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Articles

DEEPENING THE DISCOURSE USING THE LEGAL MIND'S EYE: LESSONS FROM NEUROSCIENCE AND PSYCHOLOGY THAT OPTIMIZE LAW SCHOOL LEARNING

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I. INTRODUCTION

To hear is to forget. To see is to remember. To do is to understand. –Chinese Proverb

The legal academy is engaging in an extensive dialogue about innovative teaching techniques that could improve legal education[1] as

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1. Because most of the discussion on innovative teaching focuses on the positive aspects for students, the author would like to acknowledge that innovative teaching can be and feel extremely risky for law professors. For an in-depth discussion, *see* Michael Hunter Schwartz, *Teaching Law by Design: How Learning Theory and Instructional Design Can Inform and Reform Law Teaching*, 38 SAN DIEGO L. REV. 347, 371 (2001); *see also* Hillary Burgess, The Risks and Rewards of Innovative Teaching (2009) (unpublished manuscript) (on file with author).

evidenced by the publication of the *MacCrate Report,*[2] the Clinical Legal Education Association's *Best Practices*,[3] and the Carnegie Report,[4] together with the growing number of institutes, groups, and conferences dedicated to exploring the legal curriculum, teaching methods, and the goals of legal education.[5] Many of these conferences and publications also focus on what more to add to the legal curriculum to create professionally ethical, competent, and practice-ready attorneys.[6] With this growing movement, law professors are under increasing pressure to transform their teaching to teach more doctrine and more skills, at deeper levels, in the same or less time, while not overburdening their students. Additionally, professors must teach so that their students can retain their learning for a lifelong career in law.

Research on traditional teaching methods in secondary education, however, indicates that students tend to forget forty percent of what they learn within twelve months after taking final exams and sixty percent of what they learn within thirty-six months after taking exams.[7] This alarming statistic suggests that students forget much of what we teach them even before they take the bar exam and over half of the core doctrine necessary to practice law ethically and competently before they begin their careers.

To enhance the efficiency of teaching law and retention of learning law, law professors might benefit from the neuroscience, cognitive psychology, and educational psychology theories that underlie adult learning. In the past century, neuroscientists have engaged in research about how the brain works, cognitive psychologists have engaged in

2. AMERICAN BAR ASSOCIATION, REPORT OF THE TASK FORCE ON LAW SCHOOLS AND THE PROFESSION: NARROWING THE GAP (1992), *available at* http://www.abanet.org/legaled/publications/onlinepubs/maccrate.html [hereinafter THE MACCRATE REPORT].

3. ROY STUCKEY ET AL., BEST PRACTICES FOR LEGAL EDUCATION: A VISION AND A ROAD MAP viii (2007), *available at* http://law.sc.edu/faculty/stuckey/best_practices/best_practices-cover.pdf.

4. WILLIAM M. SULLIVAN, ANNE COLBY, JUDITH WELCH WEGNER, LLOYD BOND & LEE S. SHULMAN, EDUCATING LAWYERS: PREPARATION FOR THE PROFESSION OF LAW 12 (2007) [hereinafter CARNEGIE REPORT].

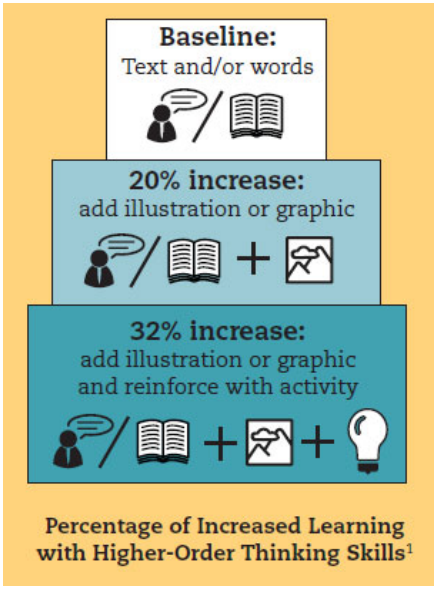
5. *See* CARNEGIE REPORT, *supra* note 4, at 12; THE MACCRATE REPORT, *supra* note 2; STUCKEY ET AL., *supra* note 3, at 6.

6. *See, e.g.*, CARNEGIE REPORT, *supra* note 4, at 12; THE MACCRATE REPORT, *supra* note 2; STUCKEY ET AL., *supra* note 3, at 7.

7. Moshe Naveh-Benjamin, Hagit Lavi, Wilbert J. McKeachie & Yi-Guang Lin, *Individual Differences in Students' Retention of Knowledge and Conceptual Structures Learned in University and High School Courses: The Case of Test Anxiety*, 11 APPLIED COGNITIVE PSYCHOL. 507, 516 tbl.3 (1997).

research about how adults learn, and educational psychologists have applied these lessons to adult education generally.[8] Although many traditional law school teaching methods are pedagogically sound teaching tools, it seems increasingly necessary to complement traditional teaching methods with methods that improve and expand learning while not increasing the burden for either students or professors.

FIGURE 1. PERCENTAGE OF INCREASED LEARNING WITH HIGHER-ORDER THINKING SKILLS[9]



By incorporating efficient and innovative teaching methods in law school, professors can teach more doctrine and more skills in the same amount of time. Because of the way the brain is designed, visual aids increase efficient learning, deepen understanding, and enhance long-term retention.[10] Additionally, empirical research demonstrates that with higher-order learning tasks, visual aids and visual exercises create a deeper understanding of material, more quickly, and for longer periods

8. *See generally* ROBERT J. STERNBERG, COGNITIVE PSYCHOLOGY 2–12 (Carol Wada et al. eds., 2d ed. 1999).

9. Thanks go to Tobi Lynn Accardi at Hofstra School of Law for creating this graphic.

10. *See* Section III., *infra*.

of time.[11] Finally, many of the new teaching methods have focused on how to retain knowledge indefinitely, allowing law students to maintain their law school lessons through the bar exam and their life-long careers as lawyers.

The literature suggests that optimal teaching methods are more important with higher-order thinking skills than lower-order thinking skills.[12] As Section II illustrates, within the law school classroom, traditional law school teaching methods engage students in the first four levels of cognitive skills. The traditional law school exam, however, tests students on concepts that require students to engage in cognitive thinking skills at levels three through six.[13] Thus, with traditional law school teaching methods, students often must learn the highest-level learning objectives on their own.[14] When students must tackle the highest-level learning objectives on their own, students who have the greatest prior educational advantages and current time and money resources often outperform students who do not.[15] This situation tends to further exacerbate the divide between the "haves" and the "have-nots," which can impact economically challenged, educationally challenged, non-traditional students, and diverse groups unequally. The amount of doctrine professors must cover, however, often does not allow for professors to explicitly teach the last two levels of law school learning. The teaching methods discussed in this article make the last two levels of learning explicit with exercises that could be performed outside of class.

This Article provides a theoretical and scientific understanding of the way law students learn, primarily to provide professors information that might be useful when they design their lessons. This Article also discusses the literature that suggests that visual aids and visual exercises allow students to learn broader subjects at a deeper level with longer

11. *See* METIRI GROUP, MULTIMODAL LEARNING THROUGH MEDIA: WHAT THE RESEARCH SAYS 12 (2008).

12. *See id.* at 13–14.

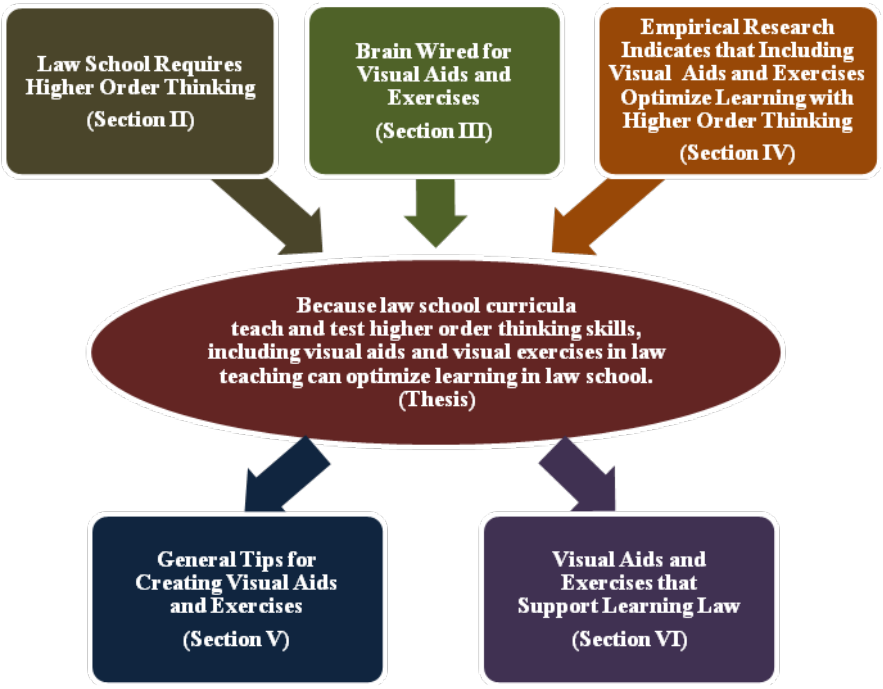
13. *See* Section II.E., *infra*.

14. *See* Section II.E., *infra*. The author would like to recognize that many law professors do not limit themselves to traditional law school teaching methods and that many professors have incorporated a variety of pedagogically sound and innovative teaching methods in their classrooms. As such, observations made in this Article are in no way a criticism of traditional legal teaching methods or of any professor's teaching methods, but rather a collection of research intended to start a dialogue that might enhance and augment the teaching methods in law school.

15. *See generally* Lisa Tsui, *Reproducing Social Inequities through Higher Education: Critical Thinking as Valued Capital*, 72 The J. of Negro Ed. 318 (2003).

retention. This Article posits that, by incorporating visual aids and visual exercises, law professors can cover more topics, at a deeper level, such that law students can better retain their learning and transfer their learning to novel situations. Further, this Article argues that professors can use visual aids and exercises to teach the highest two levels of law school learning, thereby eliminating the teaching and assessment discord common with the traditional case method model.

FIGURE 2. ARTICLE OVERVIEW



Section II provides the theoretical underpinning for the discussion in subsequent Sections about how multimodal learning is more important for higher-order thinking skills than for lower-order thinking skills. To define and explain higher- and lower-order thinking skills, this Section reviews the revised edition of the Taxonomy for Learning,

Teaching, and Assessment, commonly known as Bloom's Taxonomy.[16] Section II maps common law school learning tasks onto the Taxonomy of learning objectives, demonstrating that law school learning requires all levels of learning, but tends to focus on the highest cognitive skills.

Section III applies the neuroscience and cognitive psychology literature to the law school setting. Neuroscience and cognitive psychology explain how the brain intakes new learning. This background information provides the scientific underpinning for why multimodal learning, discussed in Section IV, is so effective.

Section IV applies the literature on both learning preferences and multimodal learning to the law school setting. Generally, the results of this literature suggest that professors can improve student understanding and retention by adding more visual aids and exercises into their classrooms.

For professors who are interested in incorporating visual aids and visual exercises into their classroom, Section V provides guidance on how to select and create pedagogically sound visual aids and visual exercises.

Section VI provides concrete explanations of various types of visual aids and visual exercises. This Section also describes examples of visual aids and visual exercises to provide a concrete illustration of these teaching materials within a law school setting.

Section VII concludes by arguing that incorporating visual aids into legal classrooms assists students in learning more legal concepts more quickly, at a deeper level, while retaining learning for a longer period of time.

II. TAXONOMY OF LEARNING OBJECTIVES: A THEORETICAL FRAMEWORK THAT EXPLAINS HIGHER- AND LOWER-ORDER COGNITIVE THINKING

A. What is a Taxonomy of Learning Objectives?

In law school, an overarching learning objective is to learn to "think like a lawyer."[17] Similarly, professors often say, "it's not about memorizing the law, it's about understanding and applying the law." These objectives tend to capture what it means to "learn law." For at

16. David R. Krathwohl, *A Revision of Bloom's Taxonomy: An Overview*, 41 THEORY INTO PRACTICE 212, 212 (2002).

17. CARNEGIE REPORT, *supra* note 4, at 2.

least the past fifty years, psychologists have attempted to understand what it means to "learn."[18] The result is that psychologists have been able to classify, categorize, and create theoretical frameworks for understanding different types and different levels of learning.[19] Of the various models of educational classifications, Bloom's Taxonomy is one of the oldest, most widely known, and most researched.[20] This Section reviews the Revised Taxonomy of learning objectives. One of the original authors of Bloom's Taxonomy updated the model with fellow collaborators.[21] This Section explains the Bloom's Taxonomy model within the context of law school learning. Because the focus of this Article is how visual aids and exercises increase learning most with the highest-order cognitive learning objectives, this Section identifies which law school learning objectives could benefit most from visual aids and exercises.

B. Learning Domains with a Focus on Cognitive Learning

Generally, psychologists currently believe that there are three related and overlapping domains of human learning: the cognitive, the affective, and the psychomotor.[22] The cognitive domain addresses learning knowledge and concepts, such as law and policy.[23] The affective domain addresses learning emotions and behaviors, such as developing the values and judgment inherent in ethics.[24] The psychomotor domain addresses learning physical skills, such as

18. Krathwohl, *supra* note 16, at 212. *Bloom's* original taxonomy was published in 1956. *Id.*

19. There are at least twenty models that create a framework for understanding learning objectives and the learning process. *See* A TAXONOMY FOR LEARNING, TEACHING, AND ASSESSING: A REVISION OF BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES 259 (Lorin W. Anderson & David R. Krathwohl eds., 2001) [hereinafter THE REVISED TAXONOMY] (reviewing nineteen models in addition to the one proposed). Most of these models have striking similarities, but simply describe or divide the processes slightly differently. *Id.*

20. *Id.* at xxi.

21. *Id.* at xxv.

22. Mary J. Pickard, *The New Bloom's Taxonomy: An Overview for Family and Consumer Sciences*, 25 J. FAM. & CONSUMER SCI. EDUC. 45, 46 (2007).

23. *See* THE REVISED TAXONOMY, *supra* note 19, at 46.

24. *See id.* at 279-80.

throwing a ball or performing surgery.[25] This paper focuses on the cognitive domain.[26]

According to the Revised Taxonomy, the cognitive domain is divided into what the student should learn (the knowledge dimension) and what the student should do with that knowledge (the cognitive dimension).[27] Generally, these learning objectives translate into a verb describing the cognitive dimension and a noun describing the knowledge dimension.[28] For example, professors will often say that they want students to be able to apply (cognitive dimension verb) the rule against perpetuities (knowledge dimension noun).[29]

The knowledge dimension and cognitive dimension combine to form an objective of what the student should do with identified knowledge. A third dimension, however, is the overarching goal of the objective: whether students should be able simply to retain and use the knowledge or to transfer knowledge to new situations.[30] For example, professors can have a goal of "applying the rule against perpetuities" to a specific fact pattern (retention), or they can have a goal of applying the rule against perpetuities to novel fact patters (some transfer), or they can have a goal of learning how to apply law generally, in other areas of property or other areas of law (significant transfer). Anderson and Krathwohl argue that meaningful learning occurs when students must both retain and be able to transfer the information to new situations.[31]

In the law school curriculum, professors tend to want students to engage in meaningful learning of both retention and transfer.[32] Some professors, however, emphasize the importance of transfer by negating the importance of retention with comments like, "it's not about knowing the rules, it's about being able to transfer those rules to novel

25. *See id.* Teaching law presupposes basic psychomotor learning such as writing and/or typing, but law school curricula tend not to incorporate lessons on how to use a pencil, or other presupposed learning from the psychomotor domain.

26. Many learning tasks involve multiple domains. For example, Professional Ethics requires students to learn both cognitive knowledge of legal rules and the affective knowledge of incorporating professional values. There is a general perception that lawyers possess less than moral characters, and that there is an increasing number of bar applicants who have a negative history. As such, research into how learning within the affective domain can assist teaching Professional Ethics, and more importantly professional values throughout the legal curriculum, is long overdue.

27. *See* Pickard, *supra* note 22, at 48; Krathwohl, *supra* note 16, at 213.

28. Krathwohl, *supra* note 16, at 214.

29. *Id.*

30. THE REVISED TAXONOMY, *supra* note 19, at 64–65.

31. *Id.*

32. *See* CARNEGIE REPORT, *supra* note 4, at 13.

situations."[33] Because so much emphasis is placed on the ability to transfer the information to new situations, students sometimes lose sight of the fact that they must retain the knowledge in order to transfer it.

C. Knowledge Dimension: What Students Should Learn

Within the knowledge dimension, there are four types of knowledge that students can attain: factual, conceptual, procedural, and metacognitive.[34] Factual knowledge refers to the most basic elements of knowledge, such as being able to recite the intentional torts or the elements of a particular rule.[35] Conceptual knowledge refers to the relationships between factual knowledge, such as understanding that all intentional torts require that the actor intend to engage in a particular behavior.[36] Procedural knowledge refers to knowing how to complete a task, including knowing different methods of completing the task and when to use different procedures.[37] In law school, procedural knowledge could refer to the judgment involved with issue-spotting or how to write in IRAC form. Metacognitive knowledge refers to contextual and conditional knowledge of the subject area and tracking one's own subject-specific knowledge.[38] Metacognition refers to understanding learning objectives as well as assessing one's strengths and weaknesses against those learning objectives.[39] Metacognition includes the self-regulated learning that law school requires students to engage in to succeed.[40] Self-regulated learning means that a student understands what the learning objectives are, accurately identifies sources of confusion, actively seeks to clarify confusion, and accurately

33. *Cf. id.* at 123 (relating the thoughts of a former law student who described that law school primarily focused on the application of rules to abstract sets of facts).

34. THE REVISED TAXONOMY, *supra* note 19, at 27, 29 tbl.3.2; Krathwohl, *supra* note 16, at 214 tbl.2.

35. THE REVISED TAXONOMY, *supra* note 19, at 45; Krathwohl, *supra* note 16, at 214 tbl.2.

36. THE REVISED TAXONOMY, *supra* note 19, at 48–49; Krathwohl, *supra* note 16, at 214 tbl.2.

37. THE REVISED TAXONOMY, *supra* note 19, at 52–53; Krathwohl, *supra* note 16, at 214 tbl.2.

38. THE REVISED TAXONOMY, *supra* note 19, at 55; Krathwohl, *supra* note 16, at 214 tbl.2.

39. THE REVISED TAXONOMY, *supra* note 19, at 56; Krathwohl, *supra* note 16, at 214 tbl.2.

40. *See* MICHAEL HUNTER SCHWARTZ, EXPERT LEARNING FOR LAW STUDENTS 3 (2005).

assesses when she has met the learning objectives.[41] Self-regulated learning relates to the proverbial three steps of knowledge: first, when a student doesn't know enough to know what she doesn't know, then when she knows enough to know what she doesn't know, then when she knows.[42] Self-regulated learning refers to when a learner can identify what she does not know and then learn it.[43]

D. Cognitive Dimension: What Students Should Do with the Knowledge

The cognitive dimension describes what a student should be able to do with the knowledge.[44] This dimension specifically deviates from behavioral objectives because behavioral objectives fail to consider the learning processes that allow students to achieve the objective.[45]

For example, a behavioral objective could be to visit a courthouse; a cognitive objective, however, would focus on what the student was supposed to learn from the experience of visiting a courthouse. If the objective were simply to "visit" the courthouse (behavioral), a student could physically walk into a courthouse, observe nothing, make no mental effort, leave, and the student would have met the behavioral objective. By addressing the cognitive dimension, however, the objective focuses on the cognitive process that the student should master through the visit. For example, a low-level cognitive objective might be to find and record the names of the current sitting justices. A higher-level cognitive objective might be to describe how the physical layout of the court contributes to courtroom decorum and how the physical layout, as well as how the cultural norms of courtroom decorum contribute to or detract from just results in lawsuits. Another way to frame the difference is that the cognitive dimension focuses on the outcome measurement, whereas the behavioral objective could focus solely on the means to achieve the outcome.[46]

Bloom and his successors divided the cognitive processes into six major categories: remembering, understanding, applying, analyzing,

41. *See id.* at 27–31.
42. *See id.*
43. *See id.*
44. *See* THE REVISED TAXONOMY, *supra* note 19, at 30; Krathwohl, *supra* note 16, at 215 tbl.3.
45. THE REVISED TAXONOMY, *supra* note 19, at 14.
46. *Id.* at 17.

evaluating, and creating.[47] These categories can be difficult to transfer into law, however, because the terminology is similar to the terminology the legal academy uses, such as apply and analyze. The definitions that the Taxonomy attaches to these terms are simultaneously overbroad and under-inclusive when compared to the legal academy's use of these terms.

The Revised Taxonomy proposes that the six levels are generally hierarchical, such that a novice student should be familiar with a less advanced level of learning before tackling a more advanced level of learning.[48] The Revised Taxonomy, however, acknowledges some overlap between the six cognitive processes.[49] Each of the six categories of cognitive processing is further divided into a total of nineteen subcategories.[50] The Revised Taxonomy places greater emphasis on these subcategories when guiding educators about how to create instructional objectives.[51]

Level 1: Remembering

Remembering is the first level of learning. With remembering, the student does not need to understand the concept to have met the objective.[52] Hence, when my two-year-old recited the preamble to the Constitution, she met the learning objective of remembering, and specifically recalling, the words, but had no understanding of what "domestic tranquility" meant. Remembering is divided into recognizing and recalling.[53]

"Recognizing" means being able to accurately identify information when it is presented.[54] For example, a student could recognize that duty,

47. *See id.* at 31 tbl.3.3. The original taxonomy used the terms "knowledge" to refer to remembering, "comprehension" to refer to understanding, "application" to refer to applying, "analysis" to refer to analyzing, "synthesis" to refer to creating, and "evaluation" to refer to evaluating. Krathwohl, *supra* note 16, at 214. Additionally, the original taxonomy reversed the order of synthesis and evaluation. *See* Pickard, *supra* note 22, at 47 fig.1.

48. Krathwohl, *supra* note 16, at 215. Most of the other models of learning also posit that the levels are hierarchical. *See generally* THE REVISED TAXONOMY, *supra* note 19, at 259-294.

49. Krathwohl, *supra* note 16, at 215.

50. THE REVISED TAXONOMY, *supra* note 19, at 67 tbl.5.1; Krathwohl, *supra* note 16, at 215 tbl.3.

51. Krathwohl, *supra* note 16, at 214. *See also* Pickard, *supra* note 22, at 50.

52. *See* Krathwohl, *supra* note 16, at 215 tbl.3.

53. THE REVISED TAXONOMY, *supra* note 19, at 66; Krathwohl, *supra* note 16, at 215 tbl.3.

54. THE REVISED TAXONOMY, *supra* note 19, at 69.

breach of duty, cause, and damages were the complete major elements of a tort when presented with a list of terms. "Recalling" is a more complex process, involving retrieving information from long-term memory with, at most, cues.[55] Although recalling is a more complex cognitive process than recognizing, both still represent relatively low levels of cognitive processes.[56]

In law school teaching, professors often tell students that law school is not about memorizing rules. This advice is obviously correct in that memorization itself is not the educational objective of law school, but, more accurate advice to law students would be that remembering the law *is* necessary but *not* sufficient. If we accept Bloom's Taxonomy's assertion that the levels of cognitive processes are hierarchical, students must be able to remember a rule before they can do anything with it. This principle also makes common sense. Although law students tend to graduate law school having met the educational objective of learning to think like a lawyer, which engages the highest cognitive levels, lawyers are not competent to represent a client in an area of expertise that they never learned because they do not know (and therefore cannot remember) the applicable law.[57]

It is not necessary, however, for a lawyer to be able to recall the law verbatim in the higher-order cognitive processes. The level to which a lawyer must be able to recall the law varies from task to task. For example, in an oral argument, a lawyer must recall the law fairly specifically in order to be an effective oral advocate. If the lawyer were writing a motion, however, the lawyer could simply recall the law well enough to spot relevant issues, then look up a relevant law and recognize it without recalling it. To write an analysis, the lawyer would have to recall the law long enough to write the analysis.

Level 2: Understanding

Understanding is the next level of learning in the Revised Taxonomy.[58] When professors say, "it's not about memorizing the law," they often mean that rote memorization with no understanding of the law

55. *Id.* at 69.

56. *See id.* at 67 tbl.5.1.

57. Note that if lawyers can acquire knowledge of the law, then they can ethically represent clients. Here, "acquiring" the knowledge means that they will learn and remember the law.

58. THE REVISED TAXONOMY, *supra* note 19, at 70.

will not earn points in law school nor make for the good practice of law as lawyers. Understanding is limited to being able to construct meaning from information provided.[59] Constructing meaning often refers to incorporating new information into prior knowledge.[60] For example, when students use their own words to brief cases, they are demonstrating that they understand the case.

Understanding is subdivided into interpreting, exemplifying, classifying, summarizing, inferring, comparing, and explaining.[61] These categories, however, overlap and, especially as part of the overall category of understanding, it is often not as important to differentiate the specific subdivisions of this learning objective. Many assessments (including class participation) will combine more than one sub-category of understanding.[62]

"Interpreting" includes paraphrasing, converting visual aids to words, or vice versa, etc.[63] When students create the fact section of a case brief, they often engage in interpreting because they are simply paraphrasing the facts.

"Exemplifying" means being able to provide or identify an example of a concept.[64] Exemplifying includes illustrating and instantiating.[65] When students think of relatively simple alternatives to a factual scenario, they demonstrate that they understand the element by providing an alternative example. For example, if a student understands that touch is required in battery, and the fact pattern involved *A* punching *B*, then the student could demonstrate understanding of the concept of "touch" by providing alternative examples such as slapping, kicking, pushing, etc.

"Classifying" means being able to identify that a specific instance fits within a larger concept.[66] For example, if a student were to categorize punching as part of a larger category of touching, the student would meet a "classifying" learning objective.

"Summarizing" means being able to capture the essence of a concept in a briefer version of the original.[67] Students often summarize

59. *Id.*
60. *Id.*
61. *Id.* at 70–76; Krathwohl, *supra* note 16, at 215 tbl.3.
62. *See* Krathwohl, *supra* note 16, at 215.
63. THE REVISED TAXONOMY, *supra* note 19, at 70.
64. *Id.* at 71.
65. *Id.* at 72.
66. *Id.*
67. THE REVISED TAXONOMY, *supra* note 19, at 73.

fact patterns in their briefs by capturing the essence of the event that gave rise to the lawsuit.

"Inferring" means abstracting a generalized principle from a series of examples and includes extrapolating, interpolating, and predicting.[68] When students read one case that indicates that a punch is a touch, then a second that a kick is a touch, then the professor asks whether a slap would be a touch, the student can infer that the slap would constitute a touch. When students infer, they do so by comparing examples and noting relationships between them.[69]

"Comparing" means both comparing and contrasting because it includes identifying both similarities and differences between two or more concepts.[70] When students compare whether a kick is more like a punch than a stomp, they identify the smaller elements of each concept. Comparing contributes to reasoning by analogies.[71]

"Explaining" means communicating a cause-and-effect system that identifies how each part of the whole relates to the other individual parts and to the whole.[72] For example, a student could demonstrate understanding through explaining that even though the element of touching has been met, because the element of offensive or harmful has not been met, the act cannot be the tort of battery.

A Note of Caution About Levels 3 & 4: When Analyzing Does Not Mean Analyzing

The next two levels of the Revised Taxonomy are "apply" and "analyze."[73] Colloquially, law school learning objectives often equate applying law to fact with analysis, but the terms in the Taxonomy refer to specific, discrete processes that are subsumed in the colloquial use of applying law to facts and analysis. Both apply and analyze, as used in the Revised Taxonomy, also refer to specific cognitive tasks that the legal use of these words does not include.[74] As such, when compared to the legal use of the terms apply and analyze, the Revised Taxonomy is both overbroad and under-inclusive.

68. *Id.* at 73–74.
69. *Id.* at 73.
70. *Id.* at 75.
71. THE REVISED TAXONOMY, *supra* note 19, at 75.
72. *Id.* at 76.
73. *Id.* at 77–83.
74. *See, e.g.*, Krathwohl, *supra* note 16, at 215 tbl.3.

Levels three through six are among the higher-order thinking skills. As discussed in Section IV below, visual aids assist students learning the most when applied to these higher-order cognitive skills.

Level 3: Applying

Applying means to "execute" a familiar procedure or to "implement" an unfamiliar procedure.[75] With "executing," the student engages in a procedure with specific steps that must be completed in a specified order.[76] If the student executes the steps correctly, the student arrives at a predetermined answer or goal.[77] Execution can even be completed without understanding.[78] For example, many computer illiterate people are able to install software successfully because they can imitate the steps in a well-written and illustrated instruction manual. Within the law school context, a student might engage in an executing task as a precursor to learning a more advanced skill. For example, a writing professor might have students enter specific search terms into an online search engine such that the cases that the engine returns are pre-determined as a first step to expose students to how legal search engines work. The professor could then follow this lesson with reflective questions and/or more advanced exercises to help students develop independent research skills.

"Implementing" applies to both procedural and conceptual knowledge where the student must identify which procedure or concept to apply to a situation.[79] Issue-spotting on exams is an example of implementing procedural knowledge. The student must identify which law applies before they can evaluate the impact of the law on the facts to reach a conclusion. Implementing also applies to cognitive knowledge such as theories and models.[80] The key that distinguishes implementing theories from executing procedures is that there is no predetermined, unique method or answer with implementing theories.[81] When students "apply a rule of law to a novel fact situation," students are implementing the theory of the rule of law, which produces infinite numbers of correct and incorrect results. Implementing is very similar to creating, discussed

75. THE REVISED TAXONOMY, *supra* note 19, at 77.
76. *Id.*
77. *Id.*
78. *See id.*
79. THE REVISED TAXONOMY, *supra* note 19 at 78.
80. *Id.*
81. *Id.*

below, but the key distinguishing element is that the theory provides structure and guidance in approaching the novel situation, whereas creating requires students to engage in a more generative task.[82]

Level 4: Analyzing

Analyzing begins with complete knowledge and requires that the student then be able to identify discrete elements of the whole.[83] The student must also be able to identify how each element relates to each other element and how each element relates to the whole concept.[84] According to Anderson and Krathwohl, analysis is less often an end objective in itself.[85] More often, analysis is used as a means to deepen understanding or to prepare the student for the higher cognitive levels of evaluating and creating.[86] For example, when a professor asks questions involving analysis of a rule, the questions are often a means to deepening students' understanding of the rule of law.

Learning *how* to analyze, however, is also often an educational objective. The same classroom questions designed to deepen students' understanding of the rule of law simultaneously demonstrate the process of *how* to analyze, which is an educational goal itself. This distinction illustrates how the knowledge domain intersects with the cognitive domain. When a professor wants a student to analyze knowledge, the learning objective is usually to deepen the student's understanding of factual or conceptual knowledge. When a professor wants students to learn how to analyze, however, the learning objective is procedural knowledge at the analysis level.

It can be difficult to differentiate between a goal of analyzing versus a goal of learning how to analyze because the assessment for both would be to analyze knowledge.[87] In law school, this distinction often represents the gap between students' understanding of learning objectives and professors' understanding of those same objectives. When a professor provides a hypothetical to the class, the objective of the exercise is rarely solely to be able to analyze that specific hypothetical, as some students believe. Rather, analyzing the

82. *Id.* at 78.
83. THE REVISED TAXONOMY, *supra* note 19, at 79.
84. *Id.*; Krathwohl, *supra* note 16, at 215 tbl.3.
85. THE REVISED TAXONOMY, *supra* note 19, at 79.
86. *Id.*
87. *Id.* at 80.

hypothetical simultaneously serves both the purposes of deepening students' understanding of the rule that applies to the hypothetical and teaching students the procedural knowledge of *how* to analyze similar problems in the future.

Analyzing is subdivided into differentiating, organizing, and attributing.[88] Organizing is perhaps the most relevant of the analysis learning objectives within the law school context, but psychologists argue that these objectives are predominately hierarchical.[89]

"Differentiating" includes learning objectives that ask the student to discriminate, select, distinguish, or focus.[90] Differentiating requires that students distinguish between relevant and irrelevant information or concepts.[91] When students distinguish between facts that are critical to understanding the holding of a case from facts that are given for context, students engage in differentiating.[92] Differentiating also involves prioritizing relevant information or concepts according to purpose.[93] When students attempt to formulate a rule of law from seemingly conflicting cases, one of the first steps is to prioritize the facts and reasons that determined the holding in each case. For example, if the first case indicated that a punch (contact, offender's hand) was a battery whereas a second case indicated that a stomp was not a battery (no contact, offender's foot), to evaluate whether a kick would be a battery (contact, offenders foot), the student would have to differentiate that the contact was more important to the holding than the part of the body that the offender used. Issue-spotting also involves differentiating relevant from irrelevant facts.[94]

"Organizing" asks students to impose a structure on material the professor has provided.[95] Organizing requires students to understand how individual components relate to each other to form a coherent

88. Krathwohl, *supra* note 16, at 215 tbl.3.
89. *Id.* at 215.
90. THE REVISED TAXONOMY, *supra* note 19, at 80.
91. *Id.*
92. *Id.*
93. *See id.*
94. In practice, issue-spotting definitely involves differentiating relevant facts from irrelevant facts that can often be completely disregarded. On law school exams, however, professors rarely include extraneous information. Either all of the information is relevant, or students must specify why the information is irrelevant to the factual scenario. Because students must justify their conclusion, however, the "irrelevant" information is relevant to the assessment, even if not the ultimate outcome.
95. THE REVISED TAXONOMY, *supra* note 19, at 82.

whole.[96] In order to organize information, students must first differentiate relevant from irrelevant or non-critical information.[97] Organizing is synonymous with structuring, integrating, finding coherence, outlining (rudimentary, not outlining for exams), and parsing.[98] In the law school setting, the more advanced aspects of case briefing are a good example of organizing new knowledge because students integrate many facts, rules, and reasons scattered throughout the opinion into a coherent outline of the case. When students create study outlines, they also engage in organizing to the extent that they decide the order and hierarchy of a rule or set of rules. Most of the thinking skills involved in outlining, however, involve significantly higher-order cognitive tasks such as synthesizing.

"Attributing" asks students to distinguish pure facts from representations of facts and opinions.[99] For example, in law school, although one common objective is to understand the "rule of law," law professors also want students to understand that common law is derived from opinions written by judges, and therefore is subject to modification and reversal. Another common "attributing" learning objective is to recognize the levels of the court issuing the decision and to determine which of two contradictory opinions holds more weight.

Level 5: Evaluating

Evaluating requires students to assess a situation based on criteria or standards.[100] The evaluation can be relative to either internal consistency (checking) or external criteria (critiquing), and can be either quantitative or qualitative.[101] In general learning environments, evaluation criteria include quality, effectiveness, efficiency, and consistency.[102] Although this level of cognitive process involves judging, evaluation requires more than mere opining.[103] Additionally, many lower and higher cognitive levels include an element of "judging" or "evaluating."[104] For example, discriminating between relevant and

96. *Id.* at 81.
97. *Id.*
98. *Id.*
99. THE REVISED TAXONOMY, *supra* note 19, at 82.
100. *Id.* at 83; Krathwohl, *supra* note 16, at 215 tbl.3.
101. THE REVISED TAXONOMY, *supra* note 19, at 83.
102. *See id.*
103. *Id*.
104. *Id*.

irrelevant facts requires some level of judgment or evaluation. The evaluative cognitive level, however, refers only to judgments or evaluations made against clearly defined criteria.[105]

What the legal academy refers to as legal analysis mostly falls into the evaluating cognitive level. For example, after students synthesize a rule, they must *check* their new understanding of the rule for inherent inconsistencies in the rule itself and with the cases that helped create the rule. When students attempt to discern the likely outcome of facts relative to an existing rule, they engage in the *critiquing* process of evaluation.[106] Similarly, when students assess the policy rationale behind a rule or balance competing policies, they engage in the *critiquing* process.[107]

Additionally, when students engage in the self-regulated learning process of law school, they evaluate whether they have met the learning and assessment objectives (as they understand them).[108] Students evaluate their factual, conceptual, and procedural knowledge against what they believe to be the learning objectives for each of their law school courses.[109] Students can also evaluate their metacognitive processes to determine if their learning strategies are effective.[110]

Level 6: Creating

The final level of the Revised Taxonomy is creating.[111] The original taxonomy referred to this level of learning as "synthesizing,"[112] which is a much closer definition to the learning objective within the legal academy.[113] Generically, synthesizing involves "mentally reorganizing some elements or parts into a pattern or structure [that was] not clearly present before."[114] The new pattern or structure does not have to be unique or creative, however. Rather, the novel construction is relative to what the student was given or knew prior to engaging in the

105. THE REVISED TAXONOMY, *supra* note 19, at 83.
106. *See id.*
107. *See id.*
108. *See id.*
109. *See* THE REVISED TAXONOMY, *supra* note 19, at 83.
110. *See id.*
111. *Id.* at 84.
112. Krathwohl, *supra* note 16, at 214.
113. The term "creating" evokes philosophical debates about whether law is created or applied. This level of learning has nothing to do with that debate and simply refers to synthesizing laws.
114. THE REVISED TAXONOMY, *supra* note 19, at 84.

learning activity.[115] Hence, a young child might engage in a synthesis of an activity, such as understanding how letters combine to make different sounds. Because the child is discovering and creating this new understanding, the child is engaged in creating his own knowledge. As in this example, however, the child must develop the "correct" understanding of how letter combinations sound. Additionally, a literate adult engaged in the same lesson would not be involved in a cognitive process of creating or synthesizing if the adult were already familiar with the sounds created by letter combinations.

When students combine multiple cases to create an understanding of the rule of law, they are involved in the synthesizing or creating level of cognitive processing. Students are not "creating law"; rather they are creating *their own understanding* of how the cases work together. Additionally, even though students are constructing their own knowledge, they are not free to create a rule that is incorrect or bears little relationship to the rule of law. Rather, the process of creating refers only to the process that takes place within their own minds about how the individual cases combine to form elements of a rule of law and how individual elements combine to form a rule of law. The understanding of the law that they create must match the understanding of the law that the profession (or at least their professor) generally accepts as accurate.

Synthesizing includes generating, planning, and producing.[116] "Generating" requires students to form various possibilities, and is synonymous with hypothesizing.[117] Note, however, that although many law professors use hypotheses in class, in many situations, the professor generates the hypothesis and asks the student to evaluate it against the rule. To create a "generating" learning objective, the professor must ask the student to devise the hypothetical.

"Planning" involves setting goals and establishing procedures for meeting those goals.[118] Because so much of law school involves self-regulated learning, students who succeed consistently set learning goals for themselves, then establish procedures for meeting those learning goals. In so doing, they are engaging in the planning process of evaluation. When professors provide learning goals explicitly, and especially when professors provide the process by which to achieve

115. *Id.* at 85.
116. *Id.* at 86; Krathwohl, *supra* note 16, at 215 tbl.3.
117. THE REVISED TAXONOMY, *supra* note 19, at 86.
118. *Id.* at 87.

those goals, professors reduce the planning-based objectives from student learning.

"Producing" involves constructing a solution that addresses a problem within certain limitations.[119] When law professors give students the typical law school exam, students are expected to produce answers that are well-articulated, that are well-organized, and that evaluate a fact pattern based on a synthesized understanding of the law.

Synthesizing distinguishes itself from the lower levels of cognitive processing because it involves combining elements to create a novel construct, whereas the lower levels of cognitive processing involve working within a whole structure that has been provided.[120] Although the lower levels of cognitive processes often involve working with individual elements of the whole, the students work within the provided whole in the lower levels.[121]

E. Summary of the Revised Taxonomy Applied to Law School

Law school learning requires students to engage in all levels of learning, but focuses on the highest levels of cognition. Students recall and paraphrase facts of a case (levels one and two) starting before the first day of law school. Many of the visual aids employed in law school textbooks are only tangentially related to the text (as in a picture of the judge who wrote the opinion), or are related to the lowest levels of cognitive tasks, as in a diagram of the plots of land in a property dispute. As discussed below in Section IV.C., however, these types of visuals do not statistically significantly increase student learning for these lower-level thinking skills.

119. *Id.*
120. *Id.* at 85.
121. THE REVISED TAXONOMY, *supra* note 19, at 85.

FIGURE 3. SAMPLE LAW SCHOOL OBJECTIVES MAPPED ONTO BLOOM'S TAXONOMY

	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4	LEVEL 5	LEVEL 6
FACTUAL		Identify case facts				
CONCEPTUAL	Remember wording of rules			Identify relevant case facts		Synthesize rules
PROCEDURAL			Spot issues		Apply rule to novel facts	
METACOGNITIVE						

Even the most basic law school learning, however, often requires students to operate at level three (issue-spotting) and level four (understanding how elements interact with each other). Much of law school class time is spent on levels one, two, and four. Students are often tested on issue-spotting (level three), evaluating the strengths and weaknesses of a fact pattern against a synthesized rule (level five), and synthesizing cases (level six). As such, one of the biggest pedagogical flaws of some legal education is that students are taught at levels one through four, but are tested on levels three through six, leaving students to do the most cognitively difficult work on their own, often with little guidance or feedback from the professor.[122] Certain flowchart exercises, which will be discussed in Section VI, address this problem because they guide students through learning at levels three, four, five, and six, so professors can use the exercises to ensure that they are teaching all of the cognitive levels on which they will be assessing students at the end of the semester.

The next two Sections describe how adults learn generally, which provides the foundation for the research that indicates that adults learn better when they engage in multimodal learning, especially for higher-order thinking tasks. Visual aids and exercises are particularly useful for higher-order learning, which is where the legal curriculum tends to focus its efforts and energies, as discussed in Section IV.B.

122. Part of what makes learning in law school so difficult (and less efficient) is that learning often takes place out of order. This topic, however, is too rich, broad, and tangentially-related to discuss in this article. *See* Hillary Burgess: A Taxonomy of Learning and Assessment Objectives in Law School (unpublished manuscript in progress) (on file with author).

III. THE ADULT BRAIN: A SCIENTIFIC UNDERSTANDING OF HOW ADULTS LEARN AND WHY VISUAL AIDS ASSIST LEARNING

By understanding how adults learn, the legal academy can create better classroom experiences, wider curricula, and cover topics at a deeper level, all without increasing either students' or professors' workloads. This Section reviews how the adult brain learns information and provides the neuropsychological underpinnings for why incorporating visuals increases learning, especially for higher-order thinking tasks.

In short, adults learn by paying attention to what they want to learn, thinking about it, and then using the information repeatedly.[123] In neuropsychological terms, students must filter stimuli from their environment to focus on what they want to learn, then organize the new information in their working memory to store it into long-term memory, and retrieve information from their long-term memory into their short-term memory when they want to use it or add to it.[124] Although these short explanations sounds simple, much more is happening both around and within the learning. Understanding the details of how adults learn helps us develop better instruction to meet learning and assessment goals. Additionally, understanding how adults learn helps us to understand why visuals are so integral to student learning.

The Sections below describe the detailed processes that occur with each of these steps of learning, relate each process to law school learning, and discuss how visual aids support the process.

A. Sensory Memory and Attention Focusing

The environment provides many stimuli for students (and people, more generally) to process. For example, a student sitting in class will receive auditory stimuli from the professor talking, from other students, and from noises outside the classroom. Similarly, students will receive visual stimuli that include the professor, the board, their laptop, all of the students sitting in front of the student, whatever the student can see beyond the classroom, etc. Learners will also experience tactile, olfactory, and gustatory stimuli such as how their clothes feel, what the room smells like, and whether they are hungry. All of these stimuli are

123. *See* PATRICIA L. SMITH & TILLMAN J. RAGAN, INSTRUCTIONAL DESIGN 27–29 (3d ed. 2005).

124. *Id.*

stored in sensory memory involuntarily.[125] Sensory memory degrades quickly: depending on the sense, in as little as a half a second.[126]

Sensory memory explains why students who are not "paying attention" can answer a question after a quick pause. Although the student do not encode the question into their short- or long-term memory, the student's brain involuntarily stores the information into sensory memory for about a half a second, so the student can focus their attention on the question after the question is asked.[127] If the professor uses the student's name at the end of a question that is less than half a second long, the student can move the question from sensory memory to working memory to be able to remember what the question was.[128] If more than a second has passed, however, then the student will have no memory of the question; from the student's perspective, it is as if the question were never asked.

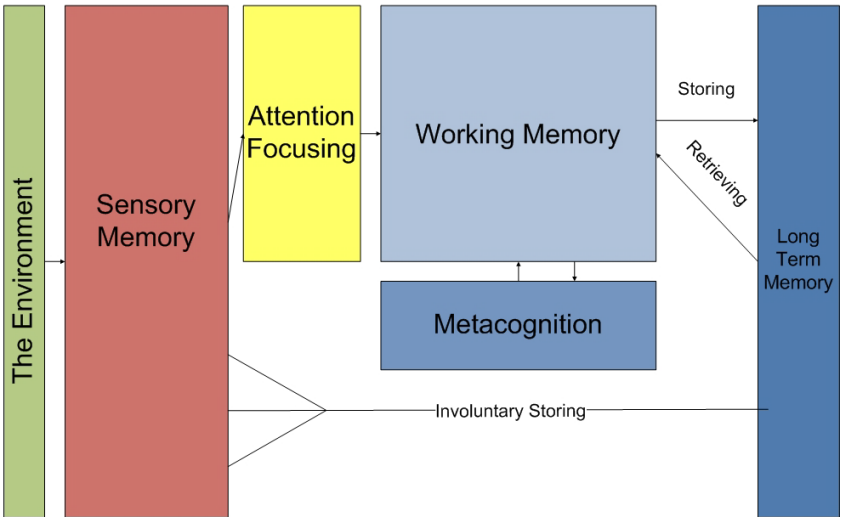
125. *See* Schwartz, *supra* note 1, at 372.

126. ROBERT W. HOWARD, LEARNING AND MEMORY: MAJOR IDEAS, PRINCIPLES, ISSUES AND APPLICATIONS 20 (1995).

127. SMITH & RAGAN, *supra* note 123, at 27.

128. *Cf.* ROBERT K. GREENLEAF, BRAIN BASED TEACHING: MAKING CONNECTIONS FOR LONG-TERM MEMORY & RECALL 6-7 (2006) (discussing how a wait time of three to five seconds after asking students a question can improve student thinking, response, and retention).

FIGURE 4. HOW PEOPLE LEARN[129]



Even though students are bombarded by many stimuli while they are in class, they choose to focus on specific stimuli.[130] For example, a student may choose to focus on what the professor is saying, or the student might focus on the solitaire game that a neighboring student is playing. When the student pays attention to sensory stimuli, the memories are stored in short-term (working) memory.[131] By controlling what they focus on, students can choose what they store in their working memory.[132]

B. Short-Term, Working Memory

Working memory has three components: verbal memory, visual memory, and thinking, which is also called metacognition or executive processing.[133] Auditory and textual information are encoded in the

129. This graphic is based on METIRI GROUP, *supra* note 11, at 9 fig.6 (providing a meta-analysis of twenty-three independent empirical research studies in educational psychology that tested the effectiveness of multimodal learning).

130. Richard E. Mayer & Roxana Moreno, *Nine Ways to Reduce Cognitive Load in Multimedia Learning*, 38 EDUC. PSYCHOL. 43, 44 fig.1 (2003).

131. *Id.*

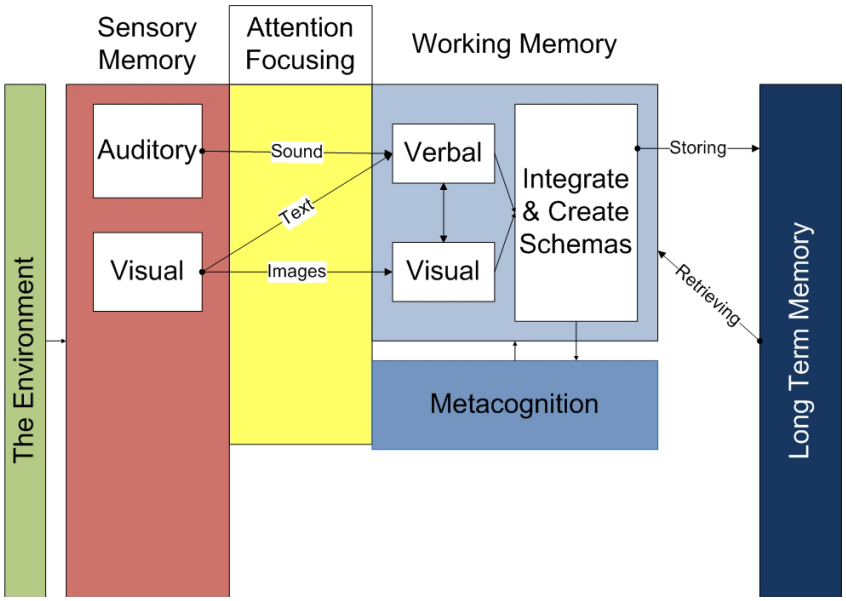
132. *See* Schwartz, *supra* note 1, at 372.

133. Alan Baddeley, *Working Memory and Language: An Overview*, 36 J. COMM. DISORDERS 189, 190–91 (2003); *see also* METIRI GROUP, *supra* note 11, at 10 fig.7.

verbal function of short-term memory, while images are stored in the visual function of working memory.[134] The executive process regulates what information the brain needs to retrieve from long-term memory.[135]

Working memory disappears within thirty seconds of not focusing on the item.[136] As such, if information is stored only to working memory, and the student stops focusing on that information, the information is lost.[137] This process explains the common phenomenon of going into a room with a specific purpose, but forgetting what that purpose was once in the room. During travel to the room, the person did not continue to focus on the purpose, so the information was lost.

FIGURE 5. WORKING MEMORY FUNCTIONS[138]



134. *See* S. Crottaz-Herbette, R.T. Anagnoson & V. Menon, *Modality Effects in Verbal Working Memory: Differential Prefrontal and Parietal Responses to Auditory and Visual Stimuli*, 21 NEUROIMAGE 340, 346 (2004). Some research suggests that tactile, olfactory, and gustatory stimuli are also stored in the visual function of working memory, but the evidence is less strong. METIRI GROUP, *supra* note 11, at 10.

135. *See* Charan Ranganath, Marcia K. Johnson & Mark D'Esposito, *Prefrontal Activity Associated with Working Memory and Episodic Long-Term Memory*, 41 NEUROPSYCHOLOGIA 378, 378 (2003).

136. HOWARD, *supra* note 126, at 20.

137. *Id.*

138 Based on METIRI GROUP, *supra* note 11, at 9 fig.7.

Learners can retain stimuli in their working memory for longer than thirty seconds by continuing to focus on the stimuli.[139] For example, walking from one room to the next, a person could repeat, "I'm going to congratulate my colleague on her recent article." By continuing to focus on the purpose, the person can keep the information in her working memory.[140] As discussed below in Section III.C., however, unless information is encoded into long-term memory within thirty seconds after the person stops focusing on it, that information is lost forever.[141] Working memory explains why students believe that they are learning when they attempt to focus simultaneously on email and what the professor is saying. The student hears the information and can store it just long enough to follow along with the conversation, but forgets what was said quickly, and the information is gone forever.

In addition to having a limited time span, working memory also has a limited capacity.[142] Researchers believe that humans can store approximately seven stimuli (plus or minus two) in the verbal function of short-term memory[143] and approximately four stimuli in the visual function of short-term memory.[144] Once either function in short-term memory is full, however, the student must continue to focus on the items within the full function to keep them in short-term memory.[145] If the student shifts focus to another stimulus within the same full function, the student forgets one of the previous stimuli within that short-term memory function.[146] For example, if the student focuses on seven verbal stimuli and one visual stimulus, and then the student shifts focus to an

139. SMITH & RAGAN, *supra* note 123, at 27.

140. HOWARD, *supra* note 126, at 20.

141. *Id.*

142. *Id.*

143. George A. Miller, *The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information*, 63 PSYCHOL. REV., Mar. 1956, at 81, 90; Schwartz, *supra* note 1, at 372–73. Some researchers, however, believe that this magical number seven is more related to the number of letters a person can say in a second rather than an absolute figure. *See, e.g.*, Alexander Pollatsek & Keith Rayner, *Reading*, *in* THE HANDBOOK OF COGNITION 276 (Koen Lamberts & Robert L. Goldstone eds., 2005). This number varies from language to language. *Id.* at 286. For example, native Chinese speakers can remember more than seven items, in theory because Chinese letters can be recited more quickly, allowing native Chinese speakers can recite more letters in a second than English speakers. HOWARD, *supra* note 126, at 62.

144. G.A. Alvarez & P. Cavanagh, *The Capacity of Visual Short-Term Memory is Set Both by Visual Information Load and by Number of Objects*, 15 PSYCHOL. SCI. 106, 110 (2004).

145. METIRI GROUP, *supra* note 11, at 9. *See also* SCHWARTZ, *supra* note 40, at 22.

146. METIRI GROUP, *supra* note 11, at 9.

eighth verbal stimuli, the student will forget one of the previous seven verbal stimuli, even though the visual short-term memory function is not yet full. If the student were focusing on seven verbal items, however, then added four visual items to their working memory, they could simultaneously remember all eleven items. As such, the visual function of working memory expands the number of items that students can simultaneously focus on while learning the law.[147]

Cognitive load refers to the amount of information currently active in a student's working memory.[148] When cognitive load is high, students often find it more difficult to learn information.[149] When the amount of information that students are integrating exceeds the maximum capacity of working memory, students are unable to learn the information.[150]

Some research suggests that students can reduce cognitive load and/or expand the amount of information in working memory by "chunking" information.[151] Chunking information allows students to group complex knowledge into categories or schemas,[152] discussed in more detail below, in Sections III.C. and III.D. The chunk only occupies one slot in working memory.[153] For example, instead of trying to remember the following list of items: assault, battery, intentional infliction of emotional distress, false imprisonment, interference with property, trespass to land, trespass to chattel, consent, self-defense, recovery, necessity, and negligence (twelve verbal stimuli, which exceeds the seven-slot capacity of the verbal function by five stimuli), a student could chunk this data into intentional torts, defenses, and negligence (three schemas that only occupy three verbal slots in working memory). By shifting focus to just the defenses, a student could bring into short-term memory self-defense, recovery, and necessity, (three verbal stimuli) while still retaining the categories of intentional torts and

147. *Id*.

148. John Sweller, *Cognitive Load During Problem Solving: Effects on Learning*, 12 COGNITIVE SCI. 257, 265 (1988).

149. *See id.* at 276.

150. *See id.*

151. HOW PEOPLE LEARN: BRAIN, MIND, EXPERIENCE, AND SCHOOL 32–33 (John D. Bransford, Ann L. Brown & Rodney R. Cocking eds., 2000). Chunking is sometimes referred to as forming schemas. Sharon Tindall-Ford, Paul Chandler & John Sweller, *When Two Sensory Modes Are Better Than One*, 3 J. EXPERIMENTAL PSYCHOL.: APPLIED. 257, 260 (1997).

152. Nelson Cowan, *The Magical Number 4 in Short-Term Memory: A Reconsideration of Mental Storage Capacity*, 24 BEHAV. & BRAIN SCI. 87, 90 (2000).

153. *See id.* at 89.

negligence (for a total of five verbal stimuli). Similarly, a student could further chunk all twelve items and their three related sub-categories into one giant schema of torts, thereby only occupying one verbal slot in working memory.

When students are first introduced to a discipline, they have not yet organized the associated information into "chunks." As such, novices tend to use more working memory to store the same information than an expert who focuses on the same information.[154] Thus, when professors design lessons, they should design lessons that account for how much information they expect students to store in their working memory, given that these novices will often be storing concepts and elements of concepts individually rather than in chunks.[155] Additionally, as discussed below in Sections III.C. and III.D., experts tend to have better organizational systems for their knowledge than novices, so it is helpful for professors to guide novice students through creating schemas that are more efficiently organized.[156]

Even with stimuli chunking, however, the visual function of short-term memory expands the verbal function of short-term memory.[157] Visual aids can help professors maintain content in a course in which they realize that their past verbal-only instruction was overtaxing their students' working memory because professors can transfer some of the overtaxing information to the visual aid. Where students are mastering the lessons readily, law professors could use visuals to add more complex ideas to their lessons in the same amount of time without overwhelming students.

The verbal and visual functions can work together, allowing students to better understand the stimuli.[158] For example, some studies

154. HOWARD, *supra* note 126, at 126.

155. HOW PEOPLE LEARN, *supra* note 151, at 33.

156. *Id.* at 36.

157. Stephan J. Bera & Daniel H. Robinson, *Exploring the Boundary Conditions of the Delay Hypothesis with Adjunct Displays*, 96 J. EDUC. PSYCHOL. 381, 381 (2004); Roxana Moreno & Alfred Valdez, *Cognitive Load and Learning Effects of Having Students Organize Pictures and Words in Multimedia Environments: The Role of Student Interactivity and Feedback*, 53 EDUC. TECH. RES. & DEV., no. 3, 2005 at 35, 43 ; Daniel H. Robinson & Kenneth A. Kiewra, *Visual Argument: Graphic Organizers Are Superior to Outlines in Improving Learning from Text*, 87 J. EDUC. PSYCHOL. 455, 465–66 (1995).

158. METIRI GROUP, *supra* note 11, at 12; Moreno & Valdez, *supra* note 157, at 36; *see also* Slava Kalyuga, Paul Chandler & John Sweller, *Managing Split-Attention and Redundancy in Multimedia Instruction*, 13 APPLIED COGNITIVE PSYCHOL. 351, 353, 362, 368 (1999); Jeroen J. G. van Merriënboer & Paul Ayres, *Research on Cognitive Load Theory and Its Design Implications for E-Learning*, 53 EDUC. TECH. RES. & DEV., no. 3, 2005 at 5, 7.

have shown that where students need to concentrate on a visual to integrate it with verbal information, students understand the concept better and retain their learning longer.[159]

Once a student has focused on specific stimuli to encode them in working memory, the student must think about those short-term memories.[160] Thinking involves integrating the new stimuli with existing knowledge, organizing the new information, analyzing the new information, making sense of the new information, integrating the new information into existing schemas, and creating schemas.[161] The process of thinking about the stimuli in working memory automatically encodes the new information in long-term memory.[162]

C. Long-TermMemory

1. Schema Creation: Organizing Information Efficiently for Maximum Understanding and Retention

In order to encode new information in long-term memory, the brain links new ideas to old ideas.[163] The easier the concept is to integrate into an existing framework or schema, the easier the concept is to learn, understand, and retain.[164] Thus, the goal of any learning objective tends to be to create efficient schemas that reflect advanced or expert understanding of a discipline.

Many professors have experienced this common phenomenon at some point in their teaching careers: a professor creates a lesson that makes perfect sense and seems to explain the concept with crystal clarity, only to have the lesson completely confuse and bewilder students. This phenomenon is due to the "expert reversal effect" which indicates that experts learn differently than novices.[165] Lessons that are helpful to experts are inefficient for novices and vice versa.[166] As such, it is important for professors to structure lessons in the way that leads

159. Kalyuga, Chandler & Sweller, *supra* note 158, at 353, 362.

160. SCHWARTZ, *supra* note 40, at 24; METIRI GROUP, *supra* note 11, at 10.

161. *See* SCHWARTZ, *supra* note 40, at 23 (discussing the schemata structures in learning new information); METIRI GROUP, *supra* note 11, at 10.

162. SCHWARTZ, *supra* note 40, at 22; METIRI GROUP, *supra* note 11, at 10.

163. METIRI GROUP, *supra* note 11, at 10.

164. *See* HOW PEOPLE LEARN, *supra* note 151, at 32–33.

165. Marcy P. Driscoll & Kerry J. Burner, *The Cognitive Revolution and Instructional Design*, *in* THE COGNITIVE REVOLUTION IN EDUCATIONAL PSYCHOLOGY 199, 221–22 (James M. Royer ed., 2005).

166. *Id.*

their novice students through learning, even if they are not organized in the way that appeals to an expert.

When experts learn new information within their discipline, they build upon their foundation of knowledge.[167] They understand how to distinguish meaningful information when faced with new information containing both critical and less relevant information.[168] Additionally, experts have existing frameworks (or schemas) to allow them to integrate new knowledge efficiently.[169] As such, experts can integrate new knowledge with little cognitive load to understand and are able to organize the new information efficiently into their schemas.[170] For example, in law school, all professors are experts of learning and understanding legal principles generally. Even though professors might specialize in a few areas of the law, they are able to learn new areas of law more quickly, and at a higher level, while taxing their working memory less, than someone who has no expertise in law or legal learning.[171]

Novices tend to learn very differently from experts, in part because they do not have a foundational schema within the discipline that they can use to incorporate their new knowledge.[172] Thus, when novices encounter new knowledge, the new knowledge tends to create a higher cognitive load because each part of the new knowledge uses working memory, and novices cannot yet chunk information efficiently.[173] Professors can support novice learning by structuring lessons to recognize the higher cognitive load of new concepts and creating narrow lessons that move incrementally, rather than globally, through the material. Professors also can help novice students by explaining foundational topics before relying upon them.[174] Additionally, professors should attempt to avoid evoking marginally related topics when introducing a new topic.[175] As discussed above in Section III.B., professors can also help improve learning for novices by reducing cognitive load through using visuals, which shift some of the new

167. *See* HOW PEOPLE LEARN, *supra* note 151, at 31.
168. *See id.* at 36.
169. *See* HOWARD, *supra* note 126, at 4–5.
170. *See id.*
171. *See id.*
172. *See id.* at 126.
173. *See* HOWARD, *supra* note 126, at 126–27.
174. *See* Driscoll & Burner, *supra* note 165, at 222.
175. *See* SMITH & RAGAN, *supra* note 123, at 225 (suggesting limiting extraneous information when presenting a problem).

information to the visual working memory instead of relying entirely on the verbal working memory.

When novices first learn a concept, they attempt to relate information into their existing frameworks.[176] Because novices do not have a domain-specific framework, however, novices will link topics to their existing knowledge in a different domain.[177] For example, a novice might attempt to relate the concept of future interest to their own expectations of what will happen when they or a family member dies. For a novice who lacks even personal familiarity with a concept, however, the novice will still attempt to link new learning to their existing knowledge.[178] For example, a novice might attempt to relate the concept of the court system to a family tree in terms of who can dictate actions: the Supreme Court acts as the parents, with all lower courts listening, but courts of appeals in different jurisdictions act like siblings where the court might take note of rules established in their sibling courts, but are not bound by the sibling-court rulings.

When novices first learn a topic, they often create pathways that are irrelevant, such as "the professor was wearing a yellow tie the day we studied personal jurisdiction and a red tie the day we studied subject matter jurisdiction."[179] They will also relate faulty ideas to concepts, such as personal jurisdiction and subject matter jurisdiction are simply synonyms for the same concept. [180] As novices become experts, they weed out irrelevant connections.[181]

Novices also lack a good organizational system for the new knowledge, so they tend to create inefficient organizational patterns with new information.[182] In the legal field, for example, many new students lack the big-picture understanding of the difference between the criminal and civil systems. New law students also tend to miss how concepts within one doctrine relate to each other, such as how adverse possession relates to color of title, and often lack an understanding of how cases

176. *See* HOWARD, *supra* note 126, at 4.
177. *See id.* at 127.
178. *See id.*
179. *See id.* at 133.
180. *See* HOWARD, *supra* note 126, at 133.
181. *See id.*
182. *See id.* at 132–33.

relate to each other, for example, how *International Shoe*[183] relates to *Pennoyer*.[184]

Professors can support novice learning by guiding novice students through an efficient organizational system that encourages novices to link related concepts. For example, the use of skeletal outlines to help students organize their notes has proven to be a very useful learning tool.[185] Graphical organizers support students to see how experts organize their material.[186] Graphical organizers also help novices create efficient organizational systems for their knowledge and weed out inefficient or incorrect connections.[187] Finally, exercises that guide students through the process of creating efficient organization for their new knowledge are especially helpful for moving students from a novice level of understanding to a more advanced level.[188] As novices become experts, they weed out irrelevant connections, they connect previously unconnected information, and they create more efficient pathways between information.[189]

Although it is important for novices to be able to create their own schematic understanding of the material, professors can make learning more efficient by providing learning activities that help novices see connections and organizational schemas that experts commonly use for a topic.[190] The quicker that novices move to more advanced learning, the quicker a professor can cover more advanced material at a faster rate without overtaxing either the professor or the students.[191]

2. The Basics of Encoding Information into Long-Term Memory

Although the end goal of long-term memory is efficient schema creation, it is helpful to understand how the brain encodes information when creating these schemas. When students encode information, they

183. Int'l Shoe Co. v. Wash. Office of Unemployment Comp. & Placement, 326 U.S. 310 (1945).

184. Pennoyer v. Neff, 95 U.S. 714, (1877).

185. *See* SMITH & RAGAN, *supra* note 123, at 138.

186. *Id.*

187. *See id.* at 161.

188. *See id.* at 162.

189. HOWARD, *supra* note 126, at 133.

190. *See* HOW PEOPLE LEARN, *supra* note 151, at 58.

191. Driscoll & Burner, *supra* note 165, at 222 (warning that instructional designs that are not tailored to the expertise of the students can actually be counterproductive).

store it in the semantic function of their long-term memory.[192] Unlike short-term memory, which is extremely limited, long-term memory capacity is currently thought to be limitless, both with respect to how much information humans can store and how long humans can store the information.[193] As explained in this Section, some evidence suggests that once information is learned, it is stored in the brain forever, even though "forgetting" is possible.[194] Being able to recall information depends first upon the information being stored in long-term memory, and then upon being able to both locate and retrieve the information.[195] This Section will provide more detail about how the brain encodes and retrieves information from long-term memory.

Learners store information in nodes within the brain.[196] These nodes are made up of nerve cells that transmit chemicals and electrical signals between other nerve cells.[197] When memories are stored in nodes, they tend not to be stored as whole information, but rather as information fragments.[198] For example, if a law student saw a gavel for the first time, she would tend to store the word in part of her brain, the texture in another part of her brain, the smell in yet another part of her brain, the purpose of the gavel in another part of her brain, etc. Each piece of information is stored in its own node.[199]

The way people remember entire concepts, even an easy concept such as a gavel, is to link these nodes via electrical currents called synapses.[200] These synapses connect information stored in nodes with other information stored in other nodes, forming a network.[201] This synaptic network allows people to remember new information by connecting information stored in individual nodes.[202] If the brain loses the capacity to connect information stored within a node with any other

192. SCHWARTZ, *supra* note 40 at 22; METIRI GROUP, *supra* note 11, at 10. Learners also store sensory memory involuntarily directly in their episodic long-term memory. *Id.*

193. *See* Ian Neath & Aimée M. Surprenant, *Mechanism of Memory*, *in* THE HANDBOOK OF COGNITION 221, 225 (Koen Lamberts & Robert L. Goldstone eds., 2005).

194. Although some portions of the brain do diminish over time, this decay is very limited, so most of what humans learn over their lifetimes remains stored in the brain until they die. *See* HOWARD, *supra* note 126, at 78.

195. *See* Neath & Surprenant, *supra* note 193, at 221.

196. STERNBERG, *supra* note 8, at 260 (describing that nodes are the fundamental elements of the synaptic network in which knowledge is stored).

197. *Id.* at 30.

198. *See id.* at 260.

199. *See id.*

200. STERNBERG, *supra* note 8, at 260.

201. *Id.*

202. *Id.*

node in the brain, then the person will not be able to retrieve the information.[203] The information is there whether it is retrieved or not, just like a house exists in the woods whether or not anyone visits it.[204]

In the same way that the brain separately stores and relates characteristics about a single piece of information, the brain separately stores and relates characteristics about many pieces of information.[205] For example, in order to remember a courtroom, a person would not only have to remember all of the characteristics related to the concept of a gavel, but also the characteristics related to the bench, the judge, the jury box, etc. All of these pieces of information would link together through synapses to form the concept of a courtroom. Not every separately stored piece of information will link to every other piece of information, however.[206] For example, if a person were looking at a gavel, a judge, and a jury member, her brain might develop a connection between the jury member and the judge because both are people. Additionally, the brain might develop a connection between the jury box and the gavel because both are made of wood. Hence, by remembering the jury member, the brain can remember the gavel by remembering either the judge or the jury box. The brain will take extra steps to remember the gavel, however, when beginning with the jury member. Although these examples have used concrete items, the same process works to store abstract information such as jurisdiction, mens rea, future interests, or intentional torts.

This storage system helps explain why people can remember parts of information, but not the information itself, commonly called the "tip of the tongue" phenomenon.[207] For example, when attempting to remember a case name, a student (or law professor) might remember the facts, pertinent reasoning, or even which judge or justice wrote the decision, but not the case name.[208] Each piece of information can be linked to many other pieces of information.[209] For example, if a person could not remember the case name, they might have links between other cases that the judge also authored. If one of the links from those other

203. *See id.*
204. *See* Neath & Surprenant, *supra* note 193, at 225.
205. *See* STERNBERG, *supra* note 8, at 260.
206. *See id.*
207. Deborah M. Burke, Donald G. McKay, Joanna S. Worthley & Elizabeth Wade, *On the Tip of the Tongue: What Causes Word Finding Failures in Young and Older Adults?*, 30 J. MEMORY & LANGUAGE 542, 542 (1991).
208. *See id.* at 571–72.
209. *See id.* at 543, 544 fig.1.

pieces of information link more strongly to the case name, the person can access the judge's name by following the pathway from the case, to the judge's name, to the other cases the judge authored, then to the case name in question.[210]

These synapses and nodes form physical schemas of information.[211] As discussed in Section III.C.1., above, when students create more efficient schemas, they tend to understand connections better and hence understand concepts better. As discussed in Sections III.C., above and IV, below, visual aids and exercises help students create efficient schemas.

3. Enhancing Long-Term Memory Retention and Retrieval Speed

Once a student creates nodes and synapses to encode information in her long-term memory, the memory theoretically exists forever.[212] Humans, however, sometimes have a difficult time retrieving the information on command. Additionally, humans tend to forget much of what they have learned, especially information learned within classroom settings, by losing the pathways to information.[213] This Section discusses how the brain encodes information for quick and efficient retrieval. This information can assist professors in creating learning activities that reinforce important concepts. As this Section emphasizes, visual aids and exercises can reinforce long-term retention and retrieval.

Research demonstrates that students are better able to encode new information into their long-term memory when they create meaning rather than take meaning.[214] For example, students learn better when

210. *See id.* at 571.

211. *See* STERNBERG, *supra* note 9, at 263.

212. *See* Neath & Surprenant, *supra* note 193, at 225.

213. *See id.* at 224.

214. Moreno & Valdez, *supra* note 157, at 36; *see also* Michelene T.H. Chi, Miriam Bassock, Matthew W. Lewis, Peter Riemann & Robert Glaser., *Self-Explanations: How Students Study and Use Examples in Learning to Solve Problems*, 13 COGNITIVE SCI. 145, 175 (1989) (discussing the self-explanation effect); Vicky L. Martin & Michael Pressley, *Elaborative-Interrogation Effects Depend on the Nature of the Question*, 83 J. EDUC. PSYCHOL. 113, 117–18 (1991) (discussing interrogation); Jan C. Rabinowitz & Fergus I. M. Craik, *Specific Enhancement Effects Associated with Word Generation*, 25 J. MEMORY & LANGUAGE 226 (1986) (discussing research on the generation effect); Wolfgang Schnotz & Thorsten Rasch, *Enabling, Facilitating, and Inhibiting Effects of Animations in Multimedia Learning: Why Reduction of Cognitive Load Can Have Negative Results on Learning*, 53 EDUC. TECH. RES. & DEV., no. 3, 2005 at 47 (discussing how unrelated or too many animations could reduce meaningful cognitive processing by inappropriately facilitating a task).

they are engaged in a discussion of case law than they do from listening to a lecture or discussion about a case.[215] This phenomenon explains why students learn best when they are the ones being called upon and also provides pedagogical support for the common advice that students should actively engage in class discussions and answer all of the questions asked, even if they must do so silently.[216]

Similarly, this research would suggest that the processes of synthesizing cases and creating an outline helps the student store her understanding of the rule of law in long-term memory more effectively than reading a commercial outline.[217] Although commercial outlines or other study aids can provide feedback as to whether students have accurately synthesized a rule, if students use them in lieu of synthesizing cases, their learning is likely to be more superficial and last for a shorter period of time. As such, although flowcharts can be great teaching tools, if the professor simply provides flowcharts to students, then the student will not be able to create their own meaning, and the information will be less well-encoded in their long-term memory. To account for this problem, professors can have students attempt to learn a concept, then correct the organization of the concept with a flow-chart at the end of the learning module. Additionally, professors can provide visual exercises that guide students through the process of creating their own organization, but provide enough guidance so that students develop an organizational framework that is similar to an expert's framework.[218]

Adults tend to remember information longer when they learn it over a distributed period rather than in a single instance.[219] For example, law students would find their learning enhanced by reading cases a week before class, then reviewing their case briefs every few days rather than reading a case immediately before class. This phenomenon explains why students who cram for exams tend to forget most of what they learned shortly after the exam.[220] Those students did not properly reinforce the pathway over a sufficiently distributed length of time. Professors can distribute learning over a longer period of time than the classroom setting allows by designing exercises that students can

215. *See* Robin A. Boyle, *Employing Active-Learning Techniques and Metacognition in Law School: Shifting Energy from Professor to Student*, 81 U. DET. MERCY L. REV. 1, 3–4 (2003–2004).

216. *See id.* at 4–5.

217. *See id.* at 11–12.

218. *See infra* Section VI.C. for specific examples of guided flowchart exercises.

219. STERNBERG, *supra* note 8, at 186.

220. *See id.*

complete outside of the classroom, well after students have learned a topic in class.[221]

The more developed a synapse is, the easier it is for a student to find the pathway and retrieve information, just like a dirt pathway becomes easier to drive on the more it is used.[222] Once a pathway is well-developed, the brain can locate and retrieve information very easily.[223] This process is called "automatization," both because the brain can locate information easily and because the brain uses very little working memory or cognitive load to locate and retrieve the information.[224] Locating, retrieving, and using the information all become automatic.[225] Automatization reduces cognitive load, which is discussed in Section III.C.4., below.[226] Additionally, visual aids tend to be easier to remember and to recall after extended periods of time.[227] Because of the way synaptic networks connect information nodes, however, once a person remembers the visual, she has access to any node that is connected to the visual by an existing pathway.[228] In this way, visuals help students remember much more than just the image over the long-term.[229]

The more pathways that a person has to a particular piece of information, the easier it tends to be to remember that piece of information because the person can begin by remembering any of the related items to recall the target information.[230] As such, it tends to be a good idea to create connections between information to be learned and as many related concepts as possible. Visual aids assist students in seeing connections between concepts.[231] Additionally, visual aids can connect concepts in ways that transcend hierarchical relationships.[232] As such, visual aids have the capability of connecting concepts in ways that outlines cannot.

221. *See infra* Section VI.C. for several visual exercises designed to reinforce learning, which could be provided to students as out-of-class exercises.
222. STERNBERG, *supra* note 8, at 72–73.
223. *Id.*
224. STERNBERG, *supra* note 8, at 74.
225. *Id.*
226. *See infra* notes 255–256.
227. *See* SMITH & RAGAN, *supra* note 123, at 179; METIRI GROUP, *supra* note 11, at 12.
228. *See* STERNBERG, *supra* note 8, at 260–63.
229. *See id.*
230. *See id.*
231. *See* SMITH & RAGAN, *supra* note 123, at 161–62.
232. *See id.* at 162.

Additionally, there is evidence to suggest that the more different types of pathways that a person creates to specific information, the easier the information is to remember.[233] Thus, relating concepts both textually, via reading, listening, or speaking, and visually, via graphics, tends to create stronger pathways to allow for more efficient recall of the learned information than learning the information, even repeatedly, through just the verbal function of reading, listening, and speaking.

In sum, visual aids and exercises tend to create better learning that students retain longer because of the way visuals interact within the brain.

4. Disintegrating Synaptic Pathways: Forgetting is Not Always Bad

Even though some neuroscientists believe that the memory node exists forever, humans still forget information every day. Humans forget information when the pathway to the information becomes less defined or no longer exists.[234] Just like a dirt path will erode if it is not used, so too will the electrical path that connects information in the brain.[235] Generally, the more reinforced the pathway is, the more time it takes for non-use to disintegrate the pathway.[236]

Although disintegrating pathways might sound very bad for memory, it can actually be a very useful tool because the brain constantly stores more information than it needs to remember in the long term.[237] For example, while it might be important for a person to commit a shopping list to long-term memory (because short-term memory lasts only thirty seconds), the person does not need to retain the information after the shopping trip is complete.[238] Accordingly, the brain will, over time, disintegrate the synaptic pathways leading to the shopping list.[239] In a law school learning environment, professors tend to include information that helps students understand the material as well as information that is important for long-term retention. The information that is simply a means to the learning objective need not be as memorable as the ultimate learning objective. For example,

233. *See* STERNBERG, *supra* note 8, at 260–63; SCHWARTZ, *supra* note 40, at 23. .
234. STERNBERG, *supra* note 8, at 200.
235. *See id.*
236. *See* HOWARD, *supra* note 126, at 78.
237. *Id.*
238. *See id.*
239. *See id.*

professors often use hypothetical situations to help students understand the nuances of a rule. Ultimately, it is not important that a student remember the particulars of the hypothetical situation, such as the names of the people in the hypothetical situation or whether, in a battery example, the defendant hit the plaintiff with a stick or a bat. It is important, however, that the student remember the overall concept along with the relevant nuances. As such, professors can maximize their use of visual aids and exercises by using images that emphasize the knowledge and concepts that need to be most memorable.[240] Because novices often lack the expertise to discern learning objectives from learning tasks, professors can also use their visual aids and exercises to implicitly reinforce the most important learning objectives.[241]

More importantly, the brain reorganizes information according to new understandings about the information.[242] Thus, the brain is able to correct faulty pathways.[243] For example, if a student originally understood personal jurisdiction and subject matter jurisdiction as the same concept, once the student realizes that these two, related concepts are very different, the brain will prune the synapse that linked the concepts as synonyms.[244] Again, visual aids and exercises can be used to help students correct their understanding of how concepts relate to each other.

D. Tying Short-Term Memory, Long-Term Memory, and Schema Creation Together: Optimizing Learning by Optimizing Cognitive Load

The tax on working memory is called cognitive load.[245] Long-term memory, however, helps alleviate cognitive load because of schema chunking and automation.[246] Colloquially, pedagogical suggestions for optimizing cognitive load refer to structuring lessons to give the students enough information to keep them interested and focused, but not too much so as to overwhelm them.[247] Optimizing cognitive load allows students to learn more information faster.[248] Too much information in

240. *See* HOW PEOPLE LEARN, *supra* note 151, at 36.
241. *See id.*
242. *See* HOWARD, *supra* note 126, at 8–9.
243. *See id.*
244. *See* HOW PEOPLE LEARN, *supra* note 151, at 122.
245. SMITH & RAGAN, *supra* note 123, at 144–45.
246. *See* STERNBERG, *supra* note 8 at 74; SCHWARTZ, *supra* note 40, at 22–23.
247. *See* SMITH & RAGAN, *supra* note 123, at 144.
248. *See id.*

working memory creates a high cognitive load, resulting in students forgetting some of the information that is crucial to understanding the topic, which ultimately leads to less learning.[249] Too little information in working memory leads to too little cognitive load, allowing students to focus on distractions or believe that the information is too "Mickey Mouse," which also leads to less learning, even of the very information that the student may have considered too easy.[250]

Cognitive load can be decreased by creating schemas to organize information, which allows students to "chunk" the information.[251] When students form connections between information in their long-term memory, they can chunk the entire schema into one memory slot.[252] Novices must first create these schemas, however, before they can use them to decrease working memory.[253] Visual aids and visual images help novices create schemas.[254]

The more automatized information or connections are, the lower the cognitive load.[255] Automatization refers to the amount of work a person must put into conjuring up the schema and remembering the details of the schema.[256] For example, while a property professor can usually identify whether a tort is intentional or not, she must use more working memory than a torts professor would to generate a list of intentional torts, because the property professor has not automatized torts concepts to the same degree as a torts professor. The property professor would have several advantages over a novice law student listening to the same discussion, however, because the property professor would have the foundational concepts of law automatized, whereas the novice law student would have to focus on each new concept. The property professor would have words such as plaintiff, appellant, opinion, holding, etc., automatized, so these concepts would take little or no working memory to understand the bigger discussion about intentional torts. The student, however, might have to stop and focus on each of these words, remember the definition of the word, relate the definition back to the topic, and then adapt their understanding of the topic accordingly. During this process, the student is focusing their attention

249. *Id.*
250. *See* Schnotz & Rasch, *supra* note 214, at 47.
251. *See* STERNBERG, *supra* note 8, at 264.
252. *See* HOWARD, *supra* note 126, at 22.
253. *See* SMITH & RAGAN, *supra* note 123, at 222.
254. *Id.* at 162.
255. *See* SCHWARTZ, *supra* note 40, at 22.
256. *See id.*

on understanding what *was* said instead of what *is* currently being said. Hence, the law student is likely to miss critical information, even though the student was "paying attention" the entire time. If, instead, the student continued to listen to the professor without understanding the terms, the student would have more difficulty encoding the information into his long-term memory because the student did not understand the terms. Either way, even though the student was paying attention the entire time, the student will likely miss important concepts that the professor communicated.

Cognitive load can be high for both intrinsic and extrinsic reasons.[257] Intrinsic cognitive load relates to how objectively easy or difficult the information is to learn.[258] Generally, the lower the knowledge and cognitive levels on the Revised Taxonomy, the lower the intrinsic cognitive load; the higher the knowledge cognitive levels on the Revised Taxonomy, the higher the intrinsic cognitive load.[259] The more concrete a topic is, the easier it tends to be to learn.[260] Intrinsically high cognitive load generally results because the information is copious, abstract, complex, or counter-intuitive.[261] Many concepts in law school result in intrinsically high cognitive load because they are difficult concepts for novices to learn.

Extrinsic cognitive load relates to how easy or hard the presentation of the material is for the student.[262] The more material that is presented at once, the higher the cognitive load, while the more incrementally new material is presented, the lower the cognitive load.[263] The more instruction assumes schemas that are not automated for the student, the higher the cognitive load; the more instruction relies solely on automated schemas when introducing new concepts, the lower the cognitive load.[264]

257. SMITH & RAGAN, *supra* note 123, at 144; Henk G. Schmidt, Sofie M. M. Loyens, Tamara van Gog & Fred Paas, *Problem-Based Learning* is *Compatible with Human Cognitive Architecture: Commentary on Kirschner, Sweller, and Clark (2006)*, 42 EDUC. PSYCHOL. 91, 93 (2007).

258. SMITH & RAGAN, *supra* note 123, at 144.

259. *See, e.g.*, *id.*; *see also* Schmidt, Loyens, van Gog & Paas, *supra* note 257, at 93. Even rote memorization, however, can result in a high intrinsic cognitive load when there are high quantities of information to memorize, which explains why studying for the bar exam is cognitively taxing, even for students who have excelled in law school and who possess all of the necessary basic skills. *See id.*

260. *See* SMITH & RAGAN, *supra* note 123, at 144.

261. *See id.*

262. Schmidt, Loyens, van Gog & Paas, *supra* note 257, at 93.

263. SMITH & RAGAN, *supra* note 123, at 144.

264. Schmidt, Loyens, van Gog & Paas, *supra* note 257, at 93.

It is important to *inversely match* the extrinsic cognitive load to the intrinsic cognitive load that students are likely to face given their familiarity with related concepts.[265] When the intrinsic cognitive load is high, as it often is for novices learning a new topic, better learning occurs when the extrinsic cognitive load is lower.[266] When intrinsic cognitive load is low, as it often is for experts acquiring new knowledge within their expertise, better learning occurs when extrinsic cognitive load is higher.[267] To create challenging, but not overwhelming, learning environments, a professor must appropriately match the extrinsic cognitive load to the intrinsic cognitive load for the students.[268]

Because 1Ls have little or no familiarity with legal concepts or processes, any instruction in law will have an intrinsically high cognitive load. Thus, in a law school setting, this phenomenon means that professors should attempt to lower both the intrinsic and extrinsic cognitive loads for 1Ls. Although students tend to be doctrine-specific novices for each new doctrine studied in law school (such as business organizations or environmental law), upper level students have more developed schemas for the underlying principles of the discipline, so it is important to increase both the intrinsic and extrinsic cognitive load with each successive semester to avoid the third-year "bore them to death" phenomenon.

Because law is such an abstract, logic-based discipline that involves the highest-order thinking skills, most teaching within law starts with an objectively high intrinsic cognitive load. Professors can decrease intrinsic cognitive load by starting with the most concrete subjects within the doctrine.[269] For example, if a professor first taught causation, then the contact element of battery, students are likely to perceive the course initially as being impossibly hard, then too easy because causation is a much more abstract and foreign concept than contact to a novice law student. By teaching the contact element of battery, then causation, however, students are likely to see the course as increasingly challenging because the professor taught a more concrete and familiar topic first before moving to the more abstract, less familiar topics.

265. *See* DIONYSIOS POLITIS, E-LEARNING METHODOLOGIES AND COMPUTER APPLICATIONS IN ARCHAEOLOGY 296 (Kristen Klinger et al. eds., 2008).

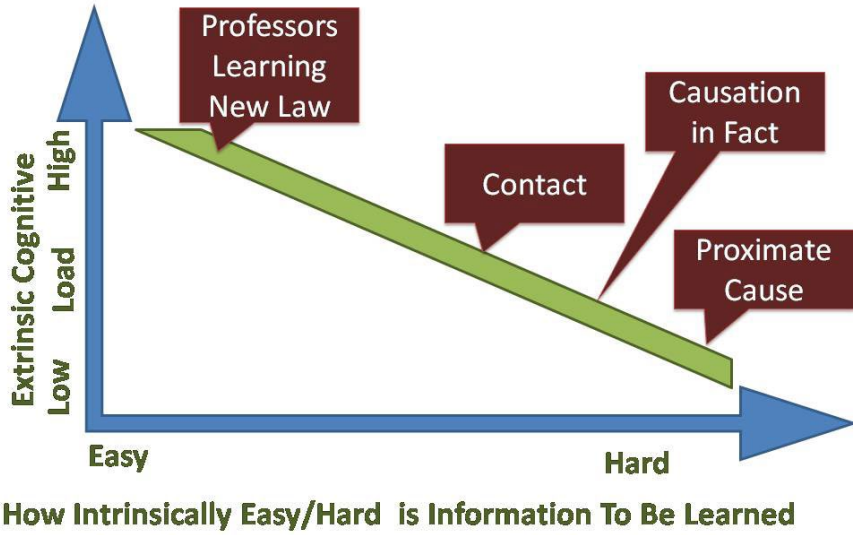
266. *See id.* at 296–97.

267. *See id.*

268. *See id.*

269. SMITH & RAGAN, *supra* note 123, at 144.

FIGURE 6. INTRINSIC AND EXTRINSIC LOAD



Professors can increase intrinsic cognitive load by teaching more abstract topics as the semester progresses and with upper-level courses. For example, in Contracts, an offer is much more concrete than consideration, so if a professor teaches consideration before offer and acceptance, many students will find the initial lessons extremely difficult to learn, and could well become overwhelmed. Once students work to master consideration, they would be likely to find the later lessons about offer and acceptance overly easy. Students who find it too easy are likely to learn the material less deeply. Alternatively, if a professor reverses the order and teaches offer and acceptance first, the students would be likely to find this material intrinsically challenging, but not overwhelming. By mastering the concrete concepts first, students would be better prepared for the more abstract concept of consideration, creating a challenging, but not overwhelming intrinsic cognitive load.

Professors can lessen extrinsic cognitive load by relating concepts to students' common knowledge, teaching lessons in smaller units, and providing exercises that reinforce learning. Visual aids can help students relate information to what they already know by using familiar graphics or organizational structures. Visual aids can help professors teach in smaller units because it can often be difficult to find visuals that encompass large concepts, forcing professors to divide their lessons into more discrete units.

Professors can increase extrinsic cognitive load by requiring students to relate new information to the whole topic or by moving quickly through new material. Visual aids can help students relate new information to the whole topic by providing graphical overviews or explicit visual connections. Visual aids can help professors move more quickly through materials by providing a graphic to refer to a concept, which uses the visual working memory, instead of a phrase, sentence, or paragraph, which uses the verbal function in the working memory. Because the verbal function in working memory is likely to be taxed already through reading, lecture, and discussion, visual aids can decrease extrinsic cognitive load while increasing the number of topics and details.

IV. MULTIMODAL LEARNING INCREASES MASTERY OF HIGHER-ORDER THINKING

A. Difference Between Multimodal Learning Research and Learning Styles

Multimodal learning involves learning material through multiple means, such as reading, listening, writing, practicing, and viewing images.[270]Recently, newspapers and law faculty have focused on learning styles or learning preferences in an attempt to identify which mode of learning a specific student prefers.[271] However, this research remains hotly contested in the psychology community as to whether preferences exist, as to whether preferences, if they exist, should impact teaching instruction, and as to how teaching methods can or should vary if the preferences do in fact exist.[272]

Over the past thirty years, however, psychologists have also been examining whether multimodal learning increases learning generally, *regardless* of learning preference.[273] Research from neuroscience and

270. Neil Fleming, *Multimodal Study Strategies*, VARK: A GUIDE TO LEARNING STYLES, http://www.vark-learn.com/english/page.asp?p=multimodal (last visited Oct. 31, 2010).

271. *See, e.g.*, Alice Y. Kolb & David A. Kolb, *Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education*, 4 ACAD. OF MGMT. LEARNING & EDUC. 193, 194–95 (2005).

272. *See* Aïda M. Alaka, *Learning Styles: What Difference Do the Differences Make?* 5 CHARLESTON L. REV. (forthcoming 2011), *available at* http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1675168.

273. M. H. Sam Jacobson, *Learning Styles and Lawyering: Using Learning Theory to Organize Thinking and Writing*, 2 J. ASS'N OF LEGAL WRITING DIRECTORS 27, 37 (2004).

cognitive psychology, reviewed in Section III above, on how the brain receives, encodes, and retrieves new learning strongly suggests that the students will learn better when new learning is provided via multimodal means.[274] This logical conclusion has been confirmed with direct research on learning, which indicates that visual aids and exercises lead to better learning.[275] Perhaps surprisingly, the research indicates that multimodal instruction increases both initial learning and retention more when students are attempting to learn higher-order thinking tasks than lower-order thinking tasks.[276]

I do not take a position on the existence of learning styles within this article. Because the existence of learning styles is a contested issue, and because there is an abundance of uncontroversial research that supports the benefit of visual aids and exercises in law school, however, this article relies upon the uncontroversial research rather than attempting to resolve the controversy over learning styles.

B. Definition of Multimodal Learning

Multimodal instruction refers to teaching that utilizes multiple means of communicating the learning objectives.[277] Under the common mode distinctions as designated by visual-auditory-kinesthetic learning preferences, every law school professor engages in multimodal learning because they engage students via textual reading and aural lectures. However, "multimodal learning" that is not based on learning preferences divides these learning modes slightly differently, such that they align more with the current understanding of brain functioning.[278] As such, reading text and listening to a lecture, while different activities, would constitute similar modes of learning because the verbal function of working memory processes both reading words and listening to words. Visual images are categorized as a separate mode of learning, as are any activities that involve experiential learning.[279] Kinesthetic

274. *Id.*

275. *See, e.g.*, Sarah Guri-Rozenblit, *Effects of a Tree Diagram on Students' Comprehension of Main Ideas in an Expository Text with Multiple Themes*, 24 READING RES. Q. 236, 245 (1989).

276. Matthew T. McCrudden, Gregory Schraw, Stephen Lehman & Anne Poliquin, *The Effect of Causal Diagrams on Text Learning*, 32 CONTEMPORARY EDUC. PSYCHOL. 367, 382 (2007) [hereinafter McCrudden].

277. Fleming, *supra* note 270.

278. *See* Moreno & Valdez, *supra* note 157, at 43.

279. *See id.*; *see also* Kolb & Kolb, *supra* note 271, at 194.

learning is also a different mode of learning, though it is not understood how the other senses (taste, touch, smell) are stored in working memory.[280]

The overwhelming evidence establishes that visual aids improve learning by allowing students to understand concepts more quickly, understand concepts more deeply, and retain more concepts longer.[281] Research indicates that visual aids improve learning most significantly when the learning task involves abstract concepts and high-order thinking skills.[282] This Section reviews the detailed findings on how visuals improve learning and applies these research findings to legal education.

C. Visual Aids Improve Learning

People tend to remember visuals more accurately, more quickly, and for a longer period of time than they remember words.[283] The research for this phenomenon has been so broadly and repeatedly consistent that researchers in the field have coined the term, "pictorial superiority effect."[284] For example, one study found that ninety-eight percent of students increased their learning by using text and visual aids instead of text alone, with eighty-five percent of students yielding statistically significant results.[285] Another study demonstrated the superiority of visual aids over text by creating incongruent pictures and text and then testing the subject's recall; subjects tended to recall the detail from the picture instead of the incongruent detail from the text.[286] Additionally, one researcher found that graphic organizers helped students understand concepts and answer questions more quickly than text alone.[287] Finally, research has also demonstrated that students better retain information they learn through visuals than information learned

280. There is some evidence that kinesthetic experiences are stored in a different part of long-term memory, called episodic long-term memory, but this distinction falls outside the scope of this paper. *See* STERNBERG, *supra* note 8, at 168.

281. Kalyuga, Chandler & Sweller, *supra* note 158, at 362.

282. McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 382.

283. JOHN MEDINA, BRAIN RULES: 12 PRINCIPLES FOR SURVIVING AND THRIVING AT WORK, HOME, AND SCHOOL 233–34 (2008).

284. *Id.*

285. W. Howard Levie & Richard Lentz, *Effects of Text Illustrations: A Review of Research*, 30 EDUC. COMM. & TECH., Winter 1982 at 195, 213.

286. J. Peeck, *Retention of Pictorial and Verbal Content of a Text with Illustrations.*, 66 J. EDUC. PSYCHOL. 880, 885 (1974).

287. Bera & Robinson, *supra* note 157, at 385.

verbally.[288] In one study, students who read a passage of text and viewed a graphic outperformed students who read the same text and viewed an outline; they also outperformed students who just read the text.[289] These results held true both when researchers tested students immediately and also when they delayed testing.[290]

In fact, a few studies have demonstrated that memory for visual aids can last several decades.[291] This pictorial superiority effect could translate into students remembering important concepts from class, not just several months later on the final exam, but also several years later on the bar exam and, later, in practice.

The effect of increased learning though graphics is more significant for higher-order thinking skills such as integrating a whole from its parts, applying rules to novel situations, and dissecting the whole to understand individual aspects and relationships between the parts.[292] A meta-analysis of many studies researching multimodal learning found that, for higher-order thinking skills, adding a visual increased learning by twenty percent and adding both a visual and an exercise increased learning by thirty-two percent.[293] In the law school setting, visuals could help students remember rules, apply rules to slightly modified hypothetical situations during class participation, and apply rules to completely novel situations in exam situations.

Graphics help students understand the "big picture" as well as relationships between individual elements of a concept.[294] Visuals also

288. *Id.* at 382.

289. *Id.*

290. *Id.*

291. Raymond S. Nickerson, Bolt Beranek & Newman Inc., *A Note on Long-Term Recognition Memory for Pictorial Material*, 11 PSYCHONOMIC SCI. 58, 58 (1968) (finding that individuals could correctly identify photos viewed for two five-second intervals one year later sixty-two percent of the time); J. Don Read & Roger H. Barnsley, *Remember Dick and Jane? Memory for Elementary School Readers*, 9 CAN. J. BEHAV. SCI. 361, 362 (1977); Lionel Standing, Jerry Conezio & Ralph Norman Haber, *Perception and Memory for Pictures: Single-Trial Learning of 2500 Visual Stimuli*, 19 PSYCHONOMIC SCI. 73, 74 (1970) (concluding that memory for visuals lasts much longer than that for names).

292. Moreno & Valdez, *supra* note 157, at 43; Robinson & Kiewra, *supra* note 157, at 466; Margaret S. Chan & John B. Black, *Learning Newtonian Mechanics with an Animation Game: The Role of Presentation Format on Mental Model Acquisition*, Presentation at the Annual Meeting of the American Educational Research Association (Apr. 7–11, 2006) 18, *available at* http://www.ilt.columbia.edu/publicAtions/2006/aera06_proceeding_52384.pdf.

293. METIRI GROUP, *supra* note 11, at 13–14.

294. Bera & Robinson, *supra* note 157, at 381; McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 368; Robinson & Kiewra, *supra* note 157, at 466.

explicitly articulate implicit textual relationships.[295] Specifically, visuals assist students in seeing the hierarchical and coordinate relationships between elements of a concept.[296] In fact, research has demonstrated that students understood the relationship between concepts better from studying graphic organizers than from studying outlines.[297] While outlines effectively convey linear, hierarchical information, graphic organizers encourage students to understand relationships that exist between concepts.[298] Since law school study relies so heavily on "outlining," providing students with some visual aids will enable them to augment their outlines with the visual aids professors provide. The visual aids will also serve to teach students implicitly how to conceptualize the law, so that they can create their own visual aids.

One study found that students who used visuals to understand interrelated concepts wrote more organized essays.[299] In the law school setting, when professors incorporate visuals that enable their students to better organize their thoughts, professors are likely to grade exams that are better organized. Thus, visuals could also provide an avenue for improving student writing.

Furthermore, the effect of adding visual aids to text tends to assist struggling readers more than advanced readers.[300] Perhaps more importantly in the law school context, visual aids also tend to assist students who struggle with critical thinking skills more than advanced critical thinkers.[301] Especially in the first semester, when all law students struggle to learn how to read and understand cases, visual aids could help 1Ls move from novice to advanced legal readers more quickly.[302] Visual aids could enable students with educational disadvantages pertaining to reading and critical thinking to develop these skills more quickly in the first semester (and beyond) so that they are

295. McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 368; Robinson & Kiewra, *supra* note 157, at 466.

296. Bera & Robinson, *supra* note 157, at 381; McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 382; Robinson & Kiewra, *supra* note 157, at 466.

297. Bera & Robinson, *supra* note 157, at 381; Robinson & Kiewra, *supra* note 157, at 466.

298. Robinson & Kiewra, *supra* note 157, at 455.

299. *Id.* at 466.

300. Joan Peeck, *The Role of Illustrations in Processing and Remembering Illustrated Text*, *in* 1 PSYCHOLOGY OF ILLUSTRATION 115, 135–36 (Harvey A. Houghton & Dale M. Willows eds., 1987) [hereinafter Peeck, *Role of Illustrations*].

301. *Id.*

302. *But see id.* at 137 (pictures tend to aid students with more subject familiarity than students with less knowledge of the topic).

able to compete with students who had educational advantages prior to attending law school. In sum, visual aids could serve to equalize educational imbalances that existed prior to coming to law school.

The positive effects of the graphic organizers on learning are greater when the text students are attempting to learn is at least 2500 words in length.[303] Because law students must integrate concepts that span hundreds of pages, graphic organizers would seem particularly appropriate in law school settings.

In addition to actually improving student learning, students tend to feel that visuals assist their learning.[304] In one study, ninety-eight percent of students reported that visuals increased their understanding of the text.[305] People tend to enjoy learning more through graphics than through text alone.[306] The same study found that students learning with either static or dynamic graphics indicated significantly more interest in learning the subject area than students who learned with texts and no graphics.[307] Thus, visual aids could improve self-efficacy, which is critical since self-efficacy is tied to successful learning.[308]

One reason why adults tend to learn better from graphics than from text is that adults tend to engage automatically in self-regulated learning when viewing visual aids.[309] Adults approach visual aids with expectations and modify their expectations and their understanding of the concept as they view the picture in more detail.[310] They also tend to learn from visual aids in both a systematic and sequential manner simultaneously.[311] Finally, adults tend to make inferences from the visual aids that are not explicit.[312] Because the brain encodes long-term memories through active engagement with material, the way adults approach visual aids automatically engages this active learning process.[313] By drawing inferences from visual aids, adults also engage

303. Robinson & Kiewra, *supra* note 157, at 466.
304. *Id.*
305. Chan & Black, *supra* note 292, at 21.
306. *See* Robinson & Kiewra, *supra* note 157, at 466; Chan & Black, *supra* note 292, at 22.
307. Chan & Black, *supra* note 292, at 20.
308. *See* SCHWARTZ, *supra* note 40, at 29.
309. Robinson & Kiewra, *supra* note 157, at 466.
310. Peeck, *Role of Illustrations*, *supra* note 300, at 134.
311. *Id.*
312. *Id.*
313. Bera & Robinson, *supra* note 157, at 385; McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 382; Moreno & Valdez, *supra* note 157, at 36; Robinson & Kiewra, *supra* note 157, at 466.

in schema making, which encodes learning more strongly in the long-term memory.[314]

Another reason that adults tend to learn better from visuals than text is that well-designed and integrated visuals alleviate the cognitive load functioning in the brain.[315] First, the visual occupies one space in the visual functioning of the brain, so the visual does not further tax the verbal functioning of the brain.[316] Second, visuals encourage adults to process information holistically, thereby further reducing the demands of verbal working memory required in reading text.[317]

D. Visual Exercises Improve Learning Most

While static visual aids tend to increase learning, visual aids that engage the student in an exercise or activity improve learning even more.[318] For example, one study compared two groups of students: the first group of students received a static, completed graphical organizer; and the second group of students received the same graphical organizer, but the graphical organizer was incomplete.[319] The students who completed the partial graphical organizer achieved better learning results than students who studied the completed graphical organizer.[320] In addition to the benefits of actively involving the student, this type of exercise also relates back to the idea of novice-to-expert schema creation, discussed in Section III.C.1., above. This type of exercise provides students with the expert-professor's overall organizational understanding of the material while still providing an opportunity for students to actively engage in understanding the material themselves. Sections VI.D.1. and VI.D.2., below, discuss similar exercises within the law school context.

Visual exercises appear to be effective only with higher-order learning tasks and most effective with the highest-order learning tasks. For example, Chan and Black tested subjects with a simple learning task

314. *See* McCrudden, Schraw, Lehman & Poliquin, *supra* note 276, at 382.

315. Bera & Robinson, *supra* note 157, at 381; Moreno & Valdez, *supra* note 157, at 43.

316. Miller, *supra* note 143, at 90; Schwartz, *supra* note 1, at 372–73. *See also* METIRI GROUP, *supra* note 11, at 9.

317. Bera & Robinson, *supra* note 157, at 381.

318. METIRI GROUP, *supra* note 11, at 13-14.

319. Andrew D. Katayama & Daniel H. Robinson, *Getting Students "Partially" Involved in Note-Taking Using Graphic Organizers*, 68 J. EXPERIMENTAL EDUC., no. 2, 2000 at 119, 128.

320. *Id.* at 130.

and found no difference between subjects who learned the material via text-only, text plus visual aids, or text plus visual exercises.[321] This result held true for simple recall tests, tests that involved modifying only one minor variable to determine if the modification changed the outcome, and tests that involved completely novel fact patterns.[322]

When Chan and Black tested students on moderately difficult material, however, students with text plus visual exercises outperformed both students with text plus static visual aids and students with text-only learning with respect to simple recall tests.[323] When Chan and Black asked students to modify one variable and determine the change (if any) in the outcome, students in both the text plus visual exercise and text plus visual aid outperformed students in the text-only learning group.[324]

Perhaps even most significantly, when the learning task was difficult, students who learned via text and visual exercises outperformed both students who learned via text and static visuals for recall, one-variable modifications, and novel situations.[325] Students who learned via text plus static visual aids outperformed students who leaned via text only on all three testing measures.[326] Hence, with the most difficult learning, text plus visual exercises outperformed both static visual aids and text only learning.[327]

The most difficult learning tasks in which law students engage are captured by levels five and six of the Taxonomy of learning objectives. Colloquially, the legal academy refers to these tasks as "analyzing" and "synthesizing," respectively.[328] As discussed in Sections II.D. and II.E., above, traditional legal education often leaves students to engage in these levels of learning on their own. Visual exercises, however, assist students with these levels of learning. Additionally, many of these types of visual exercises can be done outside of the classroom environment, so they do not infringe upon the professor's existing lessons.

In addition to visual exercises increasing student learning, several studies found that providing feedback about students' understanding of

321. Chan & Black, *supra* note 292, at 16.
322. *Id.* at 15–16.
323. *Id.* at 16.
324. *Id.* at 17.
325. Chan & Black, *supra* note 292, at 18.
326. *Id.*
327. *Id.*
328. Remember that what the legal academy refers to as "analyzing" most closely aligns with level five, which the educational psychologists refer to as "evaluating." *See supra* notes 83–86 and accompanying text.

the visual aid was important.[329] This feedback does not mean graded or written feedback. Rather, this feedback refers to providing students with mechanisms to self-correct their understanding.[330] For example, a professor could provide students with all of the pieces of a flowchart unassembled, have students attempt to construct their own flowchart, then later provide students with an optimized flowchart. The professor-generated flowchart provides feedback because the student can compare the student-generated flowchart to the professor-generated flowchart.

The feedback that comes from exercises must stimulate the students' cognitive process in order to be effective.[331] Simple trial-and-error methods tend to be ineffective because students can use rote processes or attempt to understand the process.[332] For example, imagine a situation where a student is assembling the flowchart piecemeal and is just randomly guessing at different locations while receiving immediate feedback about whether he placed the flowchart piece in the right location. Such a trial-and-error process would not stimulate the student to think about where the piece should go or how it fits with other flowchart pieces. A better exercise design would have students assemble the entire flowchart first. Then, the student could compare the student-assembled flowchart to the professor-assembled flowchart. A similar exercise is discussed in Section VI.C., below.

At least one study found significantly improved results when students engaged in an exercise, and then engaged in the metacognitive process of evaluating their own work before receiving external feedback.[333] This study found that retention rates remained consistent between students receiving external feedback and students engaging in metacognition before receiving feedback.[334] Students who engaged in the metacognitive process first, however, were better able to transfer their learning to novel situations.[335]

This vast body of literature suggests that including visual aids and exercises in legal instruction would improve students' ability to learn, would increase the speed with which students can learn, and would increase students' long-term retention of information, which is

329. Moreno & Valdez, *supra* note 157, at 43.
330. *Id.*
331. *Id.* at 42.
332. *Id.*
333. Moreno & Valdez, *supra* note 157, at 42.
334. *Id.* at 43.
335. *Id.*

particularly important for the bar exam and for the competent practice of law. These studies suggest that giving students exercises increases student learning. Giving students exercises with feedback that makes students think increases student learning even more. Optimal learning, however, occurs when students use visual exercises to attempt to learn the material, assess their own learning, then receive some form of corrective feedback.

V. MULTIMODAL LEARNING IN LAW SCHOOL: TIPS FOR SELECTING VISUAL AIDS

Although visual aids tend to aid in learning higher-order tasks and to increase long-term retrieval, too many graphics or the wrong kind of graphics can deter attention and learning.[336] This Section provides tips for incorporating visual aids into law school in a way that maximizes learning while providing the reason and research that support the suggestions.

It is important to remember that text does not constitute a visual aid because it uses the verbal function of the working memory. Hence, text and audio both tax the verbal function. Kalyuga found that, especially when lessons duplicated text and auditory information, the duplication increased cognitive load and depressed learning because the information is redundant.[337] Under the redundancy theory, cognitive load, and hence learning, is optimized when the information presented is not *simultaneously* redundant.[338] For example, a professor who creates a slide saturated with text, then reads the text in class, increases cognitive load and depresses learning. Instruction that duplicates information in multiple modes, but presents that information *sequentially* rather than simultaneously, however, can lower cognitive load. For example, the redundancy principle is not violated if a professor requires students to read text before class, reviews the information in auditory format during class, then provides a graphic of the material covered after class.

Visual aids should facilitate student learning by relating to the text (or auditory information).[339] Visual aids should make text "more

336. Joel R. Levin et al., *On Empirically Validating Functions of Pictures in Prose*, *in* 1 PSYCHOLOGY OF ILLUSTRATION 51, 67, 68 fig.2.11 (Dale M. Willows & Harvey A. Houghton, eds. 1987).

337. Kalyuga, Chandler & Sweller, *supra* note 158, at 362.

338. *Id.*

339. Levin et al., *supra* note 336, at 73–77.

concrete, coherent, comprehensible, or memorable" than reading the text alone would be for the student.[340] For example, since the facts of *Pennoyer*[341] are so complicated and abstract, a picture, or series of pictures, of the facts might provide a complement to students' learning by making the facts more concrete.

Text that tends to have the reader evoke spontaneous visual imagery, however, would not be augmented by a visual aid.[342] For example, readers are unlikely to have their understanding of a punch enhanced by an illustration of a punch. A visual that depicts the difference between actual and proximate cause, however, could assist student learning because students are unlikely to spontaneously evoke such an image.

Visual aids should not be used to compensate for text that is well beyond the student's level or for reading disabilities.[343] Within a law school setting, many professors begin 1L classes with some of the most difficult, abstract topics such as jurisdiction and consideration. Visuals should not be used to attempt to mitigate the fact that these topics are beyond the students' level since first-year students lack the fundamental and contextual principles that make these topics easier to understand. Rather, professors create a more pedagogically sound coverage of topics if they move from easier topics to harder topics, teach complex topics in discrete units, and augment each level of learning with appropriate visuals.

Visual aids that conflict with the text (or lecture) tend to depress student learning.[344] For example, an illustration that represents a legal concept incorrectly would retard student learning. Similarly, creating a graphical organizer that depicts steps to analyze the law incorrectly would tend depress student learning. It might be possible, however, to overcome a conflicting visual aid by having students engage in an exercise to determine the problem with the visual aid. Even with such an exercise, because of the pictorial superiority effect, it would probably be best to end the exercise with a visual that accurately represents the concept.

The visual aid should complement, not duplicate, the text or audio because duplicative visual aids with text or auditory information tend to

340. *Id.* at 74.
341. Pennoyer v. Neff, 95 U.S. 714, (1877).
342. Levin, et al., *supra* note 336, at 74.
343. *Id.*
344. *Id.* at 73–74.

increase cognitive load with redundant information, which does not enhance learning.[345] It is important, however, to distinguish duplicative information from successive information. For example, if a professor were to teach one subject, then use a visual aid to summarize the concept, the professor could then use the visual aid in subsequent lessons to refer to the entire concept. Thus, the entire concept could occupy one memory slot of the visual function of working memory, leaving the verbal function free.

If a visual aid is presented at the same time as text or audio, presenting the textual information in an auditory format is better than presenting textual information in a written format because presenting a visual aid and separate textual information splits attention by forcing the eyes to move back and forth between the visual aid and the text.[346]

Some visuals simply complement the textual learning component. Other visuals are so integrated into the textual learning component that students cannot understand either the text or the visual without the other. When it is necessary for students to integrate the visual with the textual information, however, the cognitive load increases for both.[347] As such, professors should give additional time and have fewer distracters when using integrated visuals.

The visual aid should be easy to integrate with the text or auditory information.[348] Visual aids should not require extensive search to coordinate the auditory and visual information because such searching increases cognitive load.[349] Hence, if a graphic is relatively complex, or the relationship between the graphic and audio or text is not straight-forward, the professor should provide extra time for the student to coordinate the information.

Additionally, when using written text and visuals that must be mentally integrated for deeper understanding, professors should integrate the text into the visual.[350] Professors should also provide signals about how to integrate the visual with the textual information, such as color

345. Kalyuga, Chandler & Sweller, *supra* note 158, at 362.
346. *Id.* at 369.
347. *Id.* at 353.
348. *Id.*
349. Kalyuga, Chandler & Sweller, *supra* note 158, at 353.
350. *Id*. at 352; *see also* Richard E. Mayer & Joan K. Gallini, *When Is an Illustration Worth Ten Thousand Words?*, 82 J. EDUC. PSYCHOL. 715, 716 (1990); Richard E. Mayer, *Systematic Thinking Fostered by Illustrations in Scientific Text*, 81 J. EDUC. PSYCHOL. 240, 244 (1989); Rohani Ahmad Tarmizi & John Sweller, *Guidance During Mathematical Problem Solving*, 80 J. EDUC. PSYCHOL. 424, 435 (1988).

coding the visual and the text to identify specific textual components that integrate with specific visual components.[351]

When students must integrate information from both their visual and verbal working memory into a schema, their learning tends to increase.[352] For example, if the professor provides a visual that a student must translate in order to understand how the visual relates to the text, the student must integrate the visual and verbal information. When attempting this integration technique, however, it is important to provide students time to engage in the integration process because integrating itself will consume working memory as students brainstorm different theories of integration.

This Section provided general guidance on incorporating visual aids that fulfill the potential of improving learning for higher-order thinking skills using multimodal learning. The next Section provides some sample visual aids and exercises that professors could adopt in their own law school classrooms.

VI. TYPES OF VISUAL AIDS AND EXERCISES IN LAW SCHOOL

A. Background on Visual Aids and Exercises in Law School

In addition to reducing cognitive load and providing guidance for higher-order learning, visual aids and exercises can help students understand how to "think like a lawyer." Providing a visual aid or visual exercise can help students spot issues, identify elements of a rule, understand the process of legal analysis, and understand that a slightly different approach in one area of analysis can lead to a completely different conclusion. Perhaps most importantly, visual aids and exercises assist students with the highest two levels of law school learning: synthesizing rules and evaluating a novel fact pattern against a synthesized rule.

In this Section, I present many different exercises that use flowcharts and other graphic organizers. I do not purport to provide a complete list of all possible exercises using visual diagrams in this Article. Rather, I suggest a few different exercises that tend to utilize

351. Paul Chandler & John Sweller, *Cognitive Load Theory and the Format of Instruction*, 8 COGNITION & INSTRUCTION 293, 331 (1991); Kalyuga, Chandler & Sweller, *supra* note 158, at 369.

352. Kalyuga, Chandler & Sweller, *supra* note 158, at 362.

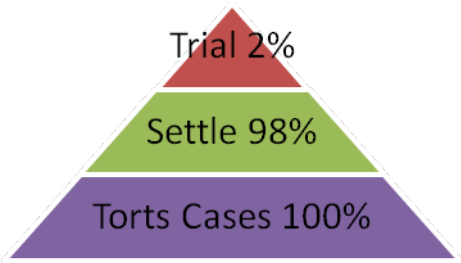
multi-modal learning. I encourage the reader to create additional types of visual aids and visual exercises.

B. Types of Visual Diagrams That Improve Law School Learning

1. Basic Organizational Graphics

Most simply, graphics can be used to visually illustrate a point. For example, a Torts professor might use a simple triangle to demonstrate graphically how few cases actually go to trial. The purpose of this type of graphic is to provide multiple opportunities to encode the same data.

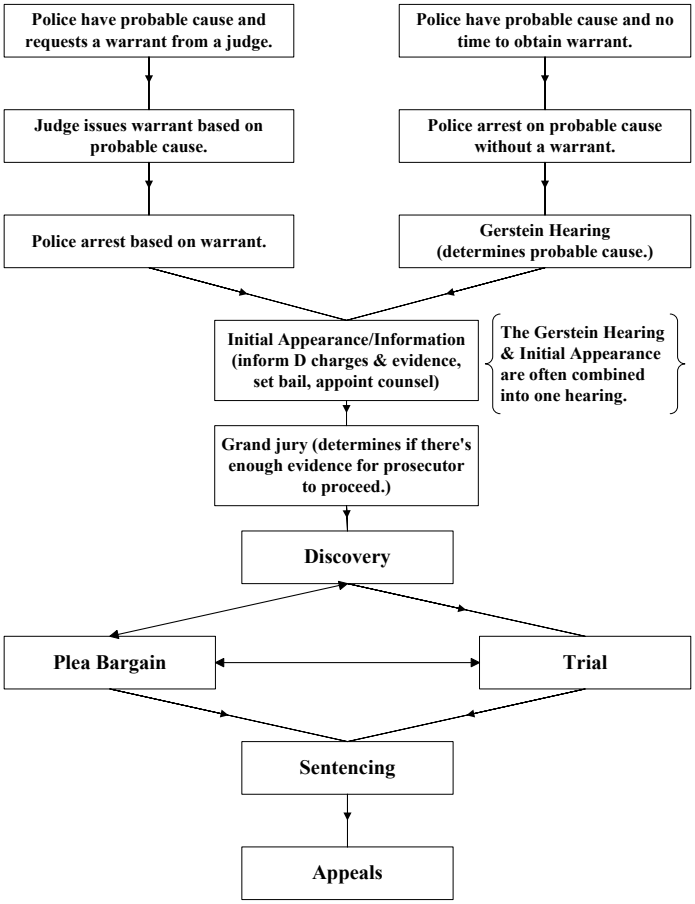
FIGURE 7.



Professors can also use graphics to provide a visual grounding to long or complicated background information. For example, a Civil Procedure diagram might illustrate how many different types of parties can exist in a civil suit while the professor discusses at length how each of these types of parties can be involved in a lawsuit. The purpose of this simple diagram is not to replicate the verbal lesson visually, but rather to ground the lecture and discussion in a visual, where the professor elaborates upon each part of the graphic.

Graphics can be used to visually reinforce a timeline or order of events. For example, a graphic could illustrate the series of events that leads up to an indictment. This type of graphic allows students to ground incremental learning in the whole concept and allows students to see how each increment fits with other increments.

FIGURE 8. CRIMINAL PROCEDURE ARREST AND BAIL TO JAIL MAP[353]



Summary graphics allow professors to demonstrate the "big picture" principles. For example, in tax, one of the concepts that students often fail to grasp is the difference between deductions that fall above or below the adjusted gross income line. To illustrate the importance of this point, a professor could use a graphic that includes a small dollar sign and small graphics to depict the deductions above the line and a large dollar sign and large graphics to depict the deductions

[353] This graphic modified a graphic provided by Richard G. Singer in Explanations & Examples: Criminal Procedure II: From Bail to Jail 2 fig.1.1 (2d ed. 2008).

below the line. Similarly, to help students categorize the different types of land ownerships, a property professor could provide a diagram that illustrates which types of ownerships require a deed of some sort and which types of ownerships can exist without a deed. These summary types of graphics simply allow students to encode their learning through multiple means: their reading, professors' lectures and discussions, and through the diagram. Such multiple pathway encoding will allow students to remember the information for a much longer time than through traditional reading and discussion.

FIGURE 9. REAL PROPERTY RIGHTS

2. Flowcharts are Good for Synthesizing and Analysis

In a legal flowchart, an overarching flowchart could identify how the overarching rules of law are connected. For example, an overarching contract diagram on contract formation might demonstrate how valid contracts are related to promissory estoppel.

Similarly, a flowchart focusing on just one rule of law could identify how the elements are inter-connected. For example, with adverse possession, a visual aid could demonstrate how every use element (actual, open and notorious, exclusive, and hostile) must be met individually, but the continuity element attaches to each of these elements.

FIGURE 10. CONTRACT FORMATION OVERVIEW DIAGRAM.

Legal flowcharts can help students analyze a fact pattern by using information flow to identify all of the relevant elements of a rule of law. A well-crafted flowchart forces students to analyze the fact pattern against each of the relevant elements of a rule of law in turn. For example, in an *Erie*[354] Civil Procedure question, a well-crafted flowchart might separately address whether the state and federal laws conflict with each other, whether the rule is bound up with rights and obligations, whether the federal rule changes the outcome of the case, whether the federal rule is constitutionally mandated, whether the federal rule is procedural, and whether the federal rule abridges, modifies, or enlarges a state right. Each of these decision points could be subdivided further to address the factors considered in each question. For example, a flowchart could have detailed decision points for whether the rule concerns procedural or substantive rights to assist a student in analyzing a fact pattern on this topic. Because students work through incremental questions, they are more likely to analyze the fact pattern against the relevant elements of a rule comprehensively.

Additionally, flowcharts can help students organize their analysis by following a series of organized decision points through to the answer, then returning to a decision point that could have been answered the opposite way and following that decision tree to an alternative answer. For example, in a Property-Nuisance-Balance of the Equities test, if a fact pattern does not clearly indicate whether the gravity of the harm

354. Erie R.R. Co. v. Tompkins, 304 U.S. 64 (1938).

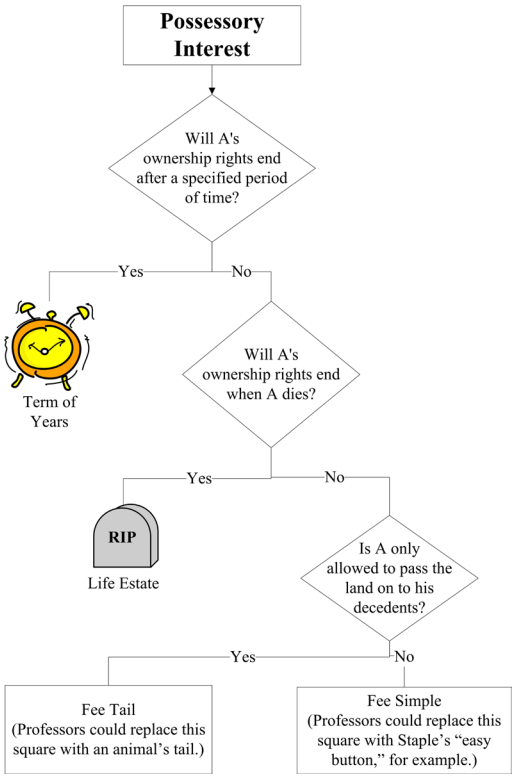
outweighs the utility of the conduct, students can first analyze the questions concerning whether the gravity of the harm does outweigh the utility of the conduct, namely if the plaintiff came to the nuisance. A student could then return to the gravity of the harm outweighing the utility of the conduct and analyze the questions resulting from the utility outweighing the gravity of the harm, namely if compensation would kill the activity. In so doing, students can identify which issue is the critical issue to predict the eventual outcome of a case correctly. In this example, the critical issue is whether the gravity of the harm outweighs the utility of the action.

3. Forced-Decision Tree Diagrams are Good for Issue-spotting

The forced-decision tree diagram flowchart is a series of decision trees where users answer questions, leading to an overarching answer to the question presented. Traditionally, each decision point is framed in terms of a "yes" or "no" answer. These flowcharts are particularly useful for emphasizing the interrelatedness of rules and issue-spotting.

Forced-decision tree diagrams can help students spot relevant issues and eliminate irrelevant issues. For example, if a professor provides a student with a fact pattern, the student must identify which graphic organizer, or which part of a graphical organizer, to use to analyze the issue. For example, with a contract question utilizing an issue-spotting flowchart, students might be required to identify whether to use flowcharts for contract formation or reliance. In some cases, the fact pattern might be fairly straight-forward in articulating that a valid contract was formed, so the student would not have to analyze a fact pattern against a reliance flowchart. In other cases, answering the questions posed in a contract formation flowchart might lead the student to conclude that the situation might not have formed a valid contract, so they must also work through the reliance flowchart.

FIGURE 11 POSSESSORY INTERESTS IN PROPERTY[355].



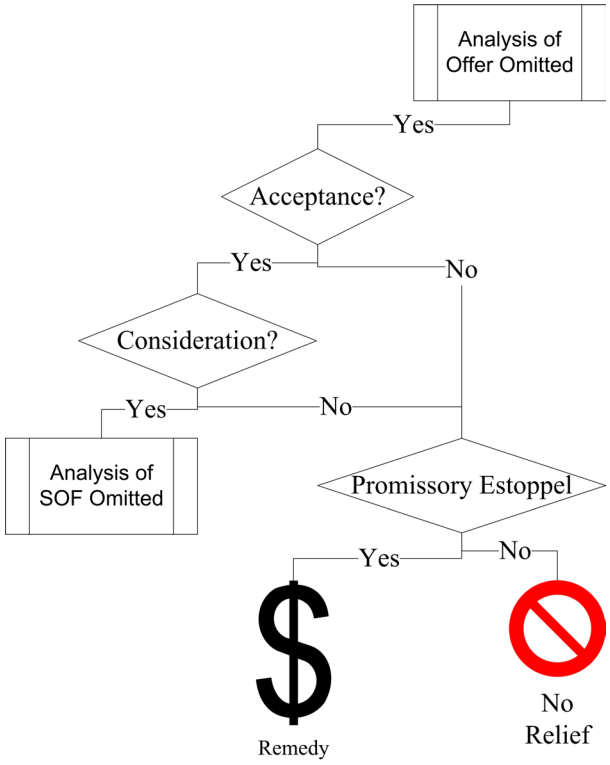
When students cannot decide whether the facts give rise to an analysis of a particular rule, answering a few of the issue-spotting questions and finding that the fact pattern does not address those questions might help students identify that this flowchart does not relate to a rule they should address. Conversely, when a student finds that the forced-decision tree diagram does ask questions that the fact pattern raises, the forced-decision tree diagram helps them spot the issue as relevant. As such, the questions posed in the forced-decision tree diagram can help students spot relevant issues and determine that other issues do not apply to the fact pattern.

[355] Thanks go to Linda Edwards for providing a book that makes estates in land so clear to understand. LINDA H. EDWARDS, ESTATES IN LAND & FUTURE INTERESTS: A STEP-BY-STEP GUIDE (3d ed. 2009)

Forced-decision tree diagrams can also help students identify missing information. Because each question is forced into a yes/no answer, the diagram must create a branch for each possibility. A student who might otherwise have explored what happens *if* a particular factor is the case will be able to see, with a tree diagram, what happens if a particular factor is *not* the case. When students do not know what happens with the alternative answer, they at least identify questions to ask their peers or professor. Additionally, if the branch was not covered in class, it is much more likely to be either outside of the scope of the class or the "grey-area" question that professors tend to ask on exams. By helping students identify missing information, flowcharts succeed where traditional outlines fail. Through this process of forcing students to examine both "yes" and "no" answers to determinative questions, flowcharts help students create a more complete outline of the rule of law.

Forced-decision tree diagrams can also help students see how many points they could lose if they answer a question too definitively. If a student answers a decision point with an "absolutely" or a "clearly," the student will only follow the "clear" answer and that branch of the tree diagram. If the question was actually a question that could have been answered either way, or worse, should have been answered the other way, the student will lose all of the points associated with the other branch of the tree diagram. The visual nature of the tree diagram can help students understand how many points they will lose if they fail to explore both sides of a question. For example, in the contracts diagram below, if a student answers that there is "clearly" consideration when this element could be argued either way, then the student would likely miss the points for analyzing the facts under promissory estoppel.

FIGURE 12. BASIC ELEMENTS OF CONTRACT FORMATION



Perhaps most importantly, forced-decision tree diagrams can help all students see how important asking questions (as opposed to providing answers) is to both the study and practice of law. Good lawyers tend to ask more questions of their clients in client interviews than do bad lawyers. They understand how important it is to get both the big picture and the details of a client's situation before counseling the client, initiating a lawsuit, or responding to a suit. Forced-decision tree diagrams focus on what types of questions a law student or lawyer must ask.

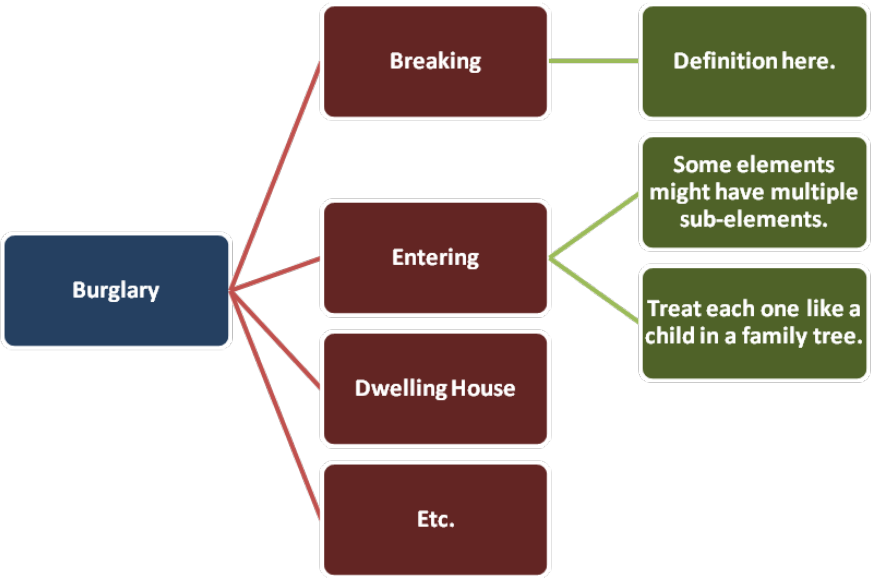
Most of the decision tree in this section have covered very basic content in each subject. Each decision point could drill down into a detailed decision tree that would guide students through the analysis required to analyze that element at a deeper level. For example, Figure 10 (Contract Formation Overview) simply asked whether a contract was

formed. Figure 12 (Basic Elements of Contract Formation) drilled down to create decision points on each of the elements. To drill down further, the consideration decision point in the basic contract formation diagram could drill down to examine such issues as pre-existing duties, gratuitous promises, and past consideration. Each of those decision points could drill down to ask the types of questions students would ask while analyzing the facts against that elements. Professors could provide one example of a drill down diagram to illustrate the process. On their own, students could then create drill down diagrams for the remaining elements.

4. Family Tree Diagrams Help Organize Exam Answers

Family tree diagrams are similar to forced-decision tree diagrams in their initial appearance. Family tree diagrams,however, do not force a yes/no answer. Rather, each point in the family tree diagram can have many pathways. These diagrams often work well for analyzing rules with multiple elements because a good analysis will address each element individually, regardless of whether the analysis of the previous element was favorable. For example, to analyze burglary, the student would analyze the breaking element. In an exam situation, whether or not breaking existed, a student should analyze the entering element, etc.

FIGURE 13. CRIMINAL LAW BURGLARY FAMILY TREE



Professors can combine family tree diagrams with forced-decision tree diagrams to illustrate which elements of a rule should always be analyzed and which elements of a rule need to be analyzed only if the facts give rise to the issue. For example, every contract formation question should analyze offer, acceptance, and consideration. A student need not mention past consideration, however, unless the facts suggest that the consideration was in the past. A combination of a family tree diagram with offer, acceptance, and consideration, with a forced-decision tree diagram for the consideration analysis would illustrate this principle well.

With many flowcharts, the words are text and are stored within the verbal function of working memory. The flowchart itself, however, creates an image of where these words fit in relation to each other and, hence, the relationships of the flowchart are visual. Additionally, formal flowchart guidelines already incorporate visual cues into the tree diagrams. For example, formal flowchart guidelines require questions to be surrounded by a diamond, while labels are surrounded by a rectangle, and stopping points are surrounded by an oval.[356] These visual cues allow readers to intuit what information they will encounter before they start reading. Professors need not adhere to the formal flowchart guidelines in order to create flowchart diagrams that appeal to students and enhance all student learning. As such, flowcharts are a good example of integrating a visual with text. Given the pictorial superiority effect, however, standard text-based flowcharts could be made more effective with graphics representing concepts, where appropriate.

C. Incorporating Pictures into Diagrams Assists with Long-Term Retention

Incorporating pictures into flowcharts can further enhance learning. To incorporate picture representations into a standard tree or family diagram, professors can represent different outcomes with picture representations. For example, as in figure 11, an alarm clock could represent a term of years, indicating that the property right expires at a

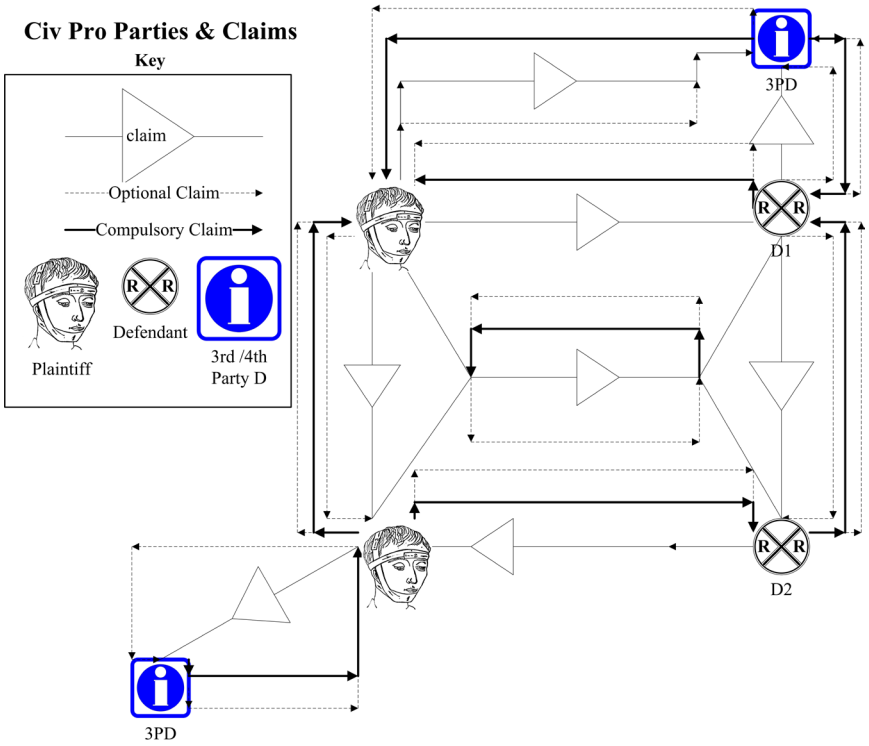
356. *See generally* INT'L ORG. FOR STANDARDIZATION, ISO 5807:1985, INFO. PROCESSING—DOCUMENTATION SYMBOLS AND CONVENTIONS FOR DATA, PROGRAM AND SYSTEM FLOWCHARTS, PROGRAM NETWORK CHARTS AND SYSTEM RES. CHARTS (1985); AM. NAT'L STANDARDS INSTITUTE, ANSI X3.6-1970, FLOWCHART SYMBOLS AND THEIR USAGE IN INFORMATION PROCESSING (1970).

particular time, and a tombstone could represent a life estate, indicating that the property right dies with the person.

Additionally, professors can incorporate pictures into the forced-decision questions where appropriate. For example, a professor could use a mailman to represent the "carrier" exception in the trespass element of larceny. A background image to an otherwise very formal flowchart would also make the flowchart more memorable, provided the picture was relevant. For example, a professor could also use Lake Erie as a background image for the same flowchart to remind students that they are applying the *Erie* doctrine.

When incorporating pictures, professors should be careful to avoid pictures that might offend students. For example, a defendant would be better represented by a bandaged person than by a handicap sign. Professors should be particularly aware of pictures that reinforce racial, ethnic, religious, gender, or sexual orientation stereotypes. Professors should also be careful to avoid pictures that only have meaning to a particular culture. For example, using a dog to represent a best friend could lose meaning to foreign students who might not be familiar with the colloquial phrase. However, the railroad sign often makes a good representation for a defendant, especially in Civil Procedure, because it gives students a sense of belonging to the legal profession since they understand why the railroad represents the defendant after reading the *Erie* case. When presenting to a lay audience, however, McDonald's or a pack of cigarettes might make a better visual representation of a defendant.

FIGURE 14. CIVIL PROCEDURE CLAIM POSSIBILITIES



D. Samples of Visual Exercises that Optimize Learning Law

Incorporating flowcharts into experiential learning exercises increases learning dramatically, as discussed in Section IV.D., above. This Section contains a number of exercises that professors can use with forced-decision tree or family tree diagrams. Professors could easily apply any of these principles to other types of visual aids, however.

Professors can use visual exercises in class to break up a lecture. Additionally, professors can provide visual exercises for students to complete outside of class as a way for students to monitor their own learning and to disperse learning over a longer time than class allows. Finally, professors can use visual exercises as a mid-semester assessment tool that is both very quick and easy to grade.

1. Fill-in-the-Blank

Professors can create their own graphical organizers or flowcharts and then remove critical information from the diagram. Learners then determine the missing information that will complete the flowchart as a take-home exercise, in pairs, or in small groups, and students can determine the missing questions or outcomes that will complete the flowchart. This exercise is especially effective for students to engage in self-monitoring to ensure that they are learning the critical components of the rule of law. This method also allows novice students to see how an expert in the field organized the information, which could help the novice create more efficient schemas.

2. Multiple Choice

Professors could also remove information from a visual aid and replace it with a multiple choice of right and wrong questions. Learners would then have to choose which question correctly identifies the issue that allows the flowchart in its entirety to become a rule of law. To make the exercise more challenging, professors could replace more than one decision point with multiple choice options for how to complete the flow chart. To make the exercise even more challenging and to help students understand the organization of the rule of law, professors could repeat some of the multiple choice options throughout the missing decision points so that students must consider both which elements are present in a rule of law and how these elements fit together in an organized fashion. As an easy illustrative example, in contracts, it is impossible to have an acceptance without an offer. If both the offer and the acceptance elements were missing and both elements were choices in a visual aid, the student would be faced with whether it is possible to identify an acceptance without an offer. Although this example is fairly obvious, other concepts in law are not, especially to novices.

3. Puzzle

Puzzle exercises create an excellent opportunity for novices to attempt to create their own schemas. First, the professor creates a flowchart and cuts the flowchart into pieces. The student must reassemble the flowchart. This exercise is often challenging because students must understand the natural order of analyzing different elements of a rule of law and how these elements fit together, quite

literally. This exercise can be effective as a take-home exercise, small group exercise, or as part of a guided class discussion.

A second variation is to provide half the students with a complete flowchart. The other half of the students receive the flowchart in pieces. Learners then work in pairs, back-to-back, so that they cannot see each other's work and discuss how to put the pieces of the puzzle together. This variation can be a fun exercise to break up a lecture and it encourages students to ask each other questions about why the flowchart is arranged in a particular order. This exercise also provides great feedback to both the students and the professor about what elements the students find confusing. Additionally, for a professor who wants to incorporate lawyering skills into their classroom indirectly, this exercise reinforces the importance of clear communication and careful listening.

Both of these exercises will force students to work with the topic. To refocus the class on the topic, the professor could take this opportunity to allow the class to ask questions about why the various elements of the rule of law fit together as they do.

4. Pair and Share

One peer exercise variation is to distribute a pre-made flowchart to half the class and have them study it and "teach" the concepts to partners (who represent the other half of the class) the following class period, when everyone receives a copy of the flowchart ("paired exercise"). Generally, students explaining the flowchart will learn by teaching other students, and the listeners will learn from hearing the information presented in a mode distinct from the methods typically employed by the professor. To ensure that students are providing accurate information to each other, this exercise could be followed with a question and answer session or a group discussion about the concepts. Often times, students will feel more comfortable asking questions when a peer has taught them the information than when a professor provides the information because the question is less likely to appear as a threat to the professor's authority or as an inability for the student to understand the professor. As such, this method, followed by a question and answer session, can provoke many questions that students have about the information that they otherwise might not have recognized they had or not felt comfortable asking.

A second variation on this theme is to distribute the flowchart to the entire class and have students generate questions about interpreting the flowchart in small groups ("small group exercise").

5. Fact Pattern Problems

Professors can ask students to work through the tree diagram using a hypothetical fact pattern. This exercise will mimic what students are expected to do on exams, thereby preparing students for exam expectations in the first semester and providing them with exam practice in any semester. This exercise could be done alone, at home, or in class as part of a peer-pair, small group, or large classroom discussion. Combining a fact pattern and a tree diagram reaches visual and kinesthetic students, while using this technique as part of a peer or small group exercise or larger classroom discussion also reaches both types of aural students.

To make this variation even more interactive, a professor could combine the fact pattern with a fill-in-the-blank flowchart and have students determine what question would complete the flowchart. If the professor carefully selects to omit a question from the flowchart that is crucial to the fact pattern presented, the professor will demonstrate how important that fact is to determining the ultimate outcome of the case, thereby reinforcing careful analysis.

6. Human Hopscotch

The hopscotch tree diagram exercise requires the most preparation by the professor, but could be one of the most memorable learning experiences a student encounters in law school. The basics of the hopscotch method involves drawing a flowchart on the floor of an open area. Then, the professor provides fact patterns to one, a few, or all students in the classroom. The students approach the hopscotch at the starting point, and then navigate through the flowchart by analyzing their fact pattern against the questions from the flowchart. By answering the flowchart question, the student proceeds to the next question in the flowchart, literally walking to it.

Professors could provide a typical exam answer flowchart in which the answers are not clear, so that some students might answer "yes" to the same question to which other students answer "no". Class discussion can then revolve around the questions students answered differently and why. Professors can take that learning opportunity to express their own preference for how to answer exam questions, especially when they want students to back-track in an exam and analyze the fact pattern against both answers and the resulting branches of analysis.

Professors could also provide two versions of a fact pattern in which some crucial facts differ slightly, but produce very different results. When the volunteers arrive at different points of the flowchart, the professor can debrief the exercise, discussing with the student volunteers which critical facts differed, thereby highlighting both the rule of law and how critical facts are when analyzing them against a rule of law.

Another variation on this exercise is to use students as the decision points in addition to using students to analyze the fact pattern. As advanced preparation, each student at each decision point should become an "expert" in that one critical element. The student with the fact pattern would approach the student at the first decision point and that student would then ask the decision point question. The two students could then discuss and analyze the facts for that decision point. Once the students reach a conclusion, the student standing at the decision point gives the student analyzing the fact pattern directions about which decision point to visit next, as in "proceed to student *X* for your next question."

To reinforce that students should analyze both answers when the facts could be answered either way, when a student answers "yes" to a question, the professor could have all of the students volunteering as decision points branching out from the "no" answer sit down, thereby representing the points the student would lose if she answered too firmly and did not explore both possible answers.

This exercise engages students in meaningful analysis, but using different modes of learning than the traditional classroom provides. It also requires students to physically move around the classroom. Finally, because of the unusual nature of the exercise, students are likely to remember the exercise for a very long time.[357]

7. Treasure Hunt

The treasure hunt exercise is similar to the hopscotch exercise. The professor creates a tree diagram flowchart and one or more fact patterns that the students use to work through the treasure map. Instead of giving the students the completed flowchart, the professor creates decision points at various places throughout the classroom or law school. Each decision point tells the student where the next decision point is, based on

357. *See* Patrick S. R. Davidson & Elizabeth L. Glisky, *Is Flashbulb Memory a Special Instance of Source Memory? Evidence from Older Adults*, 10 MEMORY, no. 2, 2002 at 99, 100.

the answer the student provides. For example, "If you answer 'yes,' go to the chalkboard for your next question. If you answer 'no,' go to the podium." The students answer each question based on the fact pattern the professor provides.

To make this exercise even more interesting, the professor could place various items at each decision point (such as labeled popsicle sticks or trinkets) that students would collect. When the exercise is complete, the professor can award game points for each of the items students should have collected if analyzing the problem in an exam answer. Here, again, a lesson could be that in a law school exam answer, it is often best to argue both sides of an issue.

To supplement this exercise even further, the professor could ask the students to analyze (in writing) their decisions for each answer before proceeding to the next decision point. To save grading time, the professor could ask the students to write their answers in an abbreviated note or outline form or submit group answers.

If a school would like to encourage students to participate in activities, such as getting to know the dean, the academic support professor, or the reference librarian, the decision points could be strategically placed throughout the law school to have students visit these areas during the treasure hunt. These faculty members could even become "experts" on their designated decision point, thereby engaging students with their analysis of a problem.

Additionally, professors could reinforce what analysis means by having the professors designated at decision points engage in a discussion that allows the student to develop his or her analysis fully. The person would only provide directions to the next decision point when the students have provided a full analysis of that element.

Although this exercise must fit with the professor's teaching style, it could serve to reinforce learning because the exercise engages the students and is unusual.

VII. CONCLUSIONS

The traditional legal curriculum tends to underuse meaningful visual learning aids. The absence of visual aids works against the way adult human brains are generally wired to learn. Additionally, this absence of visual aids is contrary to the research that educational psychologists have completed, which indicates that visual aids create faster, deeper, and longer learning, especially for the types of higher-

order cognitive learning that law school requires. Visual exercises increase learning even more.

By using visual aids and exercises, professors can eliminate unnecessary struggle from the legal curriculum, especially in the first semester and the beginning of each new semester. Eliminating unnecessary struggle creates opportunity for professors to increase the amount of content or skills that professors teach. Eliminating unnecessary struggle also gives students with fewer past educational resources an opportunity to excel in law school and serves to equalize the imbalance between educationally advantaged and educationally disadvantaged students.

When professors incorporate visual aids and exercises into legal classrooms, students tend to retain information for a longer period of time. This length of time is particularly useful for students who take core bar courses over a three-year period and must retain the information for the bar exam. More importantly, to be competent, lawyers should be able remember and spot issues from most core courses in law school, even if the issue only comes up rarely in their practice area. Thus, visual aids and exercises can assist students in becoming more competent lawyers.

Finally, when professors use visual aids and visual exercises that help students synthesize rules, synthesize the course, or evaluate a novel fact pattern against synthesized rules, professors support the highest-order thinking skills that law school requires. Because these highest-level thinking skills are traditionally taught implicitly or left to students to learn on their own, professors can support students in learning the highest levels of law school learning by incorporating such visuals into their classrooms.

It is worth noting that these exercises do take time to develop initially. Because the exercises are formative rather than evaluative assessments, however, professors can reuse these exercises from one year to the next. Additionally, it takes time to revise slides to match the guidelines set forth in this article. As such, the author recommends incorporating visual aids and visual exercises incrementally each semester.

In sum, traditional legal teaching methods and other innovative teaching methods provide many benefits to students who attempt to learn law. Professors can augment these teaching methods with visual aids and visual exercises to allow students to learn more, deeper, faster, and to retain information longer.