you know, read the first 100 pages, I might ask them to say, given what we know so far, what you've learned about this character, what do you think is going to happen?

Or if you're doing a problem, introducing a case or a problem, you might simply pause. You know, you can give the whole context for the problem, all the information that they'll need to solve it. But then pause before you present them to the solution and say, what do you think is going to happen here?

Another way to think about this is say you're teaching a course in which you're introducing different thinkers, and there are different perspectives on a particular topic. Now you might ask the students as you're about to approach a new topic, what do you think the thinker, based on what we know about him so far or her so far, might have to say about this topic? How can we use his or her past ideas in order to get us to this next topic?

So any of these types of predictive questions would get students activated in that prior knowledge and making connections in ways that should help them ultimately remember whatever it is that we're teaching more effectively. As I've argued, I think the right time for sort of interventions is at the openings and closings of class because those are the times often times that we're either preparing students for first exposure or about to get first exposure.

So, you know, right at the beginning of a class offering some opportunity to make a prediction. At the end of a class, as you're sending students off to do their reading or study new material, you might ask them to make a prediction about the reading or whatever it is they'll encounter or an online course prior to first exposure to content, having a couple of questions that

might ask them to make predictions along the way. So that's our first intervention is prediction. And this is an easy one to think about, how to make these kinds of brief exposures to.

Let's move on to our second one. And our second one, we're going to talk about retrieving. And for retrieving here, I want to tell you again about a study that's referenced in your handout. And so the first two studies that I've spoken about today are in the final handout that you'll see, which is at the end of the article, Learning on the Edge: Classroom Activities to Promote Deep Learning.

This study was conducted by Henry Roediger and Jeffrey Karpicke. Henry Roediger is one of the authors of *Make It Stick.* And this was published in *Science* magazine in 2008. And what they did was they brought subjects into a laboratory over the course of a single day and again asked them to memorize a set of English and Swahili word pairs. And the idea here was to see whether or not testing versus studying seemed to make the greater difference in having students remember these word pairs.

So what Roediger and Karpicke did was have the students separated into four groups. And all four groups went through the same process, a similar kind of process, on a single day. They had four study periods to learn these 40 word pairs. And then they had four testing periods. But the groups varied slightly in what they did.

In the first group, the students had all 40 word pairs on all 4 of their tests and all 40 word pairs in their study lists. So every time they were studying, they were studying all 40 of the word pairs. In the second group, whenever the students got a word pair right on one of the tests, it dropped off their subsequent study list. But it stayed on their tests.

A third group, just the opposite happened. Every time the students got a word pair correct on the test, it dropped off the subsequent test. But it stayed on their study lists. And in the fourth group, every time the students got a word pair correct on the test, it dropped off both. So it dropped off both their study list and their exam list. So both those things were getting smaller and smaller as the day wore on.

Now at the end of the day, all students in the experiment were able to remember all 40 word pairs on that final exam. So what that tells us is that for short-term learning, this didn't make a whole lot of difference whether they were studying and testing. But what the interesting thing these researchers did and what they were most interested in was the extent to which it would affect long-term learning.

So they brought them back into the laboratory a week later. And you can see the results here. The test and study condition students, when they came back a week later were able to remember 80% of the word pairs. Test but no study folks when they came back a week later were able to remember 80% of the words pairs.

So what that obviously tells us is that the test is what was making the big difference here in the students' attempt to retrieve was the test much more so than the studying. I sometimes, whenever I look at the study, I think back about all the time I spent staring at my notebooks or looking at my text books again in college and wonder how much of that time was well spent. Because this is, the third and fourth one tell something interesting. I've jumped to the fourth one here, which is when there's no test and no study. And you'll see that this led to them being able to remember only 33% of the word pairs.

But the really interesting one is the third one where it dropped off their test but stayed on their study lists. And you can see here that it's 35% and that they really didn't do much better than the students had no more access to the words. So what that seems to tell us is that when students want to be able to retrieve information, they have to be able to practice doing so. And Rob, I think we have a question.

Rob Kelly: Yeah, we have a couple questions actually. Getting back to making predictions, do you need to collect feedback from students when you ask them to make a prediction, or is a simple pause enough?

James Lang, Ph.D.: That's actually, that's a really good question. And what the research on that tells us is that students actually do need to get some quick feedback on the correct answer. So that is an important condition. If they get it wrong, and they're not corrected on it, that actually can lead to the kind of learning where they're going to misremember the information. Or they're going to remember the wrong information. So they do need to get some quick feedback to know whether or not their answer was right.

Now that doesn't have to be done, of course, individually when you have to respond to everything that every student is right. That can be done, for example, just sort of as a group. If you're asking them a simple question, that can be done through just sort of providing the correct answer.

In my case, I use writing exercises at the beginning of class and oftentimes will ask students to write a brief paragraph. After the writing exercise, I will quickly review what the correct answer is. But then oftentimes, if I see a student making a wrong answer as I'm quickly flipping through them, I might make a brief comment on that as well.

But again, my goal here is to try and minimize the amount of time that faculty members have to spend responding to student work with these kinds of interventions. So the easiest thing to do would be to simply sort of provide a group correction and make sure that everyone knows what the correct answer was. So what was the other question for us, Rob?

Rob Kelly: Does having students write down their predictions make a difference?

James Lang, Ph.D.: That's a good question. I didn't see any information on that. I mean, it would seem to me that's probably the case based on other things we know about having students actively engage in learning, versus sort of just thinking about an answer, versus speaking an answer or writing it out loud. So I would assume that to be so. But I'm not 100% certain that I've seen that in the literature.

We will come later actually to another example in which we see that sort of thinking actually did have some power to improve student learning even when they didn't speak it right out loud. So we'll come to that in a few minutes.

Okay. So let's talk quickly about, and please, continue to ask questions as you do. So those are two excellent questions. Let's think a little bit about why this happens. And I'm not going to get too deep into this. But I wanted to just sort of present what the literature tells us about why retrieval practice seems to work.

Daniel Schacter is a neuroscientist and the author of a great book called *The Seven Sins of Memory.* And what Schacter does is sort of go through the things that our memories do that we don't really like, which is why he calls them sins and talks about why our memories have evolved in this way. And there's a lot of interesting implications for educators.

So one of the things that Schacter tell us is that when information hasn't been used for longer and longer periods of time, it becomes less and less likely that we'll need it. So our memory systems have kind of picked up on this and essentially, as he says, made a bet that if we haven't used information recently, we probably won't need it in the future.

That is why it's important to sort of practice retrieving information relatively quickly after you get it. I'm right now using an online learning program to learn Spanish. And this is one of the things that I've noticed this program does for me. It frequently asks me to go back and learn things that I have just worked on. And then it will bring them back in a little bit later so that I'm kind of constantly being forced to remember new vocabulary or new ways of understanding syntax or grammar or other kinds of things that the program is designed to teach me.

Now another really interesting article is by Michelle Miller. It came out in college teaching a few years ago that can help explain some of this as well. And Miller argues that sort of older views of memory, the idea was that the challenge of getting things, of remembering things, was to sort of shove things into our long-term memory and that that was often times why we did things like recite things out loud or have sort of different tricks to get things in our memory.

But Miller argues that memory researchers now seem to believe that our long-term memories are much larger than we had realized. And in fact, as she says here, long-term memory is the limiting capacity is not storage. We have the ability to store an immense amount of material in our long-term memory. The challenge is being able to get it out when you need it.

And she makes a great analogy here to having a very large closet, right. It's easy to put a lot of things in. But it's difficult to get them out when you need them. So that tells us that what the challenge for us is is to help students be able to retrieve things when they need them. So it's sort of a twofold problem here. One, we need to be able to expose students to the content, make sure they understand it. But then we need to be able to make sure that they have facility in drawing it out when they need it.

So what we want to think about here is, how can we give students practice in retrieving information that they're going to need in order to succeed in our courses. Now I'm going to make a couple different suggestions here. First is to try and think about how to do this orally or in writing, again at the beginning and the end of class. So an easy thing to do is, oftentimes we faculty members walk into class and say, okay, here's what we did in the last class. And then we launch into the new material.

Instead of doing that, we might turn that responsibility over to the students to say, what did we cover in Wednesday's class? And ask a few people to summarize for us. What did we do in Monday's class? What did we do last week? Or how does the idea that we're talking about right now connect to something that we talked about last week?

So beginning class with a little bit, again, thinking about the handout that you'll find in your materials about the opening and closing places are great moments to practice to give students retrieval practice. So asking these kinds of questions at the opening, either orally or in writing, and then at the end of class. What did we talk about today that was most important? What was the key concept that you learned today? What is the concept that you want to take away as you're thinking about, as you're working on homework for next time, or as you're doing next time reading?

Now you see I have in parentheses down there, it says pause for covert retrieval. And this is what I was talking about earlier. Another really interesting study was done in which subjects were asked to memorize the features on a map. And the researchers then wanted them to be able to reproduce that map from memory.

And so one of the things they did was take parts of, the map had multiple things on it like house, river, different buildings, and natural features. And one of the things they found was that if they gave the students while they were studying the map, if they took one of the features off and asked them to try and remember what it was, but not speaking or writing it, just thinking about it, those students were able to remember the map more effectively than the ones who just studied the map.

So what that tells us is that what they call covert retrieval, which is just thinking about and trying to remember it, but not speaking it out loud or not writing it down seemed to have an impact as well. So that might get us to think back a little bit about the prediction question that we had earlier, that maybe covert prediction does have some impact, even if maybe it doesn't have as much impact as speaking or writing it.

The difficulty with covert retrieval or covert prediction is you can't be certain students are doing it, right? So I would think maybe that's one of the benefits of having students write or speak it out loud. The faculty member is able to monitor whether the student is actually engaging in active prediction or retrieval.

Now another important thing that the learning sciences tell us is that interleaved retrieval is going to be more effective than mast retrieval. Mast retrieval just means essentially cramming. It means you learn all of a material. And then you move on to the next thing. And you learn all of that, and then you move on to the next thing.

So you can see up here on the diagram I have. In a course, this might translate into, you know, learning the first three concepts, taking a quiz on them. And the students do well on the quiz, so you say, okay, they have it down. And you move on to quiz number two where they get three new concepts.

What the learning literature is telling us is that interleaved retrieval is much more effective for long-term memory. So again, think back on that study that I talked to you about in terms of the Karpicke and Roediger study when the students were being asked to memorize those English and Swahili word pairs.

At the end of the day, all the students were able to remember all of the word pairs. So cramming does work for short-term memory. And this is something probably many of us have learned and many of our students have learned as well. You can learn things for a short period through sort of mast retrieval or mast learning practices. But for long-term learning, interleaving is much better.

And interleaving just means, as you see in the example here, you go through concepts A, B, and C. And in the next unit, you might introduce concepts D and E, but you also go back and ask them questions about concept B. And in the next unit, you introduce a couple new things, but now you're going back all the way to concept A, so that the students are constantly going back to earlier material and having to try and remember things that they had learned earlier.

This is a good argument amongst many good arguments for cumulative exams. If you really want students to be able to learn the material, you need to be continually asking them about it over the course of the semester.

One really interesting study that was done with this was a study with athletes. And this was described in *Make It Stick*, in which baseball players were given some extra batting practice at the end of every practice they took. And some of the students received pitches, 15 curve balls, 15 change-ups, I think it was, and 15 fast balls. So they would get those pitches right in a row every day after batting practice, after their regular practice.

And another group got the same, also got 45 pitches of those three types. But they were mixed up randomly. Once the season begun, and they looked at the batting averages, they found that the hitters who had received the interleaved practice had higher batting averages.

Now there are a lot of reasons why this might happen. But one of the things, the easiest explanation is, this is how we normally and naturally learn things and are exposed to things. It's not like we get exposed to something and then forget it and move on with our lives. We typically, when we're trying to learn something, get repeat exposures over time. And we learn something, and then we might be going out and doing other things. And then we come back to it. And so this seems to characterize normal human learning experience.

And if we want to get that kind of long-term retrieval, we have to help students a little bit with that interleaving. So that tells us that when we're doing this retrieval practice, it is important to go back sometimes and say,

tell me about something we did two weeks ago or have that material on the quiz or on the exams.

Okay. Let's move on to our third idea, which is generating. And generating by that is sort of a catchall term. But it just means having students actively respond to something that you have exposed them to in ways that are going to allow them to generate their own ideas, their own examples, their own thinking, their own connections between the course material and things they're going to encounter in their own lives.

So for the sort of great example here, we have this experiment, which was done. And it was a 30-day recall test after students had initially been exposed to, I think it was a 40- or 50-minute art history lecture. So students all, the subjects in this experiment, were exposed to this art history lecture. And then afterwards, they had one of four things happen.

The first group of students just walked out after the lecture, and it was finished. The second group of students had focused study. They received a focus study sheet, which highlighted the key concepts from the lecture. And they were given some time to study that. A third group was given a multiple-choice exam immediately after the lecture was concluded. The fourth group was given a short-answer exam, some short-answer questions after the art history lecture had been completed.

Now they brought all the students back 30 days later and gave them a test on this subject of the lecture. And you can see the results here. When there was no activity, only 20%. Focused study and multiple choice both made a difference. So that's worth noting. It's not like studying does nothing. Focused study seemed to make a difference if it was directed, and it was able to highlight the key points of the lecture. And multiple choice did have a powerful impact as well.

But the biggest one was the short answer questions. And that short answer questions are ones that require students to do a little bit of thinking, to do a little bit of generating in terms of what they saw, to take the idea, sort of make it their own and then repeat it back out in terms of a short answer question. So that seemed to have the most powerful impact in terms of student learning.

So again, this gives us something to think about in terms of how we can help students generate a quick response to some exposure, to some content that we have exposed them to. And I liken a nice formulation that cognitive psychologist Daniel Willingham makes in his book, *Why Students Don't Like School*. Whatever you think about, that's what you remember. Memory is the residue of thought.

So if we want our students to be able to remember things, and we want them to be able to work with knowledge, we need to be able to give them some opportunity to think. We need to be able to give them the opportunity to generate their own ideas in response to the course material.

So we can think easily about an example about what that might look like in a classroom. So we might ask students, we introduce a new concept, and then we offer all kinds of examples. But we might want to be able to pause here and say, okay, now let me hear what are your examples of how you would take this idea and see it being applied in the world? Or what are your examples of how this concept could connect to something else in your own life or connect to other things that you've learned in other classes. It can really be a wide variety of things.

Now again, to getting back to this idea of what we, the question earlier about thinking versus speaking and writing. It would seem to me here that this is a place where we would want to be able to pause and let students speak out and give some examples. Or let students write some examples down. And then the class could pause to discuss those together.

This would be another example where you could use things like clickers and peer instruction. It could be a place where you could have students collaborating in teams or something in order to be able to kind of generate ideas and see how those ideas related to the content that you were providing. And so that feedback revision might look like a sort of brief discussion of the student examples.

Again, it seems like feedback is going to be important here just like it was in the prediction to make sure that students are staying on track. We want to make sure that we let students know that the examples they are generating are ones that are applicable, that are appropriate. And so giving them a chance to get some feedback and then maybe revise their thinking a little bit seems like it would be an important part of this process.

So I actually would be curious to know if there are other examples of generative interventions from your own classes. And again, here the principle is the 5- to 10-minute pause that you can make after you give students sort of a first content exposure. How can you allow students to apply course concepts to their own lives?

So if you want to write some examples in the chat room, we can talk about those. But one of the things, I'll give an example here, how one of the ways which I've tried to do this in my own class, while you're thinking, and that is to try and use Twitter. And Twitter has been an interesting way for me to try and ask students to generate connections between the course material and their own lives or try to find examples of how the course

material that I'm exposing them to might be connected to the other things they know or might generate their own ideas.

So one of the things that I'll do now in some of my classes is ask students to post two or three tweets per week. This is very low stakes. But they post two or three tweets per week about posting links, resources, ideas that connect to the content that we have been learning about. And then at the beginning of class, I might, for five or ten minutes we look over that Twitter feed together. And we talk about it. And we see which are the examples that students are generating that seem to make most sense in terms of our course content? Or we try to, you know, we might look at one of the links and talk a little bit briefly about that.

So Twitter has been one way to do this that takes a little bit of work for the students outside of the class. But Twitter is something that we know that, you know, many students are already engaged with. And so if we ask students to do that, we can bring that into the classroom in one of these brief interventions.

And typically, it takes me less than ten minutes to sort of throw up the Twitter feed onto the screen and to see the kinds of examples that students are generating or the kinds of links they're generating on their own. And that helps give them a little bit of that active thinking that we're always looking for with our students. So it looks like maybe we have an example or two that's coming up. And so, Rob, do you want to share an example or two that we see?

Rob Kelly: Sure. There's just one example right now. I teach courses about language and communication. Students respond well to videos of individuals talking and looking for specific communication features.

James Lang, Ph.D.: Great. So in that case, the students are kind of pausing and seeing sort of a real-world example of, did it say language and communication?

Rob Kelly: Yes.

James Lang, Ph.D.: Yes. So, excellent. So that kind of thing where you can sort of ask students to look briefly at a video and pause. And then maybe sort of have a brief discussion or response to it would work very well here. So if other examples come up Rob, let us know. And we'll share those as well. So any other examples where you have just sort of generally tried to get students actively responding to course content in a brief interventions, let us know about those.

In the meantime, we'll move on to our fourth idea here, which is self-explaining. Now self-explaining, as I said before, is sort of self-

explanatory in that it simply means that you speak out loud or write about the process of your learning as it's happening. So the sort of oldest and easiest example that most of us can think about for self-explaining is that as students are doing math problems, they are asked to talk about or explain or show their work.

So self-explaining or making sense of new information by explaining to one's self helps people construct new knowledge as the quote here says, by elaborating on presented information, relating them to existing knowledge, making inferences and making connections among giving information.

And the text that you see referenced here is called *Applying Science of Learning*. This is a free E-Book that's available online. And so anyone can go on. If you just google that title, you'll be able to get to it and download it. And it has lots of chapters that focus on exactly these kinds of things that we're talking about, brief sort of ideas or ways to help maximize learning with interesting studies that have been done to help support this idea.

So self-explaining, one of the sort of simplest and easiest studies here was a group of subjects were divided into three. And the first group, the students were exposed to some new content reading and asked to read it through once as if they were studying for an exam. A second group was exposed to the same content, again asked to read it through as studying for an exam. And then read it through a second time as further preparation for that exam. A third group was asked to read the information. And they were asked to self-explain as they were learning it.

So they received questions like, what information, what new information does this paragraph add? Or what might be missing from this paragraph in order to help improve your understanding? The group that had that self-explanation significantly outperformed the other two groups. So even when the students read a second time and did so deliberately, as if they were studying for an exam, they did not score as well on subsequent exams as the students who self-explained.

And so this experiment has been repeated multiple times. And the researcher that wrote the chapter on self-explaining is the lead researcher in this particular area.

So what type of self-explaining seems to work most effectively? And I'll focus on these three ideas here. Self-explanation prompts seem to be most effective when they give explanations that are principle based. So as a student is self-explaining, you want to ask them to think about, as they're being maybe exposed to a new content, or they're trying to solve a problem. What principle is important here? What key idea are you using

or should you use or can you use in order to help solve this particular problem? So focus them back on principles.

Second, elaborate on conditions and goals. So that's like the example that I just gave earlier asking students to say, what new information is this paragraph giving you? What is the overall goal of the article that you're reading? What's the objective of this section? How does it fit into the article as a whole? Or the conditions might be asking them to think about, have you been given enough information to solve this problem? What information might be useful to you still?

And lastly, to monitor comprehension. So asking students simply questions like, what are you having trouble with here? What part of this concept is posing the most difficulty for you? What part of this do you seem like you are most confident with right now?

So self-explanation questions can be given to students again orally, through writing. But you could ask students when they're solving problems to, you know, come up to the board, try to solve a problem, and make sure that they are speaking out loud when they are doing so.

You can ask students to, you can give students self-explanation prompts when they're working together in groups. You might give self-explanation prompts again at the beginning of or end of a class when students are coming in at the beginning of a class and have been, you know, read course material to solve problems, to ask someone to sort of walk through their steps and what they did in order to solve the problem or to sort of articulate their understanding and how well they feel they understand.

And the same thing might be done at the end of a class, to ask students to say, okay, what seems clearest to you? Why is that clear? What seems to be the sticking point for you? Why something might be unclear to you as well.

So you want to ask students to make self-explanations whenever they're working through new content, whenever they're trying to solve problems that are complex. And especially if you're asking them to solve problems or questions that are going to subsequently appear on exams or your high stakes assessments. Giving them the opportunity to self-explain seems to help improve. And now we're pushing ourselves up into these sort of higher levels of comprehension, being able to help them do things like analyze and synthesize and apply.

Self-explanation seems to be able to push students toward now these higher order thinking skills. So self-explanation interventions are relatively easy to think about. I teach a course in creative nonfiction

writing. And sometimes I'll ask students these types of self-explanation questions. You know, we'll talk about different types of introductions that you can use in a piece of writing. And they'll have multiple options for what they do.

And once they are, sometimes I'll actually have them be working on their essays in class. And I might just pause the students and say, okay, what strategy are you using here? Why are you choosing to open your essay with an anecdote? Why are you choosing to open your essay with a fact or you know, a striking statistic here? What is that doing?

And you'll find, I find that as a student talks that out, oftentimes they make changes. They think, well, oh, I guess that doesn't make sense in terms of what I was trying to achieve here. And that's the thing that self-explanation can really do.

Second, what missing information will help you solve this problem more easily? That gets to the conditions idea that we mentioned earlier. So, you know, giving students maybe part of a problem when they don't have all that information, ask them to sort of think about, okay, what do you still need? And that, as they articulate that, they're going to find that they are better able to recognize the problems or be better able to understand the problem.

And the last one gets to the idea of monitoring comprehension. What concept would you have the most difficulty putting into a new context? I had a really interesting experience recently in terms of seeing the power of self-explanation in helping my 16-year-old daughter learn to drive. And if you've ever tried to help a 16-year-old child learn to drive, you know that it can be a somewhat stressful experience.

And so when we first were doing this, I found that, you know, we just sort of sat there in silence. And every once in a while, I would have to sort of shout out to slam on the brakes or whatever else I might have needed to tell her. Until I was doing some, you know, going back through this literature again and reminding myself about self-explanation.

And so then I started to ask her, so what are you doing here? Why is it important that you're sort of, you know, doing this or that? You know, why are you sort of leaning over into this side of the lane here? Why are you stopping here?

And as she talked it out, I found that she started to correct herself. She would say, well, I'm doing this, oh, but I guess I shouldn't be doing that because what I learned in driver's school was that I was supposed to do

this. And so the more of that that she was doing, the more I found she was able to correct herself and sort of start becoming a more effective driver.

So you might be able to find examples of that yourself from your own experience. But for m, that was a really powerful learning moment for me to see how self-explanations could play a role in learning.

Okay. So let's get to our last topic, connecting. And again, if you have questions or suggestions or comments on any of this, please put them into the chat room. And we should have a few minutes at the end in order to be able to address those.

By connecting, I mean helping students connect new material that they're getting to things that they already know or helping students connect material that they're getting to other things that they're learning in the class. So as Susan Ambrose and her colleagues argue in the book, *How Learning Works*, which again you'll find referenced in the list of recommended resources that came with your handouts, one of the important ways that experts and novice knowledge organizations differ is through the number or density of connections among the concepts, facts, and skills they know.

Those of us who are experts might organize our knowledge in a way that's different from the way our students organize theirs. So what this research tells us is that when students get new information, they tend to take it in discrete and isolated ways. So they may have a bunch of facts or ideas. But they might have them in completely sort of separate places in the way they think about the particular knowledge domain.

Experts have lots of different connections between what their, the things they know. So when you are exposed to a new idea in your field, you're typically able to slot that into the appropriate place in your mind. And you're also able to see a bunch of connections between that idea or concept and a bunch of other things you know.

So when you're reading a newspaper article, and it references something in your field, you immediately think, oh yeah, that relates to something I talked about in my dissertation. I remember this also connects to that book that I read. I can see how that would apply in the sort of real world scenario that is happening in the world right now. And you have this ability to kind of instantly see all these connections.

The students don't have that ability. And this is one of the problems with students being able to learn and comprehend, is that lack of a sort of connected structure makes it difficult for them to encode and process information in ways that will impact their long-term memory.

So this last thing that we want to think about is, how can we use sort of brief interventions to help students start to build up those knowledge networks, to help students start to think like experts? Now again, from *How Learning Works*, they give a sort of good description here of novice versus expert learners, novices can have disconnected knowledge that lacks coherence. And they can hold and use contradictory propositions without even noticing their inconsistency.

So this is something that we have seen demonstrated in research and physics, that students can sort of have completely contradictory notions about motion or about other topics from physics. But they never put them together to see that those things contradict. So that's how they're able to sort of hold these incorrect answers. So they might bring sort of traditional or sort of common sense, what they think, ideas about motion or physics into the classroom and hold onto those even while they're learning new things that are correct and contradict with their sort of common sense knowledge.

Experts, by contrast, tend to automatically process information in coherent chunks. So as new things come in, we immediately kind of put things together into these structures. And then we kind of are able to slot them into the larger knowledge structures that we might have in our sort of given domain.

So that's the differences. And so we have to try and think about, how can we help students start to use these chunks and start to build up these knowledge structures. And the challenge is for us to think about how we can do that in these kinds of brief interventions.

But just a couple more examples of how we see this demonstrated in the literature. This one interesting experiment was done in which experts, electronic technicians and sort of regular individuals, no expertise in electronics, were shown a diagram like this one very briefly and then asked to reproduce it from memory.

And what they found, of course, was that the electronics experts were able to reproduce much more of this diagram from memory than the people who had no special knowledge of electronics because the electronic experts were able to see meaning and connection here.

They were able to recognize, oh, that's the power supply, that's the connection here. And so they were able to kind of see how things connected and understand that. And as a result, they were much able to sort of reproduce this from memory when the non-electronic experts were not able to.

Another really interesting one was done with British football, so soccer, in which people were asked to memorize soccer scores. And then they found afterwards when they asked the people how much they knew about soccer, the people that knew more about soccer were able to memorize this list of scores much more effectively, again because they could see connections and meaning. So someone might have thought, oh, I'm surprised that that team beat that team or that this team beat this team, has implications for the playoffs.

So when they were able to see meaning in the scores, they were much more able to remember and understand them. So again, this is what we're looking for, the ability of students to be able to see connections, to put things in sort of larger knowledge structures. And I'll tell you about how this sort of first came to me. I came to recognize this in my own teaching. And then I'll tell you about the intervention that I designed in order to help try and solve this problem.

So I teach a course called British Literature Survey II, which is exactly what it sounds like. It covers British literature from 1800 to the present. And the course begins with the author you see up there on the left, Robert Burns. Robert Burns is a Scottish writer. And when you teach British literature, you incorporate the writings of England, Scotland, Wales, and Ireland during part of Ireland's history. And so it's important for the students to understand that sometimes that national identity matters.

So in Robert Burns's case, it was important that he was Scottish because some of his work is about what he considered to be sort of the English oppression of the Scottish people. So when we first introduce this topic, we talk a lot about Robert Burns's Scottishness and why that's important.

Now I had done this in a class one semester. And then several weeks or a month or two later, we got to another author who was Scottish. And the students had read that author for that day's class. And I walked in and said, you know, just sort of noticed it myself and said, oh, okay well, as we can see, this author's Scottish. Do you want to tell me who was the last author, remember who was the last author we had who was Scottish?

And they all sort of sat there and were silent as I'm hearing you be silent right now. Nobody seemed to remember that. And I just thought to myself, well that's really strange. We spent a lot of time talking about Robert Burns. And they had taken a midterm exam in which they were able to talk about this. But when it came time to remember a month or two later, this was something that had sort of flown out of their memory.

So it seemed to me then that it was important to try and understand what was going on there. And what I started to think about was, well, why does it matter to me? Or why do I see this as important? And that forced me to kind of start to look and think about, well, how do I see all the authors that we're reading as connected to one another. And that's when I made up this grid that you see here.

When I get new information, or I'm exposed to a new author, you know, in British literature from 1800 to the present, I tend to group them into these categories. I think about, well, what did they write about? I think about, where are they from? And does that geography matter? I think about the type of literature they write. Do they write poetry or fiction? But even within poetry, are they writing lyrics, or are they writing sonnets? And I think about historical context. What was happening at the time that they were writing? So when I get new information about an author, I tend to automatically slot into this sort of grid, right? As you see, I have it laid out here.

My students weren't doing that. They were seeing Robert Burns. We're done with Robert Burns. Next William Wordsworth. We're done with William Wordsworth. And they were kind of moving it along that without building those larger knowledge structures.

So that led me to think about, how can I help students start to build up these connections and start to see these thematic connections and start to see the larger structures here? And that led me to this connection intervention that I call the Minute Thesis. Now there's lots of ways, of course, to help your students start to see connections and structures. But again, my focus here is to try and think about these brief interventions that you can do along the way.

And so the Minute Thesis is a classroom activity in which the students have to quickly make a series of connections between a variety of data or ideas or authors or text from the course or between course material even and novel context. And simply ask students to link course concepts or problems. Either the instructor does that, or the student does it. And then the students are required to stop and offer a brief connection or a brief thesis about what connects those two things together.

This is a little bit easier to see in terms of visual. So let's go to that next slide and notice. Typically. what I'll do, when I do the Minute Thesis is I'll have two or three lists on the board. And one of those lists might be a set of concepts like the themes that we're going to be talking about in the course.

The other list, in my case, might be authors. But in a different type of course, you might have certain types of problems that you have been dealing with throughout the semester. So once you get those concepts up on the board or however you want to do that, you might, what I typically do is walk out into the seats, hand a student a marker and say circle two of these things and draw a line between them.

And the student will do that. And then I say to everyone, now we have one minute here. And I want you to think about what connects these two things. Come up with our own thesis about how these ideas are connected. Or come up with your own way to have concept three solve problem two, okay. And students take literally a minute to do that. Sometimes they write it down. Sometimes they just think about it. And then we spend five or ten minutes talking about what they came up with.

And what I invariably find is, it starts slow. But it blossoms immediately. And it is a way for students to sort of be generating, they're thinking creatively, and they're starting to see the connections and see which connections you feel are important. You can construct the Minute Thesis in such a way that it enables you to highlight the most important ideas or the types of structures or connections that you want to use.

Now this can be done for five or ten minutes. Or it can be done for an entire class period. So sometimes I'll have students go through this iteration three, four, five times. Sometimes I'll draw the connections and ask them to come up with a thesis. Sometimes I'll ask a different student to come up with each connection or sometimes have one student sort of be the connector.

So there are all kinds of variations on this. But the idea just is to get students thinking actively, to get them thinking creatively and doing sort of these higher order thinking skills of application, synthesis, and to be able to, and to have them be starting to make connections.

So the thing that, you know, is important about this idea is that again, it lends itself both to that brief intervention, but it can also be used outside of the class. So usually I'll do this when I'm getting students ready for an exam or to write their own papers. So it can be a good exercise to help students make connections for prior to an assessment, whatever that might be.

And when I'm doing it prior to having students write a paper, typically I will, you know, have themes and novels and say, you know, start seeing connections here that are going to help you come up with your own ideas to write your paper.

So the Minute Thesis is an easy intervention to help students start creating knowledge networks and building up those structures that we have as experts in our discipline.

So we've just about reached the end of our time together. And so let's do a little bit of retrieval practice. Some of you might be faculty who are teaching. Some of you might be folks who work with faculty in terms of faculty development. So let me ask you to quickly note in the chat room which of the five interventions seem to be the most effective and interesting ones to you that you'd either be likely to use in the course that you're going to be teaching, probably in a couple weeks, or whether you'd be most likely to recommend to your faculty.

And I want to just note here that this is the kind of thing, you know, simply some of you might be able to do at the end of a class. It seems, it can almost seem silly to ask people to sort of remember something that they just learned. But again, if you think back about what the literature tells us and what some of the studies that we looked at, this seems like an important thing to be able to do directly after first exposure. Just the chance to remember seems to have a big impact.

And the other thing is, you know, what you shouldn't be doing right now is looking back at your notes. Because what the literature also seems to tell us is that's much less effective than sort of turning your notes over and just trying to remember for yourself now, what were the five interventions that we have talked about and which one seems more important.

If you put your notes away and force yourself to remember, you're going to learn and remember it more effectively than if you just looked back through your notes. And typically, I find is when I first ask students to engage in these kinds of retrieval interventions, the first thing that they do is look at their notes.

And so you have to be careful to say, close your notebooks and then see what are the answers that you can give me. So, Rob, do we have any kind of consensus here emerging on what seems to be the most effective?

Rob Kelly: Well, I saw some participants typing so there might be more coming in. But right now we just have predictions.

James Lang, Ph.D.: Predictions. All right. Predictions are a good one because they're easy to think about how to implement early in the semester. And they're easy to think about how to implement at the beginning and end of classes. So there's a good one.

So you can look at the handout as well to see more examples of how to use predictions.

Rob Kelly: Minute thesis.

James Lang, Ph.D.: Minute thesis, of course, is a good one because that draws on retrieval and can also help do a little bit of generating depending upon how you're using the minute thesis. You can ask substantive questions that get students thinking as well as remembering. And as Daniel Willingham told us, memory is the residue of thought. So you want to try and think about how to do that maybe in the Minute Thesis.

Rob Kelly: Here are some comments. I gave comprehensive final exams. But I will now incorporate a few questions from early material on the middle exams.

James Lang, Ph.D.: Yeah. And I think that's a great example of how to use interleaving, which seems to be really important for helping students remember it. Not only for your final exam but ultimately, beyond the course, which is, of course, what we all are sort of looking and hoping for, that students will be able to remember our course material even after they have left the course and are moving forward in their education. Okay, any last . . .

Rob Kelly: Yeah. Retrieving seems to be something I already do. So it will be easy to implement. Making connections with prior learning.

James Lang, Ph.D.: Yeah. The fact that, that's a good comment, that retrieving seems to be something I already do. I think a lot of times what happens when I read this new material is that I recognize, oh, that's something I've been doing all along. But it helps me to be able to sort of put a name on it and then be able to practice it more deliberately.

So even if this material is something that you feel like that you have been doing all along, I hope it has helped you maybe think about a little bit more deliberately about why it works and that you can think in the future about how you would want to implement into your courses.

So I would encourage you to think about, no matter what type of teaching you're going to recommend to your faculty or what type of teaching you engage in yourself, that you make sure that you're engaging in these sort of small acts of intervention seeded throughout a class period or course in order to maximize student learning and that these things can be really powerful no matter what type of teaching you do.

So best of luck to you in your teaching, and I look forward to hearing more about people's interventions.

Rob Kelly: Okay. Thank you, Jim Lang, and thank you participants for joining us today. As a reminder, in about an hour, the link for this presentation's recording will be live and available to view online for the next 30 days. And we will be mailing your CD near the end of that timeframe. Your campus has received an e-mail evaluation form from us. Please fill it out and tell us what you think of today's program and what programs you'd like to see in the future. Complete information about our upcoming seminars is available at www.magnapubs.com. Thanks again for joining us and have a great day.

Adobe Connect chat (questions from chat were answered during presentation)

University of Toledo 3: do you need to collect feedback from students when you ask them to make a prediction or is a simple pause enough?
University of Toledo 4: Also, does having students write down their prediction make a difference?
University of Toledo 4: I teach courses about language and communication; students respond well to videos of individuals talking, and looking for specific communication features
University of Toledo 3: predictions
University of Toledo 4: minute thesis
University of Toledo: I give comprehensive final exams, but I will now incorporate a few questions from early material on the middle exams.
University of Alabama: Retrieving seems to be something I already do, so will be easy to implement
Katherine Sink: Making connections with prior learning