Great Learners by Design

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Principles and Practices to Supercharge Learners

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Contents

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Preface

If you ask a teacher to talk about their "theory of teaching," this will be a long discussion. Teaching and theories of teaching dominate the lives of teachers and school leaders. Initial teacher education programs are devoted to discussing teaching. Professional learning focuses on new ideas in teaching. The research literature on education is rich in debates about teaching. This is wonderful and a tribute to the professionalism of educators and those who support them in their practice.

Now, if you ask the educator to tell you about their "theory of learning," the silence will be loud, the conversation brief, and hardly ever will you hear a reference to contemporary learning models. It is rare to hear debates about learning among teachers, reviews of initial teacher education texts barely mention learning, and teacher professional development rarely attends to learning.

Our current models of accountability aiming for high achievement and high standards often claim that outcomes will be better if teaching improves. But where is the student in this model? Such a focus on outcomes minimizes asking about debates about how to teach students the skills of how to learn, how to engage in error management, and how to know when to use this strategy and when to use that strategy.

Such a focus on measurable academic outcomes minimizes the question of learning and how we teach our students the skills of learning—perhaps among the more important outcomes of our systems of education. Indeed, as Stanislas Dehaene (one of the major contributors in our chapter on theories of learning) has suggested, we are *Homo docens*, the species that learns. So, where is the talk about building and enhancing our learning skills?

Students, not surprisingly, are less interested in teaching (they know it will be variable and change with each teacher), but they are absorbed, fascinated, and obsessed about learning:

How did you do that?

How do I learn this?

What do I do when I do not know what to do?

They know that by "learning," they will achieve higher grades, more enjoyment, and greater engagement in continuing to learn.

One piece of evidence struck us as to the importance of realigning a fundamental interest in developing the learning lives of students. The Programme for International Student Assessment (PISA), the series of tests administered to over 30 million students worldwide, asked about students' claims about learning. Almost 40% of students claimed that their teachers did not show interest in their learning or continue supporting their learning until they understood the material. Moeller et al. (2020) surveyed 20,000+ students and used experience sampling of what they were doing and thinking in their classes (three times a day). Three-quarters of all responses were negative (bored, tired, stressed, anxious, annoyed, sad, alone, depressed). These negative feelings were more likely expressed by girls than boys, by younger than older students, and by white students than students from other ethnic groups. Boredom is too dominant, a symptom of disengagement and an unwillingness to engage in learning challenges.

But do they love learning? Just watch these same students play their video games, engage in their sport, and work out how to flourish in their social lives. All have deep resources of motivation and remarkable skills in learning, but they choose not to spend these resources on what we want to teach them. To paraphrase the vice president on *The West Wing*—"You know what they call a leader with no followers? Just a guy taking a walk" (Misiano & Goffman, 2003)—if we are teaching and the students aren't learning, we're just taking up space.

Daniel Willingham (2021) has written extensively on "Why don't students like school?" He claims that our brains are not designed to learn; they are slow and unreliable and designed to save us from having to think. He argues that we are naturally curious, have brains that can hold little in short-term memory at any specific time, and will avoid thinking unless the conditions are tight.

It is time to bring theories of teaching and learning together, and this book's primary aim is to pursue this goal. To achieve this, we will dig into what it means to learn as we

- Outline theories of learning, both new and old
- Look to research to unpack a contemporary theory of learning that can readily be aligned with teaching theories and methods
- Discuss optimal learning strategies and when best to use them and consider practical strategies to integrate building opportunities to nurture these strategies into our classrooms
- Introduce 13 fundamental principles of learning and make your class and school a "learning organization" (see Chapter 8, Table 8.1)

- Discuss different tools for measuring how we and our students learn
- Highlight how to make your school a learning organization
- Overview the model of intentional alignment for bringing it all together

We draw on a rich database of meta-analyses, research evidence, and our school experience to achieve all the above. Together, we have 64 years of teaching in K–12 schools and 63 years of teaching and researching in university classes.

We thank those whose shoulders we stand on, our critics who have helped to improve our learning, our families, our collective 19 children and grandchildren, and our students. We also thank the Corwin implementation team for Visible Learning, who have provided many data and stories, and the production team from Corwin.

Our mission is to raise the discussions and debates about learning; may they be loud, heard, and actioned.

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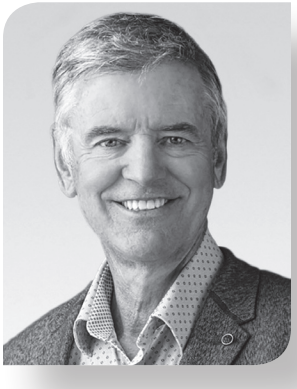

John Hattie is an award-winning education researcher and best-selling author with nearly 30 years of experience examining what works best in student learning and achievement. His research, better known as Visible Learning, is a culmination of nearly 30 years synthesizing more than 2,500 meta-analyses comprising more than 170,000 studies involving over 300 million students around the world. He has written over 600 articles, 70 books, and presented and keynoted in over 800 international conferences and has received numerous recognitions for his contributions to education. His notable publications include *Visible Learning*, *Visible Learning for Teachers*, *Visible Learning and the Science of How We Learn*, *Visible Learning for Mathematics, Grades K–12*, and *10 Mindframes for Visible Learning*.

Timothy O'Leary, PhD, is founding director of Educational Data Talks and an Honorary Research Fellow at the University of Melbourne. Tim has worked in education for 20+ years, with experience in government, independent, and faith-based schools. Within schools, Tim's roles have ranged from classroom teacher to school leadership; his most recent role was as director of learning in an inner-city F–12 school. Since leaving the school grounds, Tim has consulted with schools to consider how to use evidence best to support school improvement. Tim's passions are classroom climate, collective efficacy, and developmental approaches to teaching and learning. Tim is published in the areas of effective score reporting and collective teacher efficacy, and his debut book, *Classroom Vibe: Practical Strategies for Better Classroom Culture*, was published in 2021.

Kyle Hattie is a Year 6 teacher at Yubup Primary School (1,000 students in Melbourne, Australia). He has taught at all levels of primary school in New Zealand and Victoria, specialized in innovative learning environments, and was an acting assistant principal of Stonefields School in Auckland. He is elected into the Exemplary Teaching Program, has been a learning specialist, and coordinated teachers in a "nature of learning" project to identify students' and teachers' conceptions of learning, leading a team in developing their school's seven learning dispositions, and now integrating into the school's model of teaching and learning. He has been published in passion projects and the nature of learning, and recently coauthored (with John Hattie) *10 Steps to Develop Great Learners*.

Gregory Donoghue has over 30 years of experience working with vulnerable children—as a former child abuse detective with Victoria Police and statutory child protection investigator, and currently as an honorary researcher and lecturer in the science of human learning and student well-being at the University of Melbourne Graduate School of Education. Greg completed his PhD in educational neuroscience, during which he co-developed the Hattie–Donoghue learning model used in this book. He now combines his other qualifications in psychology, criminology, education, and neuroscience to develop and deliver evidence-based learning interventions for children and adults with various learning difficulties, particularly those caused by trauma and mental health issues.

CHAPTER 1

The Life of Brain/Brian

Imagine three classes

Class one is teacher-centered, with the teacher dominating, talking 90% of the time, asking 150 questions a day requiring fewer-than-three-word answers, presenting a preponderance of facts, preparing students for assessments and tests whereby the teacher checks to see which of the precious facts are known or not, and reteaching to ensure mastery of the detail.

Class two is student-centered, as the students choose the topics, directions, and foci of their learning; the notions of personalized learning and individualized instruction abound; there are high levels of engagement in many exciting, authentic, and real-world activities; and the teacher sees their role as the guide on the side.

Class three is led by the teacher, proposing challenging tasks just beyond the students' current grasp and understanding; there is much evidence of both explicit instruction and problem-solving teaching and learning, with the teacher being very nosy to know what the students do and do not do, know, and understand; and there is a transparent notion of mastery while allowing students different times and ways to attain and demonstrate this mastery.

Now imagine three students

Student one, Blaine, loves to come to class well prepared, attends diligently to what the teacher says and requests them to do, raises their hand to answer teacher prompts and questions, engages with little to no distraction to the tasks, and then completes them on time, at length, and with attention to the quality of presentation. The student is gritty, believes in a growth mindset, and is permitted to use learning approaches that match their learning preferences.

Student two, Briony, aims to have deep mastery of all she is asked to study. With a deep love of nearly all topics, she expends a significant investment in time and learning into each topic and demonstrates the skill of becoming engrossed in discovering more, delving more deeply, and understanding beyond the stated mastery levels.

Student three, *Brian,* is able to evaluate when he is required to master the facts and when to delve deeply into the relations between ideas. This student has the skills to learn from explicit instruction and problem-solving learning; can explain the nature, complexity, and depth of knowing the teacher desires from activities and assessments; and can play the game of being a student, recognizing when to attend and when to drift, and when to shine and when to back off.

Student one will thrive with the teacher in class one. Indeed, most teachers in our current schools look like this class one teacher (Clinton & Dawson, 2018; Skipp & Tanner, 2015). Many of our above-average students welcome teacher one—wanting more teacher talk, more focus on the facts, and more tasks that require delving more deeply into discovering more facts (Specjal, 2022). This is the game where these students are winners in the class, but they are not productive in their later lives. Successful learners are asked to know ideas and know when to relate ideas, to know when to work alone and how to work with others, and to learn how to evaluate the quality and relations between the ideas.

Student two will thrive with the teacher in class two. Deep mastery, investment in learning, and the joy of discovery have always been major outcomes of learning. But there is a time for learning the content, overlearning the ideas, and prioritizing when to focus on the content and when to focus on relating the content. There is not enough time in any school day or year to master all the curriculum, so knowing when and when not to master becomes critical. Because there is insufficient time and often facts are rewarded over relating ideas, student two is more likely to withdraw from courses, feel disgruntled with lessons, and not always get high marks in recognition of mastery.

Student three will thrive with all three teachers, especially the teacher in class three. This student knows when to focus on the facts and when on the relational deeper ideas, can more readily transfer ideas, and can think as both a student and a teacher. It is more the life of Brian that we need the most.

The claims throughout this book are that we need to move away from the current dominance of class one teachers and students and have more teachers and students from class three. We give you permission to be greedy: we want a balance of content and deep thinking, we want a variety of teaching methods, and we want students to have more than one learning strategy (especially when their first attempt fails and there is no point repeating it and then failing again). The hallmark of

teacher and student three is they know the right time to focus on the content, then on the relational deeper conceptual thinking; they know how to teach and learn the optimal learning strategies relative to where the student is along the learning continuum; and they know how to evaluate their success and seek evidence of their impact on the learning lives and understanding of all students.

Let us move to the world of insects for a moment. Fruit flies are attracted to rotten fruit, but they are the darlings of genetics. They have a rapid life cycle (generation time about 10 days), only have four pairs of chromosomes, produce a large number of offspring, and require little equipment and space. Johanni Brea et al. (2014) were interested in the mechanisms of forgetting. They claimed forgetting appears in any adaptive system of limited capacity (fruit flies and humans) and is worthwhile to release memory space for storing new associations. Their study of fruit flies showed that forgetting depends not only on the number of conditional learning trials to learn a new behavior but also on their frequency. Forgetting is slower when the same number of learning trials is spaced out over a longer period of time. "Spaced training is more informative about the environment being in a slowly changing mode than the temporally compressed massed training. . . . Spaced training increases the belief that the environment is in a slowly changing mode, whereas reversal learning leads to a strong belief about the environment being in the fast changing mode" (Brea et al., 2014). They concluded that forgetting is not necessarily a memory limitation but an adaptive feature of the memory system to optimally cope with a changing environment.

But go into most schools and you will see students engaged in similar tasks in massed practice. Textbooks are written en masse—a chapter of topic X, then the next of topic Y. Students believe if they focus on one topic for a lengthy period at any one time, this will improve their learning. Teachers demand more time to focus on one topic. This ignoring one of the oldest, most replicable findings that apply to insects and humans is astonishing. It is illustrative of our obsession with teaching and not learning, and it is the impetus for writing this book.

There are skills and strategies to learn if students are to be successful throughout their schooling and become like student three. There are right and wrong times to use various teaching and learning strategies depending on where the student is in the learning process. There is no one list of hot learning or teaching strategies, and three major claims of this book are that:

1. Teachers need to be more deliberate in aligning their teaching strategies to the desired learning strategies and outcomes.
2. These teaching and learning strategies are different depending on the level of cognitive complexity of the intended outcomes.
3. Students need to be taught a range of learning strategies and know when to use these strategies optimally.

All this is embedded in a rich, learning-language climate and culture where the challenges are understood, evident, and welcomed; where errors and failure are seen not as embarrassments but as opportunities to learn; where students are taught to work alone and work with peers; where evaluative skills are developed to know when good is good enough; and when the prime aim is to teach students to become their own teachers (Law et al., 2024).

Learning by teaching is a powerful strategy to enhance students' abilities while focusing on the processing toward solutions. We need to teach students to become their own teachers. Wong et al. (2023) argued that "through taking the role of a teacher, learners may enact behaviors that they perceive to be defined by this role when preparing to teach, such as organizing or restructuring the content when considering the relations among ideas" (p. 807). This induces a sense of "productive agency," requires anticipating those who need helping and those who may struggle, and involves tailoring their explanations to include elaborations and thinking aloud toward solutions. As many have claimed, if we do not know how we learn, how do we know how to teach?

Yes, the class one, two, and three teachers and students one, two, and three are archetypes, although we all know them. A critical purpose of this book is to discuss what it means to be a great learner, and this requires adapting to the context and to the level of complexity of what is to be learned, developing students' aptitude not to be distracted (by others or by unrelated ideas to those required for mastery), becoming confident to evaluate the most worthwhile foci of study, and understanding when and how different sets of learning strategies can be used. We will introduce the Kenny Rogers (1978) model—teaching students to know when to hold 'em and when to fold 'em or, slightly modified, "They got to know when to hold 'em, and they got to know when to play 'em."

The Life of Brian, Not Brain

A recent review of what should be taught in initial teacher education courses promoted the claim that learning about the brain is among the top four most critical topics (Teacher Education Expert Panel [TEEP], 2023). The top topic was "the brain and learning," followed by using effective pedagogical practices that "support student learning because they respond to how the brain processes, stores and retrieves information" (TEEP, 2023, p. 9). This includes knowing the differences between the brain of a novice and the brain of an expert, the features of biologically primary versus biologically secondary knowledge acquisition (Geary, 2002, 2008), how a student's brain develops from early childhood to young adulthood, how the brain learns and retains information, how the brain applies attained knowledge, and how to identify common neuromyths. This is *not* what we are talking about throughout this book.

Too often in this and similar literature, the word *brain* is used while the word *person* would make much more sense (but perhaps sound less authoritative). In the preceding claims, there is no need to know about the brain's structures, functions, and biology but a major need to know how students (i.e., people) learn. What's more, there are so many studies showing that knowing about the brain helps not one iota to make teaching and learning more effective: Despite several attempts, research is yet to show any association between a teacher's (or learner's) neuroscience literacy and teaching or learning improvements (Bowers, 2016; Donoghue, 2019). Further, other scholars have argued that such direct translation between the brain and teaching is logically flawed and thus not possible (Bruer, 1997, 2006; Donoghue & Horvath, 2016; Horvath & Donoghue, 2016), and while many studies have confirmed the preponderance of teacher beliefs in neuromyths (see Dekker et al. [2012] or Howard-Jones [2014] for an overview), no study has shown learning improvements when these beliefs are corrected.

Please do not misunderstand—there is nothing wrong with knowing about the workings of the brain. It is exciting, detailed, and has many wonderful breakthroughs. Over the past few years, two of us (John Hattie & Greg Donoghue) were members of the Science of Learning Research Centre. The Centre brought together neuroscientists, educationalists, and cognitive psychologists. The mixing and meeting of methods, knowledge, and empirical methods was exciting. We have much to learn from each other.

Mayer (2017) argued that neuroscientific "research has not yet had much impact on education" (p. 835), and Bowers (2016) concluded that "whereas neuroscience cannot help education in the classroom, the question of how education impacts the brain is fundamental to neuroscience" (p. 601). Similarly, Donoghue (2019) reviewed 363 articles on claims that neuroscience could impact classroom teaching and found that there was no empirical study reporting evidence of classroom intervention that was prescribed based on neuroscience research improving learning outcomes. Similarly, as noted earlier, there was no empirical study reporting learning improvements from increasing neuroscience literacy (or dispelling neuromyths) among teachers. This does not mean that it could not happen, and the hope is that neuroscience can contribute to classroom practice, and in particular that it can help explain some of the phenomena we see in classrooms.

Further, Horvath et al. (2018) found no overall differences between the responses of award-winning teachers and those of teachers in training and non-award-winning teachers to 15 neuromyths. They argued that despite the widely popular claims, "put simply, there is no evidence to suggest neuromyths have any impact whatsoever on teacher efficacy or practice" (Horvath et al., 2018). Again, there is every reason to dispel myths, but there is no evidence that doing so will improve learning and teaching. Instead, educational and psychological research on learning, with a focus on sound learning models and theory, has been vastly more effective

(Donoghue, 2019). We therefore argue that more attention should be placed on these than on the "seductively alluring" (Weisberg et al., 2008) science of the brain.

Jared Horvath (2022) writes:

> *Painters.* Effective painting requires a deep understanding of visual perception (function). Visual perception is mediated by retinal cells within the eye (mechanism). Does this mean you must deeply understand how eyeballs work if you wish to be an effective painter? Of course not: we've had incredible painters for millennia, but scientists are still debating over how the eye works. Painters need only understand the function (what are the rules of visual perception)—the mechanism (how does the eye literally make these rules come about) is too far removed to be practically useful.
>
> *Chefs.* Effective cooking requires a deep understanding of taste profiles (function). Taste profiles are mediated by gustatory cells along the tongue (mechanism). Does this mean you must deeply understand how tongue receptors work if you wish to be an effective chef? Of course not: we've had incredible chefs for centuries, but scientists still understand next to nothing about how the tongue works. Chefs need only understand the function (what are the patterns of taste experiences)—the mechanism (how do different tastes transduce in the gustatory system) is too far removed to be practically useful.
>
> *Teachers.* Effective teaching requires a deep understanding of the learning process (function). Learning is mediated by cells within different brain systems (mechanism). Does this mean you must deeply understand how neurons function and communicate if you wish to be an effective teacher? Of course not: we've had incredible teachers for millennia, but scientists still know surprisingly little about how the brain works. Teachers need only understand the function (how does learning manifest and progress) but not necessarily the mechanism (how does the brain process and parse information) as this is too far removed to be practically useful.

Again, there is *nothing* wrong with teachers learning about the brain; it is exciting, as is dispelling neuromyths. But we would rather teachers become invested in learning about learning: knowing various models of learning, understanding developmental issues in learning, appreciating the power and value of various learning strategies, and knowing how to make learning more visible in their classrooms.

We know a lot about how the brain functions, the various components of the brain, the critical importance of blood flow and the chemistry structures of the brain, and the changing development of the brain. Scott Bolton and John Hattie (2017)

wrote a paper showing how the various Piaget development stages correspond very closely with how the brain develops from 0 to 20. We know that the brain is not locked in at birth, and your brain changes even as you read this sentence. Neuroeducation does have a future role: new research about the brain will enable educators to conceptualize learning and teaching more "scientifically," and it will generate new and better explanations and hypotheses leading to better learning outcomes.

We also know *learning* is a verb and must have a noun—learning is always *about* something. As Entwistle (1976) noted, "The verb 'to learn' takes the accusative" (p. 2); that is, it only makes sense to analyze learning concerning the subject or content area and the particular piece of work toward which the learning is directed and also the context within which the learning takes place. Biesta (2012) argues that "the quickest way to express what is at stake here is to say that the point of education is never that children or students learn, but that they learn *something*, that they learn this for particular *purposes*, and that they learn this from *someone*. The problem with the language of learning and with the wider 'learnification' . . . of educational discourse is that it makes it far more difficult, if not impossible, to ask the crucial educational questions about *content*, *purpose,* and *relationships*" (p. 36). To enact learning we need great teaching—both the student and the teacher are core to notions throughout this book. This relation of learning to the content will become critical when we investigate optimal teaching and learning methods.

Ways of Thinking

Throughout the Visible Learning series of books, there has been an emphasis on the thinking of the key players—teachers (J. Hattie & Zierer, 2018), leaders (J. Hattie & Smith, 2020), and parents (J. Hattie & Hattie, 2022), as well as culture and climate (Law et al., 2024)—and in this book we emphasize the thinking of the students. We have called these mindframes, and the claim is that it is more how teachers, leaders, parents, and students think about what they choose to do, rather than what they do, that matters. It is the judgments, decisions, anticipations, reflections, evaluative thinking, and critiques; the triangulation from various sources of evidence; and the quality, accuracy, and depth of interpretation that matter most.

The 10 mindframes for students emphasize their skills in learning (alone and in groups) and their confidence to take on challenges with the aim of becoming their own teachers.

1. I am confident that I can learn and enjoy challenges.
2. I know when to choose, implement, and evaluate my choice of surface and deep learning strategies.

3. I strive to improve and enjoy my learning.
4. I strive to master and acquire the content *and* the relationship between ideas.
5. I work to contribute to a positive learning culture.
6. I have multiple learning strategies and know when best to use them.
7. I have the confidence and skills to learn from and contribute to group learning.
8. I can seek, hear, understand, and action feedback.
9. I can evaluate my learning.
10. I know how to be my own teacher.

The focus of this book is not on the brain but on learning.

Alexander et al. (2009) defined learning as "a multidimensional process that results in a relatively enduring change in a person or persons, and consequently how that person or persons will perceive the world and reciprocally respond to its affordances physically, psychologically, and socially. The process of learning has as its foundation the systemic, dynamic, and interactive relation between the nature of the learner and the object of the learning as ecologically situated in a given time and place as well as over time" (p. 186). The key notions include enduring change, seeing the world differently than before, a relation between the learning and that to be learned, and happening over time. They outline nine principles to their model: learning is change; is inevitable, essential, and ubiquitous; can be resisted; may be disadvantageous; can be tacit and incidental as well as conscious and intentional; is framed by our humanness; refers to both a process and a product; is different at different points in time; and is interactional. Perhaps to make it even simpler, there is an old quote: education is what remains after you have forgotten everything you learned at school.

But "learning" is all too absent in debates about teaching. For example, many have noted the lack of discussion about learning and learning theories in initial teacher education texts and courses (de Corte, 2000; Glogger-Frey et al., 2018; Harkin, 2005; Meij et al., 2022; Noel, 2011). Surma et al. (2018) found that textbooks covering learning strategies are used in a minority of teacher education programs. Hargreaves (2005) noted that "whether teachers come to use an explicit, elaborate and expert view of learning depends more upon chance than on a planned sequence of initial training and continual professional development in which teachers are helped to develop their expertise in learning in the light of the latest advances in

cognitive science and in professional practice" (p. 5). Boser (2019) asked 203 educators questions about learning. Nonsense prevails:

- 77% endorsed the idea that people are either right-brained or left-brained and that this difference impacts how they learn.
- 97% of respondents endorsed the idea of "learning styles" (e.g., auditory, visual, and kinesthetic) and that these styles impact learning outcomes.
- 69% endorsed rereading over retrieval practice despite the preponderance of the efficacy supporting the latter.
- 80% argued that solving blocks of questions of the same basic problem type is superior to interleaving—nonsense.

But there is a wealth of articles, blogs, and websites that promote the science of learning. For example, in 2007, the Institute of Education Sciences (IES), the research arm of the U.S. Department of Education, published *Organizing Instruction and Study to Improve Student Learning*. This report identified six "fundamental instructional strategies" "as having strong-to-moderate research support" "that benefit any teacher's instruction, regardless of the subject or grade level" (Pomerance et al., 2016, p. 1). The first two help students take in new information:

1. **Pairing graphics with words.** Young or old, all of us receive information through two primary pathways: auditory (the spoken word) and visual (the written word and graphic or pictorial representation). Student learning increases when teachers convey new material through both.
2. **Linking abstract concepts with concrete representations.** Teachers should present tangible examples illuminating overarching ideas and explain how the examples and big ideas connect.

The second two ensure that students connect information to deepen their understanding:

3. **Posing probing questions.** Asking students "why," "how," "what if," and "how do you know" requires them to clarify and link their knowledge of key ideas.
4. **Repeatedly alternating problems with their solutions provided and problems that students must solve.** Explanations accompanying solved problems help students comprehend underlying principles, taking them beyond the mechanics of problem solving.

The final two help students remember what they learned:

5. **Distributing practice.** Students should practice material several times after learning it, with each practice or review separated by weeks or even months.
6. **Assessing to boost retention.** Beyond the value of formative assessment (to help a teacher decide what to teach) and summative assessment (to determine what students have learned), assessments that require students to recall material help information "stick."

Pomerance et al. (2016) reviewed the textbooks used in educational psychology courses across 48 elementary and secondary teacher preparation programs and found that "looking for the six strategies in these textbooks is akin to looking for six needles in a haystack" (p. 6). At best, some described up to two of the six key strategies (most with about one or two sentences), only one mentioned posing probing questions, and instruction in all six strategies was virtually nonexistent. "Even using a low bar, no single textbook in the sample covers more than two of the six strategies, while almost half fail to cover even a single strategy" (Pomerance et al., 2016, p. 7). When they reviewed the course programs from the teacher preparation programs, less than half prepared their candidate in even one strategy (usually posing probing questions), and 35% did not require learning about any strategy.

The Organisation for Economic Co-operation and Development (OECD, 2010) completed one of the largest studies of "learning to learn," and they specifically refer to summarizing, control strategies (figuring out what I need to learn, what I do not understand, and seeking help), memorization strategies, understanding and remembering, and elaboration strategies (transfer to new situations). They reported that practicing reading by reading for enjoyment is most closely associated with better outcomes when high levels of critical thinking and strategic learning accompany it. Further, based on over 30 million students across 65 countries, almost 40% of students reported that, in most lessons, the teacher does not show an interest in every student's learning or does not continue teaching until students understand the material (OECD, 2024).

One key strategy identified by the OECD is summarizing. Students in high-performing countries generally know how to summarize information. Across OECD countries, the difference in reading performance between those students who know the most about which strategies are best for summarizing information and those who know the least is 107 score points (OECD, 2010, p. 14). Memorization was less systematically related: some memorization strategies are associated with lower reading performance in some (25) countries and higher reading performance in others (27 countries). Frequent use of elaboration strategies is positively associated with reading performance, but the effect is small (on average about 14 points from those who used and did not use elaboration). Controlling one's learning is associated with higher student performance in every country, although this

association is not as strong as an awareness of effective learning strategies (OECD, 2010). Overall, they concluded that it is less about giving students autonomy and more about teaching them how to learn more effectively.

Lave (2011) uses the notion of apprenticeship learning that leads to students learning a topic by doing what the experts in that domain do "by engaging in the structure-finding activities and mathematical argumentation typical of good" learners in the domain. She notes schools tend to adopt a "culture of acquisition" via making explicit and specific the content to be learned, and evaluate the students differently by being better or worse at "getting it." Her notion of "understanding in practice," however, is more than an apprenticeship form of learning "where knowing, thinking, and understanding are generated in practice, in situations whose specific characteristics are part of the practice as it unfolds" (p. 19; see also Collins et al., 2018; Lave & Wenger, 1991). There are so many learning opportunities outside the classroom where students aim to "think" like an expert—perhaps the most obvious case is learning video games where students seek advice and hints, watch experts, listen to expert commentaries, collaborate with peers, and are highly motivated by the chase to improve. More of this understanding in practice is needed in classrooms.

We often hear educators talk about unmotivated students who fail to learn. But these same students can be ardent learners of their video games. It is fascinating to consider the major principles game developers use to entice users to buy and play their games (J. Hattie & Hattie, 2022). We can learn a lot from them:

1. Make sure the involvement in the task is equally rewarding, if not more so, than the goal.
2. The thrill is in the challenge—not too hard, not too easy, not too boring.
3. Learners love and learn from failure.
4. Help identify enablers and barriers; error detection is a critical skill to learn.
5. Maximize feedback that is heard, understood, and actionable.
6. Be curious and curiouser.
7. Who's in control?
8. You learn to play the game in the midst of playing the game.
9. Make sure there is a story in which problems are embedded. We read for the narrative, not for the phonics.
10. Learning can be emotional.
11. Learning is best tied to past performance.
12. It's fun to learn together.

13. We can amble, trot, gallop—we can work at our pace.
14. There are many roles as a learner.
15. We are of little memory, and learning costs brainpower.

When teachers were asked, "What do you think your pupils learned today?" Meij et al. (2022) found most explained how they developed their lesson using a teaching model, and very few had insights into what the results of their activities were for the student, and even fewer could articulate how their students went about their learning or what principles of learning were at work (other than they were not motivated, they were distracted, and they were not engaged). One of the teachers claimed there was little place for theories of learning! We have much to do.

In Chapter 2, we review many of the theories of learning, and indeed, there are many—both historically and contemporaneously. Over the years, learning has meant the responses to stimuli (electric shock, teaching), which involves acquiring, storing, and using knowledge emphasizing memory, thinking, problem solving, and understanding. Learning is usually considered an active process leading to constructing ideas based on experiences and knowledge. It occurs through many forms (especially social means) and involves reflection, experience, and the pursuit of meaning and personal growth. Learning can be understood through studying brain processes, neural plasticity, and cognitive neuroscience.

Learning is a dynamic and multifaceted process through which individuals acquire, consolidate, and integrate new knowledge, skills, attitudes, and behaviors. It involves ideas and facts, finding relations between ideas, and transferring ideas into new situations. Learning relates to curiosity, critical and creative thinking, and adaptability. Most critically, it is an active process of finding meaning and constructing understanding through various experiences, engagement with information, and interactions with one's environment, peers, and resources. There are many strategies to accomplish such learning, many dispositions that help success in learning, and multiple ways and times to engage successfully in learning. Learning, however, is always about something—and while this "something" is not the focus throughout this book, it does raise the moral purpose questions about the value and worthwhileness of the focus of learning.

Chapter 2 discusses learning and outlines our learning model, which shows the term's diversity of meaning and is the basis of many of the claims throughout this book—from the learning strategies (the focus of Chapters 3, 4, 5, and 6), to the learning dispositions (Chapter 7), to the learning principles (Chapter 8). Specifically, Chapter 3 develops our learning model, and uses the results from a meta-synthesis of meta-analyses to identify the top 12 learning strategies. Chapters 4 and 5 outline ways for teachers and students to improve their use of these strategies. It is noted that we have many thousands of measures of achievement but relatively few measures of learning. A measure based on these top 12 strategies is discussed in Chapter 6.

Chapter 7 concerns how to make a school a vibrant learning organization, anchored in a shared narrative of optimal learning and learners, where teachers deliberately plan and teach the strategies to optimize learning of the various levels of cognitive complexity. The claims in Chapters 1 to 6 are integrated into a set of learning principles in Chapter 8, and Chapter 9 brings them all together in a model of intentional alignment.

There are many more attributes of learning that are beyond our scope—such as habits of learning (Liljedahl, 2023; Ritchhart & Church, 2020)—and there are many great books on learning for educators, and on our shelves, that we often use: Almarode et al. (2021), J. Anderson (2023), Bergin (2022), Dehaene (2021), Eckert (2022), Kirschner et al. (2023), Liljedahl (2021, 2023), McDowell and Miller (2022), Stern et al. (2021), and Watson and Busch (2019, 2021). There are many more web sources, and among the best is John Dunlosky's (2013) "Strengthening the Student Toolbox" (see also Faculty of Science—McMaster University, 2013).

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What is in scope are models of learning, strategies of learning, principles of learning, the Hattie–Donoghue model of learning, conceptions of learning, measuring learning, learning environments, and dispositions of learning (Figure 1.1; see J. Hattie & Donoghue, 2018). These are the focus of "learning" throughout the chapters.

FIGURE 1.1 The Hattie—Donoghue Model