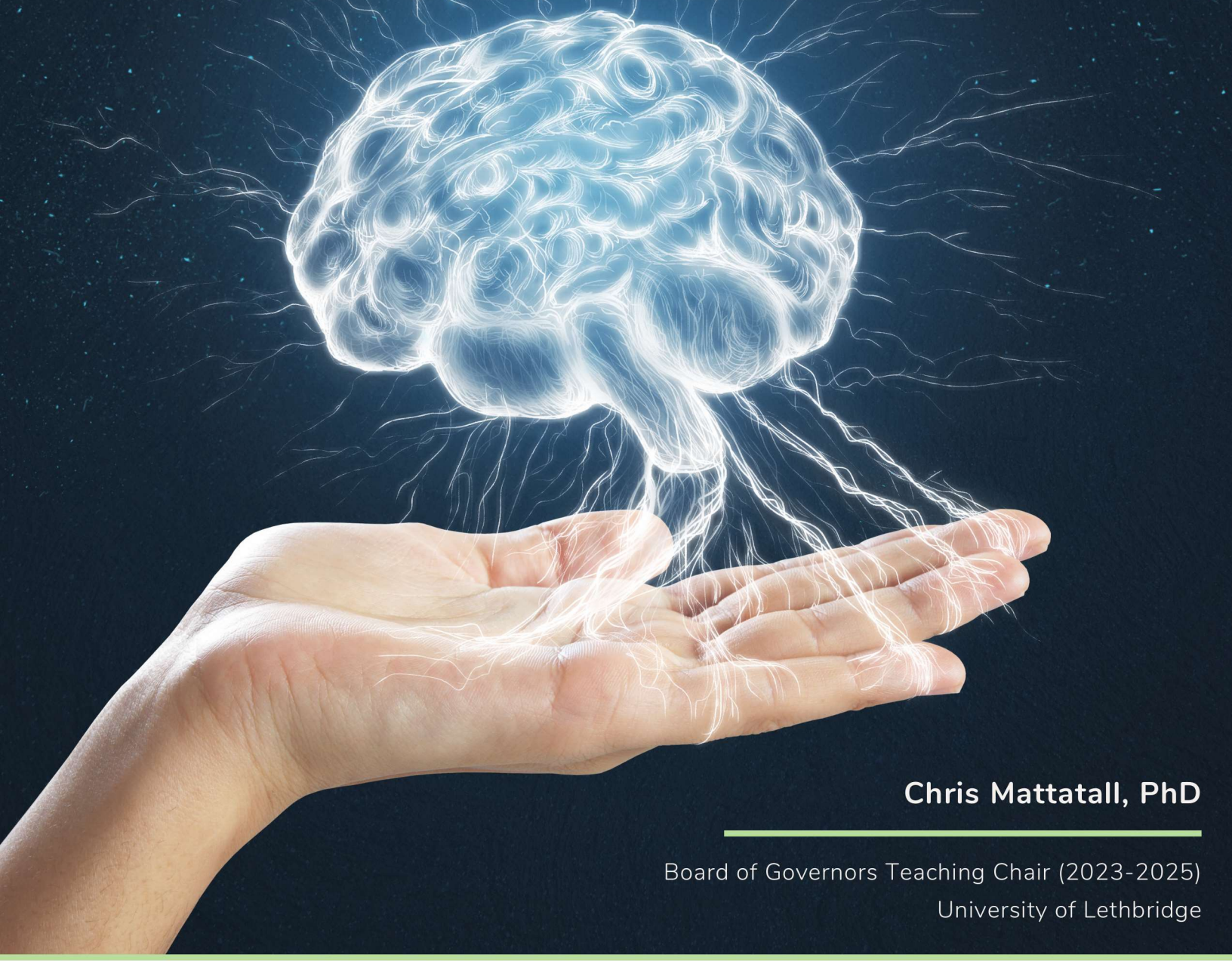
The Novice-Expert Divide:

USING CONNECTION NOTEBOOKS TO BRIDGE UNDERSTANDING



Chris Mattatall, PhD

Board of Governors Teaching Chair (2023-2025)
University of Lethbridge

"Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn." - HERBERT A. SIMON, one of the founders of the field of Cognitive Science, Nobel Laureate, and University Professor (deceased) at Carnegie Mellon University

British actor Gary Oldman, who won an Academy Award for Best Actor for his portrayal of Winston Churchill in Darkest Hour (2017) is now starring in the critically acclaimed Apple TV miniseries called Slow Horses. Oldman plays the role of Jackson Lamb, the head of Slough House, an administrative dumping ground for MI5 security agents who have made serious blunders in their previous assignments but have not been fired from the organization. They are known as Slow Horses, and under Jackson Lamb, they end up solving cases that higher ranking MI5 agents miss. The lure of the show might well be attributed to the character of Jackson Lamb. Lamb is a legendary MI5 agent sent down to Slough House because he is viewed by his superiors as a past-his-prime curmudgeon who ought to have retired many years prior. Though portrayed as the heavy drinking, slovenly, lazy, and impertinent head of the disgraced Slough House, he is anything but a slow horse himself, and often solves the complex interconnections of domestic crime before anyone else. How does he do it? Well, he is an expert. Decades of work amongst the most dangerous and sophisticated criminal minds in the underworld have developed a level of expertise that others—the novices of Slough House—simply do not have.

In many educational settings, university instructors are experts in their respective fields, while students are novices.

The Important Differences Between Experts and Novices

It is useful for university instructors to understand important differences between themselves, as experts, and their novice students. We sometimes become frustrated with our students because they do not seem to be grasping the content of our lectures or labs as easily or quickly as we hoped they would. As Dr. Eric Mazur, a physicist and educator at Harvard University frames it, the better you know something, the more difficult it becomes to teach it. Why? As you grow your expertise, your evolving mental models in those areas grow more complex, and the myriad of steps that it took you to compose them fade into the background of memory (Brown et al., 2014). In other words, we sometimes forget from whence we came, and we can be a little impatient with those we are trying to get to where we are.

In this short paper, I am hoping to challenge you to think about your students first as novices who need assistance in the development of their thinking and learning. I will describe some differences between you, the expert, and your novice students. These are important differences to keep in mind. Then I want to consider what learning is; the construction of mental models, or schemas, that form the basis of all learning. One vital cognitive activity that occurs within the brain to optimize learning is the strengthening of connections between and across new content and our prior knowledge. Then I would like to suggest to you one possible teaching strategy that you can employ in your classroom or lab to strengthen connections and move novices toward expertise in their learning.

In their book How Learning Happens: Seminal Works in Educational Psychology and What They Mean in Practice (2020), Paul A. Kirschner and Carl Hendrick felt it was important to begin their work in Chapter 1 with the title, “A Novice is Not a Little Expert” to help readers understand that becoming an effective teacher first begins by understanding the difference between instructors (experts) and students (novices). This distinction between the actions and thoughts of novices and experts is crucial in understanding how knowledge is acquired, remembered, and applied in various fields. Once we have a clear understanding of how novices think differently from their instructors, we can adjust, where necessary, our teaching to help bridge understanding.

Experts possess extensive content knowledge and have developed a deep and rich conceptual understanding of their subject matter through years of reading, research, writing, experience and thinking.

Novices, on the other hand, have limited knowledge and struggle to recognize meaningful patterns within and across content. Novices tend to focus initially on superficial features of problems and lack the conceptual understanding necessary to apply to a new challenge.

Experts can quickly draw upon their knowledge and apply their deep conceptual understanding to help solve complex problems. They approach problems differently than novices and interpret problems differently, drawing upon different sets of prior knowledge to apply to new problems. Experts correctly categorize problem types, so they know where to begin to solve a problem.

Novices do not have these networks of prior knowledge to draw from to solve new problems. Novices initially do not know how to categorize problems accurately and spend time first determining what kind of problem they are facing.

Experts have faced years of scrutiny, peer-reviews and challenges that test their thinking, buffet their assumptions, and force them to think more deeply about their knowledge.

Novices have not had the opportunity to face opposition or testing of their ideas past that of their immediate peers and likely still possess confidence in their own ideas, biases, and assumptions.

One of the earliest studies that examined how experts and novices perceived and solved problems differently was carried out by A. J. deGroot in 1946. DeGroot was interested in finding out how world-class chess masters were consistently able to out-think their opponents. He showed that chess masters' knowledge and their way of thinking is essentially different from that of beginners. Not only do experts have more knowledge and can work faster than novices, but they also see the challenges differently and tackle them differently. What deGroot found was that chess masters—experts—quickly recognize a particular chess position and then determine their next move based on their extensive prior experiences (Kirschner & Hendrick, 2020). He concluded that the knowledge they acquired over tens of thousands of hours of chess playing enabled them to out-play their opponents because they were more likely to recognize meaningful chess configurations and their strategic implications much more easily than novices, and then draw upon their experience to consider a greater array of possible moves that were superior to other moves (Bransford et al., 2000). Medical doctors do this as well. They draw upon their experiences, research, and clinical histories of patients to make a diagnosis of what is ailing their new patient. How people categorize a problem depends on previous experiences with similar problems, which shapes how they determine what the problem is and the quality of their solutions. What you know determines what you see (Kirschner & Hendrick, 2020).

In How Learning Works (2010), Ambrose et al. highlight the differences between experts and novices in how they process and position new knowledge. Experts have a much richer "density of connections among the concepts, facts, and skills they know" (p. 49). When they encounter a new piece of information or a new idea, they immediately slot it into a fully developed network that enables them to see connections between it and dozens of other things they know. Novices often react differently to newly taught material and ideas. They may absorb the new information from each lecture in a course without connecting it to other lectures or recognizing themes or patterns that span the course content. Students lack comprehension because they lack connections (Lang, 2021).

Moving Students from Novice to Expert: The Need to Make Connections

In their influential book How People Learn: Brain, Mind, Experience, and School (2000), the National Academy of Sciences highlight three principles of human learning that instructors must keep in mind:

1. Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that they are taught.

2. To develop competence in an area of inquiry, students must: (a) have a deep foundational or factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.

3. A "metacognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them.

New knowledge must be linked into existing or prior knowledge for learning to occur. “It is a basic learning principle that whenever the brain is trying to absorb something new, it tries to relate new information to something it already knows” (McQuire & McQuire, 2015, pp. 25-26). And then the next step to learning is to extract key ideas from new material and organize them into a mental model. People who can do this effectively show an advantage in learning complex mastery (Brown et al., 2014). We want our students to have rich frameworks of knowledge in our content areas; ones that enable them to connect and organize information in a meaningful and productive way (Lang, 2021). To do this, we have to not only help students organize and think upon the material that they are newly exposed to, but we need to give them opportunities to connect it to previously learned material that also serves to build connections across ideas and concepts. This leads to deeper understanding and comprehension.

I like how James Lang frames it,

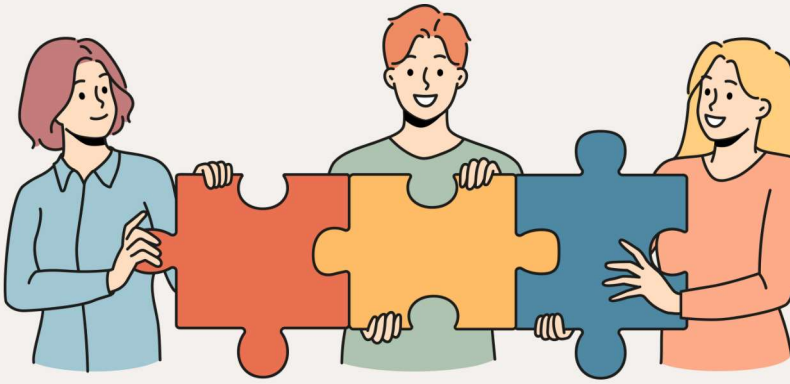
> Hence, a simple way of understanding how to build comprehension in our students would be one that consists of helping them forge rich, interconnected networks of knowledge—ones that enable each existing piece of information in our content area to connect with lots of other information, concepts, and ideas....The more connections students have in a knowledge field the better they are able to learn and remember new knowledge in that field—which may be the most important reason to emphasize connections in your teaching (Lang, 2021, p. 96).

One method of helping novices connect what they already know to what they are learning is to ask them to articulate or write down the connections they are seeing between newly learned content and their understanding of it. This allows the instructor to get a clear sense of whether their students are seeing the connections they ought to be seeing (Kirschner & Hendrick, 2020).

Helping Students Build Connections: Connection Notebooks

Our task is to create an environment that facilitates the formation of connections rather than simply lecturing them about connections. Speaking about making connections and even showing them where the connections lie may not be enough. Students must be active in building up those connections themselves with our help. Most instructors do a good job of highlighting connections, modeling connections and imploring students to think about connections within and across the subject area but may not ask their novices to show that they can make these connections.

When we make the connection for students, we are making the connection that resonates with us, that makes sense to us and is understood by us, but students may have zero interest or understanding in this kind of connection, and it may not make sense to them. It is important to allow students to generate the connections that make sense to them (Lang, 2021). By actively involving students in the process of building connections, instructors empower them to take control of their own learning and foster the practice of deeper processing (Ritchhart & Church, 2020).



The act of making connections requires effort and engagement. Elaboration, which involves explaining new material in one's own words and connecting it to existing knowledge, strengthens understanding and promotes the formation of connections. The more students can explain the relationship between new learning and prior knowledge, the better they grasp and remember the new information (Brown et al., 2014).

Connection Notebooks

I am borrowing the idea of Connection Notebooks from James Lang, which he describes in detail in his book Small Teaching (2nd Ed): Everyday Lessons from the Science of Learning (2021). A Connection Notebook can be a physical journal such as something you would purchase at the Dollar Store, or an electronic journal that someone keeps on their laptop or submits on Moodle. The way you use Connection Notebooks and the format they take is up to you. Below I will describe a few ways that I envision you could use them, but these are only my suggestions.

In a recent graduate course I taught in Summer 2023, I asked my students to keep a daily Connection Notebook as a required assignment for the course. They were asked to write out all the connections they saw within my course to what they believed, experienced, disagreed with, were challenged by, and were newly exposed to. They were asked to hand-write or illustrate connections between concepts, theories, and their own experiences as they understood them. This assignment was designed to help them think upon the material they were being taught. The connections they wrote about and illustrated (e.g., concept maps) helped them remember and think deeply upon the course content.

Please note, I use Connection Notebooks as they were described by Lang in Small Teaching—as an actual notebook—but any method to engage students in articulating the mental connections they think about is useful. I will take the rest of this paper to highlight a few ideas of how this approach can be used in your classroom as a physical connection notebook.

A Few Connection Notebook Ideas

As a focusing tool. Students come into our classes fully engaged in other things, but we hope they will quickly disengage from outside thoughts and focus on our content. One way to do that is pose an interesting, funny, provocative, or exploratory question or problem to get them thinking and writing about something relevant to the content of your class. Have them spend the first 5 minutes in class writing. This quiet time focuses the mind, helps them disengage from what they were doing, and starts the class with all students thinking about what you want them to think about.

As a summarizing exercise. Building connections within what you have just taught, or ensuring they understand last class's content so that you can continue to build upon it, may require that you ask your students to summarize content. Taking 5 minutes at the beginning or ending of class to write out a summary strengthens memory and understanding.

As a metacognitive tool. It is important that students think about their own thinking and consider what they know and do not know. Sometimes inserting a bit of cognitive dissonance is helpful in positioning students to learn. Pose a difficult question and ask students to write out (predict) what they believe the answer to be. For example, "What causes a figure skaters spin to increase in speed when they bring their arms in to their chest?" Asking students to predict or hypothesize something positions them to learn.

As an assignment. Connection Notebooks do not need to be a class-only exercise and instructors can assign questions, problems, riddles, procedures, etc. for students to take home, think about and write about. The key here, again, is to use these opportunities to help student build connections to the content you want them to learn.

As assessment of learning and understanding. By examining students' Connection Notebooks, instructors can gauge whether students are making desired connections and adjust their teaching accordingly. You can collect your students Connection Notebooks periodically to see what they are writing or illustrating.

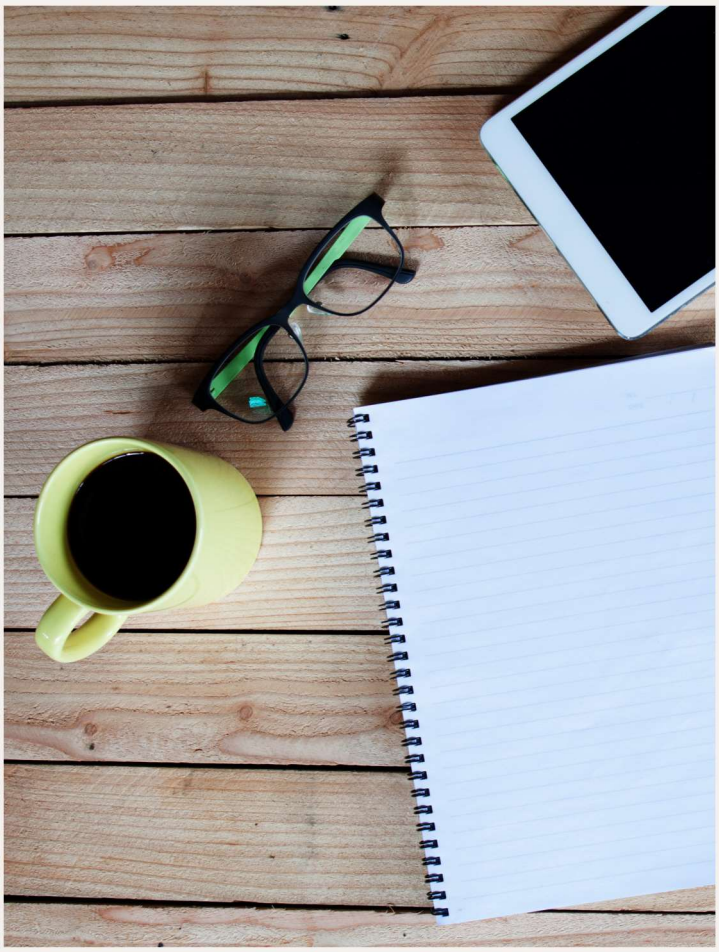
As a sampling. You do not need to collect and examine everyone's notebooks. You can inform your class that now and then you will collect a handful of notebooks to determine how concepts are being perceived.

As an exit slip. You can ask students to tell you how class went that day. Was it clear? Did students 'get' what you were trying to say? What should you start doing, stop doing or continue doing to help them understand the content? What resonated with them? What provoked them or encouraged them?

As a means of helping reluctant or shy or intimidated students. Not all our students are bold enough to admit that they do not understand our course. Many students hide their lack of understanding until it is too late. Connection Notebooks can be used to allow students to express their doubts, questions, and request for help.

Connection Notebooks serve as windows into students' thought processes, allowing instructors to gain insight into how students are thinking and understanding the material. By providing students with the opportunity to express their connections in writing, instructors can better support their learning needs.

The novice-expert divide highlights the differences in knowledge and problem-solving approaches between students and experts. By utilizing Connection Notebooks, as one among many approaches (see McGuire & McGuire, 2015, for more), instructors can facilitate the process of connecting new information to prior knowledge. Encouraging students to actively engage in making connections allows them to build rich frameworks of knowledge.



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