Going deep — and wide — into lifelong learning

What Jeopardy championships and educational psychologists say about smart thinking, and how almost anyone can achieve deep and meaningful learning

Robin Chenoweth: In 2021, Ohio State alumnus Matt Amodio was flexing his mental muscle.

Mayim Bialik: Let's go over to our champ, Matt Amodio …. This is a very, very big moment. Did you come up with Lusitania? Yes, you did. Congratulations, you are our Jeopardy champion again!

Robin Chenoweth: He was beating the odds with his exceptional memory recall xxx on the gameshow Jeopardy. And America was eating it up.

Michael Strahan: Champion Matt Amodio, who's entering the record books, knocking his 21st consecutive victory last night. It moves him into third place behind Ken Jennings and James Holzhauer.

Robin Chenoweth: And he just kept going.

Mayim Bialik: A 33-day total of $1,267,801. And you now have the second-most consecutive wins in Jeopardy history. Congratulations.

Jim Cramer: Matt, you don't, first of all, geez, you are an American hero. And this is the first time my kids have every watched the show. Because they love you so much. They cheered you every time.

Robin Chenoweth: Until he lost at 38 wins, an impressive streak that put him behind only Ken Jennings for number of consecutive wins at that time. Admit it. If you play the game alongside the champions while on your couch with your labradoodle, spouse or college roommates, you might find yourself on a streak, sweeping the category and thinking man, I'm pretty good, too. But then, maybe you blank out on every clue and say to your dog, how do they remember all of that? You kind of wish you were a polymath, or in Jeopardy-speak, a person with wide-ranging knowledge. If you're a student trying to make the grade or a wannabe trivia champion or someone who simply endeavors to be a lifelong learner, experts who study deep learning and higher order thinking at The Ohio State University have a message for you. Almost all people can learn with purpose at deeper and more meaningful levels. And not just spitting back facts but learning beyond rote memorization, in ways that construct knowledge and solve problems. And here's the kicker: for the most part, this kind of learning is not dependent on your age or on your IQ.

Robin Chenoweth: This is the Ohio State University Inspire Podcast, a production of the College of Education and Human Ecology. I'm Robin Chenoweth. Carol Delgrosso is our audio engineer. Meghan Beery is our student intern. The human brain has an incredible capacity for absorbing information. Lauren Hensley is senior associate director of Ohio State's Dennis Learning Center.

Lauren Hensley: Researchers are continuing to understand this. It wasn't too long ago that the brain was just described as well, it's a bunch of file folders and the folders go into cabinets and things are organized. And-when you're about adult age, that capacity is going to stop growing. And those assumptions have really been debunked, as we start to think about our brain, not as a limited storage cabinet that's like a computer, but really as a network, something that is full of energy and connections and relationships …. One of the best things that we can do for our memories is to recognize that we're not really limited.

Robin Chenoweth: So by and large, our capacity to learn is without measure. But the way we go about learning and remembering that knowledge, matters. Going back to our champion alumnus, here's what Matt Amodio had to say about his method for learning:

Matt Amodio: Read. That's the best advice I can give anybody. Read. If you find it mildly interesting, read more about it. If you don't find it mildly interesting, read more about it. You just need to know more, and then you'll find that interesting, too.

Robin Chenoweth: He elaborated in Ohio State's Alumni Magazine when he said: "People always reference history. And I say to myself, is it true? Were people really taller or shorter after the Middle Ages? And when I'm doing that, it's answering questions that feel important in the moment." I asked Lauren Hensley about Amodio's approach.

Robin Chenoweth: So, I thought that was interesting, because it correlated with something that was in the book chapter that you co-wrote: Learners gain more information/understanding when they create meaning, rather than simply studying information that was provided to them. Do you think that might be what Matt Amodio was talking about?

Lauren Hensley: I love that quote from Matt because I think it really does demonstrate how that personal connection and relevance are key to learning. So certainly, this idea of making meaning of something, making that personal connection, and tapping into the desire to learn: How it's going to be something that serves you, how it has some meaning beyond itself, is a big part of it.

Robin Chenoweth: Why does memorization not work all by itself?

Lauren Hensley: You want that foundation to connect to something else or lead to something else because, ultimately, our brains are thinking about, what information do I keep? What information do I prune, and essentially, what is going to be forgotten? And when it's just facts that are isolated, there's not a purpose for them. There's not a use for it. They're not applied in some context. Basically, we're giving ourselves a signal. I don't really need this. And when we

make that leap to — this is valuable; this is useful; it's applicable; it's connected to other ideas that are already in my memory or things I might use in the future — we're giving ourselves those signals of, this is important. I need to hold on to it and keep it accessible for future learning and future use.

Robin Chenoweth: A mini neuroscience lesson here. The secret to creating lasting memories is embedded within some of the 100 billion cells of the human neocortex, where the brain stores long-term memories. But before a memory gets there, it must be processed.

Lauren Hensley: Part of it comes down to, how is the information accessed and processed, stored and retrieved? One of the ways that we initially tend to first take in any information is through our sensory register.

Robin Chenoweth: We hear something, or see something, or smell it or maybe read it.

Lauren Hensley: And our brain has to sift through the thousands and thousands of pieces of information that might possibly hold some meaning.

Robin Chenoweth: The ones that grab our attention go to short term memory, in the hippocampus.

Lauren Hensley: The content that seems like it could be relevant to us later on, or that was processed in a meaningful way, the information can move into the longer-term memory storage. And that's where, later on maybe, you're retrieving that information on an exam, using it in a proposal or even at that dinner party talking about the information. We are retrieving it out of our long-term memory. And I'm working on it in a way that can be acted upon. So there's basically a little bit of transfer from initially receiving it, encoding it into our memory and then retrieving it from our memory.

Robin Chenoweth: *Voila*. The information that has meaning to us, that which relates to something we already know or think, sticks. Everything else goes the way of: Name of the body of water God separated for the Israelites, a Panamanian dictator overthrown by the U.S. and the last word in film *Gone with the Wind*, among the few questions that Amodio missed. Stay tuned for those answers, triviaphiles.

Lauren Hensley: And what's really interesting is in terms of effective learning, often it is the process of storing it, and then retrieving it, that helps it stick. And this is why sometimes the use of time and learning is really valuable. If you only learn something or use it once, especially maybe in a studying situation, the memory traces that exist might not be as strong. But when we space out our learning over time and we practice, retrieving it, using it and then doing that again spaced out over multiple instances, basically, we have this memory track. This path. They get stronger and stronger each time they use that information and revisit those memories.

Robin Chenoweth: If the memory travels the path more, you'll remember more.

Lauren Hensley: Identifying relevance in the future, or connection to what we already know is so valuable, because it's allowing your brain to think about when this piece of information is activated, these other things that I already know, are also activated. And basically, we're storing it together by means of those connections.

Robin Chenoweth: It's creating kind of a network in our brain, right?

Lauren Hensley: Absolutely. And our brains are already doing this already. But when we bring intention to the learning process, by really thinking about what connections exist, and how are they connected? And how are they things that tap into my prior learning, and the future relevance, we are just allowing ourselves to be more metacognitive in that process, and really powering up our learning.

Robin Chenoweth: Oh, by the way, what we're doing right now, thinking about learning, scientists have a name for that, too. And if you use it, you will learn better.

Robin Chenoweth: What is metacognition?

Lauren Hensley: Metacognition, in the most basic sense, is thinking about thinking, but it also includes a way of engaging in the learning process to understand, what am I thinking, what are my thoughts here? How am I learning it? How well am I learning it? And so it involves being a little bit more reflective in the learning process to check in with oneself and then to be able to make some adjustments to the learning process if needed.

Robin Chenoweth: How is that different from deep learning?

Lauren Hensley, 10:19: Deep learning refers to the level at which learning occurs. And deep learning is often best understood in contrast with surface learning. Surface level learning deals more with the surface features of some information. Pretty much just the straight facts, definitions. Deep learning gets more into what is the meaning of this content? How does it relate to something else? How is it evaluated or used in combination with other facts and features, and allows a person to understand information in other contexts.

Robin Chenoweth: Sometimes there's so much to remember. Anatomy class. Constitutional law. World languages. What ways could you make all of that information relevant to yourself?

Lauren Hensley: I am fascinated by really the example of even if we're tapping into our innate curiosity as learners, that is something that drives us. So, to just make it more interesting in the sense of, I wonder what those people experienced? How can I visualize what that moment might have been like? Or how it had repercussions into today? I think those ways of thinking are more than just relevance in the sense of I'm going to use it, but I'm going to pull on sort of my human drives for discovery, curiosity and connection.

Robin Chenoweth: Human drive. It might be the greatest dependent factor upon which deep learning hinges. That's why it's so important that children learn to harness it early. Tzu-Jung Lin is an associate professor of educational psychology who studies learning processes and developing dynamic classroom environments.

Robin Chenoweth: How integral is curiosity, to both a child's learning and an adult's learning?

Tzu-Jung Lin: Oh, it is so important. It should be integrated into all stages of learning, not just for young children, but also for adults. I often relate curiosity to intrinsic motivation. If you are curious about something, it's very likely that you will learn because you want to learn better. And not because you want to get a good grade, or try to impress others. That's what makes curiosity so meaningful ….What makes a better school, in my opinion, is that it creates an environment where students would be curious about different things, and driven by that acute sense of curiosity, they would be willing to construct knowledge. They can use their creativity, and through social interactions, to construct a good argument, a good project, a good piece of art, something that has their own voice in it, instead of just copying and pasting things from Google, or from what their teacher has said.

Robin Chenoweth: How do you foster curiosity in a child or even in yourself?

Tzu-Jung Lin: I have a seven-year-old and a four-year-old. And they're very different children. I spend a lot of time trying to find what their interests are. Take my daughter. She loves creative drawing. She can sit and draw for two hours. And I give my son the same pen and pencil, the same paper and he wouldn't stay there for more than three minutes. And that's how I know that, oh, this is not something that would fascinate him. This is not within his realm of curiosity. But he loves puzzles. He loves word searching games. It's through these daily interactions that I get to learn that, okay, your curiosity mainly lies in a certain area. Those may be the areas that can be nurtured more.

Robin Chenoweth: So you've got to pay close attention to see what those things might be and offer them lots of opportunities, right.

Tzu-Jung, 51:01: Opportunities, yes.

Robin Chenoweth: I guess you could say the same thing for adults, really, allowing opportunities to see what it is you like, right?

Tzu-Jung Lin: That's absolutely right. And with my doctoral students, I say the same thing. When they first entered our program, I always encourage them to explore different topics. And don't delve into one area too quickly. The first year is a perfect year for them to explore different ideas, different methodologies, different philosophies.

Robin Chenoweth: Back to that term that Dr. Lin used: Intrinsic motivation. One researcher called it the spontaneous tendency "to seek out novelty and challenges, to extend and exercise

(your) capacity, to explore." Some people just seem more prone to go deep with learning. The bibliophile who knows everything ever written about Ruth Bader Ginsberg, or how climate change impacts wetlands. The kind of people I gravitate to at a party. How does that spark ignite in them? Sometimes our educational systems strike the match, but not often enough. Kui Xie, Ohio State's Cyphert Distinguished Professor, studies learning technology and student motivation.

Kui Xie: Another important part about students' motivation is, it's very much malleable, which means that we, as an educator, can change people's motivation to drive different types of engagement. So that's a very important part. That's why I study motivation. Because once I'm able to understand the kids' motivation, then I can design strategies and situations to change their motivation.

Robin Chenoweth: How can we make kids engage more with their learning?

Kui Xie: If a student feels their learning or engagement is forced by their parents, they are less likely to enjoy the learning process. So, this is an important concept we call autonomy. When students feel they have a choice, when students feel they're self-determined, they're more likely to enjoy the tasks. They're more likely to engage in a more adaptive, higher quality fashion. One strategy is then to give students some choice, give students some autonomy. At least we need to let them to perceive they are not forced to learn.

Robin Chenoweth: So, offer choices. You can read Ray Bradbury or Kwame Mbalia. Perform a skit or write a poem. Solve an algebra problem or write your own. This works for learners of all ages. Also, Xie said, to learn, you must believe that you can succeed.

Kui Xie: I am not a gamer; I don't play video games, because every time I play, I lose, and then my friends make fun of me.

Robin Chenoweth: Oh, no!

Kui Xie: I don't want to be in that situation. So, I actually don't play video games at all, especially in front of a group. So that is a disengaged situation, right? So, turn it around. If we can give students a sense of accomplishment, a sense of competence, then they will gradually be able to re-engage. We need to make sure students have a chance to succeed, by creating assessments that match to their competence level, by giving them materials that is developmentally appropriate, and so forth. Once they have a taste of success, and then gain that confidence, then they will engage maybe also have a better quality of engagement.

Robin Chenoweth: Another way to deepen learning is to get people working together to generate thought. Tzu-Jung Lin studies ways to foster higher-order thinking.

Tzu-Jung Lin: Higher order thinking is one of my main major research focus. And by definition, high order thinking refers to the type of thinking that's purposeful, evaluative, reflective and

also metacognitive …. This type of thinking requires a purpose. Students are performing higher order thinking to pursue a goal.

Robin Chenoweth: In her research, Lin works with K-12 teachers to help students consider varying perspectives on complex societal issues, such as Native American histories, food insecurity and immigration.

Tzu-Jun Lin: We invite students to reason about the root causes of these social issues. There are no right or wrong answers for students. Some of these issues are highly open ended. And it opens up a space for students to argue or to debate among each other what is right, what is wrong, what is true and what is not true. And through the press process of argumentation, students get to know, “Oh, yeah, my perspective of immigration laws may be very different from your perspective. And let's reconcile these differences together.” And in that process of reconciling differences between individuals or even within individuals, that process is what I called the higher order thinking process.

Robin Chenoweth: Students aren’t just listening to lectures or taking multiple choice quizzes. They aren’t just processing information. They are critically evaluating it. Forming their own ideas and then shaping them according to their peers by debating. It is the quintessence, the epitome, and the apotheosis of democratic thinking. This higher-order thinking is a two-parter.

Tzu-Jung Lin: It's like thinking about their own thinking, critically evaluating what their ideas were about.

Robin Chenoweth: And…

Tzu-Jung Lin: It is higher order, because first of all it is they have to go outside of their own box to think from other people's perspectives. And this can be difficult for even adults, because we all like to hear what we like to hear. And sometimes, we’re hearing something that's completely different from our own beliefs can be difficult. But the ability to put down our own perspectives and consider what others may think, is a type of higher order thinking, because a requires a lot of reconciliation and coordination among different ideas.

Robin Chenoweth: Wow, it sounds like something that we're really lacking in our society right now.

Tzu-Jung Lin: In this society. I definitely agree.

Robin Chenoweth: You're working with students to do this, when perhaps their own parents or even our own leaders might be having real difficulty doing this higher order thinking.

Tzu-Jung Lin: Uh-huh.

Robin Chenoweth: If this episode is expanding your thinking about thinking, hopefully you are coming to realize what I did as I interviewed these experts. There is more than one kind of deep learning, more than one type of intelligence.

Tzu-Jung Lin: There's a notion of multiple intelligence …. People can be good at certain things and less good at others. And this multiple intelligence can include art, music, it can be more about sport, communication. It can be related to social skills. Some people may be more sensitive to other people's feeling than others. And that's part of this multiple intelligence framework.

Robin Chenoweth: Jeopardy champions might have high IQs based on the traditional definition of intelligence. But social and cognitive scientists have realized for some time there is more.

Tzu-Jung Lin: If we think about intelligence more broadly, with multiple types of intelligence, then the type of intelligence associated with the success in Jeopardy game may be just one part of intelligence. It doesn't represent the whole idea of intelligence.

Robin Chenoweth: And we can hardly talk about deep learning without touching the other kind of deep learning, which Matt Amodio went on to study at Yale. Deep learning as it relates to Artificial Intelligence is machine learning that uses algorithms inspired by the most amazing of machines: the human brain. Kui Xie.

Kui Xie: So, neural networks attempt to simulate the behavior of our human brain that allows it to learn from large amount of data. For example, in deep learning, the computer model learns to perform classification tasks directly from images text or sound, so a lot of data involved.

Robin Chenoweth: These machines learn by experience and continue to acquire skills, just as humans learn as we tackle a task repeatedly. AI deep learning algorithms improve performance over time. This kind of deep learning is the key technology behind driverless cars and the face-recognition on your cell phone. It also was behind the Watson computing system that in 2011 took on Jeopardy champions, including Ken Jennings, and won.

Ken Jennings: Let’s go to legalese for 1200.

Alex Trebeck: Watson.

Watson: What is executor?

Alex Trebeck: Right.

Watson: Same category, 1600.

Alex Trebeck: Answer, the daily double.

Alex Trebeck: The category is 19th century novelists.

Alex Trebeck: Now we come to Watson. Who is Bram Stoker? And the wager? Hello! $17,973 and a two-day total of $77,147.

Robin Chenoweth: It's probably no surprise that AI's deep learning can be harnessed to improve human deep learning. Kui Xie.

Kui Xie: I primarily use intensive data to understand how people learn. And then based on some of the findings, then we design technological interventions to improve student's learning or improve our teaching.

Robin Chenoweth: AI learns from humans. Can humans learn from AI?

Kui Xie: I think my answer is yes. But I want to make a clear distinction. AI is not replacing human cognition. The purpose of designing AI is not to substitute human intelligence. It is to augment or support human intelligence …. Can humans benefit from AI? Of course. AI techniques can provide a lot of applications in modern classrooms. For example, using AI techniques, we are able to more conveniently provide personalized learning, which in a large classroom is very difficult to do, by a teacher, a human teacher. AI can serve as a teaching assistant, consistently diagnose students' data, continuously analyze student data.

Robin Chenoweth: And relay that information to a teacher who might be able to turn around and offer some kind of help to the student that they might not have otherwise picked up on.

Kui Xie: Exactly. Because computers or AIs are very good at repeatedly analyzing data, consistently monitor the data, and then doing that sort of analysis that take the load from a human teacher …. Helping them to make personalized decisions on individual students.

Robin Chenoweth: It's not going to replace teachers as well, right?

Kui Xie: Oh, no …. We haven't replaced teachers with all this revolution of technology for many, many years, for many, many rounds of revolution, our classroom are here, our teachers are still here …. Information processing is only a part of education. Education involves a lot more, a lot more social emotional learning, problem solving, collaboration, leadership, management, self-regulation, all this needs to be interacted with human beings in order to gain those skills …. I do believe classrooms and teachers will change a lot. In the next 50 years, or 100 years, when we visit classrooms it will no longer be the classroom that we have right now. It may well be augmented by advanced technologies, will be changed a lot humans, will learn much more efficiently with AI support.

Robin Chenoweth: Here's a thought. If used properly, Xie says, AI could eventually replace something almost universally hated by students, and some teachers. Tests.

Kui Xie: With AI with this big data movement where computers are collecting students' behavior all the time, the AI techniques can provide some diagnostic information without testing. We cannot keep testing our students every week or even every day. So, AI is now able to provide day to day diagnostic, or even, hour-to-hour or even second-to-second diagnostic information to the teachers. So, it's much, much more fine-grained sort of information that we can get from AI.

Robin Chenoweth: Imagine. More time for learning driven by our curiosity, guided by what inspires us. Intentional, reflective, purposeful learning that maximizes the vast potential of our brains. Learning that is willing to consider another way, that collaborates and creatively solves problems around us. The kind of learning that makes everyone a champion in their own realm.

If you waited to the end to hear the answers Matt Amodio missed, how curious of you! What's: the Red Sea, Manuel Noriega and day, as in, "Tomorrow is another day." If you skipped to the end, clever, but that's cheating!