The Power of Stories and Images in Law School Teaching

Scott DeVito
The Power of Stories and Images in Law School Teaching

Scott DeVito

Table of Contents

I. Introduction ........................................................................................................................................... 1

II. Legal Scholarship ................................................................................................................................. 4
   A. Arguments for Using Stories to Teach Law ..................................................................................... 5
   B. Arguments for Using Images to Teach Law .................................................................................. 7

III. Cognitive and Brain Science: The Theoretical Basis for the Studies .............................................. 8
   A. Squeezing More Into Limited Memory ....................................................................................... 10
   B. Doubling Up With the Two Hemisphere Brain or 1 + 1 = 3 ....................................................... 12

IV. Empirical Analysis .............................................................................................................................. 13
   A. Summary of Key Findings ............................................................................................................. 13
   B. First-Year and Upper-Level Students Learn Differently ............................................................. 14
      i. The Study Design: Contracts, Sales, and Article 2 ..................................................................... 14
      ii. Learning Improves With Visual Supplementation .................................................................... 15
      iii. Stories for 1Ls and Flowcharts for 2Ls and 3Ls ................................................................. 17
      iv. Explaining the Results: The Interaction of Story and Image .................................................... 18
   C. Sophistication and Naïveté in the Law or Why Upper-Level Students Learn Better With Flowcharts ......................................................................................................................... 21
      i. The Study Design: Professional Responsibility ......................................................................... 22
      ii. Upper-Level Students Learn Differently Because They Interpret Law Within a New Framework ........................................................................................................................................................................ 23

V. Next Steps ............................................................................................................................................ 24

VI. Conclusion .......................................................................................................................................... 25

* Associate Professor of Law, Florida Coastal School of Law. Ph.D., 1996, University of Rochester, Department of Philosophy; J.D. 2003, University of Connecticut. I thank Michael Hunter Schwartz, Brian Foley, B.J. Priester, Christopher Roederer, Bradley Shannon, and Jeff Todd for their encouragement and insightful responses to earlier drafts of this Article. I am also grateful to the participants of the 2011 Applied Legal Storytelling Conference who attended a talk based on an early version of this work for their valuable comments. This research was generously supported by a summer research grant from Dean Peter Goplerud of Florida Coastal School of Law.
ABSTRACT

Through the use of empirical studies informed by theories of memory and brain functioning, cognitive scientists have made impressive gains in understanding how stories and images help student learning. Law professors have laid an important foundation for bringing the usefulness of stories and images to light but have not empirically determined whether and in what circumstances stories and images improve law student learning. This Article fills the gap by discussing three studies conducted by the author. The results are quite dramatic. For first-year students, supplementation of classroom material with images is 30% better at improving law student understanding than supplementation with text-based material. For upper-level students, the improvement is even larger—images are 50% better than text. Stories are 9% better than exposition at improving first-year student learning with one type of story outperforming the improvement seen by any other medium by 53%. For upper-level students, the results are flipped on their head (empirically demonstrating that upper-level students learn differently than first-year students). Exposition improves performance 8% more than stories with flowcharts outperforming the next best medium by 12%. These results, and others discussed in the Article, provide a firm empirical basis for adding stories and images into the law school teaching mix.
I. Introduction

Jamie woke up with his head pounding. "One hundred fifty seven thousand owed for the J.D. This interview has to go right." Splashing water on his face, he looked in the bathroom mirror and saw the black eye, the twisted bloody nose, and remembered last night.

Stories have power. They pull us in. Good stories, like good images, can be extremely persuasive. But can mere stories and pictures help law students learn? While many legal educators have posed that question, none have empirically answered it. This Article

---

2 See, e.g., Linda L. Lohr, Creating Graphics for Learning and Performance: Lessons in Visual Literacy 6-7 & Figure 1-3 (2003) (demonstrating the power of visuals to instruct).
4 See, e.g., Top Tobacco, L.P. v. N. Atl. Operating Co., Inc., 509 F.3d 380, 381 (7th Cir. 2007) (noting in a tobacco trademark infringement case that “[t]his case illustrates the power of pictures. One glance is enough to decide the appeal.”); Clay Calvert, Every Picture Tells a Story Don’t It? Wrestling With the Complex Relationship Among Photographs, Words and Newsworthiness in Journalistic Storytelling, 33 COLUM. J.L. & ARTS 349, 351 (2010) (“Given the power of images, it is not surprising that the First Amendment protects not only spoken or printed words, but also pictures, films, paintings, drawings, and engravings, unless the content depicted therein is obscene or falls within the confines of another category of unprotected expression.”) (citations omitted) (internal quotation marks omitted).
fills that gap by describing the results of three empirical studies testing whether, and if so, to what degree, supplementation with stories and pictures helps students learn law better than supplementation with exposition or text.6

These studies produced a number of striking results.7 For first-year students, stories are 9% better8 than exposition at improving student learning while cartoon-strip style stories are the best kind of supplementation for learning—outperforming the next best performer (flowcharts) by 53%. These results are flipped for upper-level student for whom exposition is 8% better than stories—with flowcharts outperforming the next best performer (movies) by 12%.9 Even more impressive, visual supplementation improves student learning better than textual supplementation for every kind of student. For first-year students visual supplementation is 30% better than text and for upper-level students it is 50% better.

---

6 When dealing with terms that have both a common and technical meaning it is often useful to define the terms as they are to be used. A “narrative” is a set of causally or temporally connected events that are experienced by, occur to, or affect one or more actors who cause or experience the events. See MIKE BAL, NARRATOLOGY: INTRODUCTION TO THE THEORY OF STORY 5 (2d ed. 1994); William F. Brewer, Literary Theory, Rhetoric, and Stylistics: Implications for Psychology, in THEORETICAL ISSUES IN READING COMPREHENSION 223 (Rand J. Spiro, Bertram C. Bruce, & William F. Brewer eds., 1980). A “story” is a particular kind of narrative in which the characters “struggle[] to overcome obstacles and reach an important goal.” See, e.g., HAVEN, supra note 1, at 79 (emphasis added); see also DANIEL T. WILLINGHAM, WHY DON'T STUDENTS LIKE SCHOOL?: A COGNITIVE SCIENTIST ANSWERS QUESTIONS ABOUT HOW THE MIND WORKS AND WHAT IT MEANS FOR THE CLASSROOM 69 (2009) (discussing “the four Cs: causality, conflict, complications, and character”). A writing is “expository” if the writing describes or depicts a concept but is not character driven. CRAIG POHLMAN, REVEALING MINDS: ASSESSING TO UNDERSTAND AND SUPPORT STRUGGLING LEARNERS 174 (2008) (describing “[e]xpository discourse [as] intended to convey information and . . . often nonfiction and more detail-laden”). The fundamental difference between expository and Story material is that “exposition’s basic structures are logical and informational, not temporal” or causal. ROGER H. BRUNING, GREGORY J. SCHRAW, & MONICA M. NORBY, COGNITIVE PSYCHOLOGY AND INSTRUCTION 242 (5th ed. 2011) [hereinafter COGNITIVE PSYCHOLOGY].

7 One not so striking result was that supplementation of any kind is better than no supplementation.

8 Determinations of percent “better” or “outperforming” relative to another supplementation method were made by calculating how much each supplementation method improved learning as compared to no supplementation then dividing that amount for the better supplementation method by the amount for the weaker supplementation method.

9 Flowcharts outperform cartoon-strip stories by 45%.
These results are consistent with the theoretical underpinnings from cognitive science.\textsuperscript{10} The value of stories for first-year students is consistent with the recognition that people learn better and can absorb more when the material can be put into a recognizable structure. Stories provide that structure for first-year law students. On the other hand, the benefits of stories fall away as upper-level students develop a new structure (a law school specific structure) for processing the information. Moreover, the success of providing students at all levels with both textual and visual information fits perfectly with our expectations in the context of the two hemisphere brain.

Law jobs are scarce,\textsuperscript{11} law firm margins are thinner than ever,\textsuperscript{12} tuition costs are up,\textsuperscript{13} and student enrollment is down.\textsuperscript{14} Law firms have little time to train law school graduates in the practice of law and expect them to come ready to practice from day one.\textsuperscript{15} As a result, law schools find themselves pressured to teach more and more quickly while students are asked to learn the traditional curriculum in a compressed time as well as the practice-ready skills demanded by law firms.\textsuperscript{16} The results described below help all of these stakeholders achieve

\textsuperscript{10}See infra Part III.
\textsuperscript{12}See, e.g., Jennifer Smith, Layoffs Threaten Law Firms, WALL ST. J., January 7, 2013, at B1 (discussing how due to the weak demand for legal services, some law firms are laying off partners). See also Chris Fletcher, A Message to Aspiring Lawyers: Caveat Emptor, WALL ST. J., January 2, 2013, at B1 (noting that law firm “[s]alaries have plummeted, with the mean private-practice compensation . . . falling 16% from where it was in 2009 . . ., and 8% from 2002”).
\textsuperscript{13}See, e.g., Fletcher, supra note 12, at B1 (noting the “dramatic increase in law-school tuition—which has increased 434.8% at private schools since 1985”)
\textsuperscript{15}See, e.g., Elise Young, A Residency Program for Lawyers, Inside Higher Ed (June 26, 2012, 3:00 a.m.), http://www.insidehighered.com/news/2012/06/26/arizona-state-plans-create-law-firm-hire-and-train-recent-graduates (quoting Dean Sylvester of Arizona State University Sandra Day O’Connor College of Law who stated “what we see now is either the agencies or firms are not willing to hire untrained attorneys because they won’t train them, or they hire them and just immediately throw them into the fire”).
\textsuperscript{16}See, e.g., Ilene Fleischmann, January Courses at UB Law School Develop Real-World Skills (January 9, 2013), http://www.buffalo.edu/news/releases/2013/01/008.html (quoting Professor Charles Patrick Ewing, vice dean of academic affairs, at the University at Buffalo Law School regarding the creation of bridge classes “[a]s part of the
their goals by providing information about how to supplement law school material to help students learn better.17

This Article proceeds in the following manner. It begins, in Part II, by quickly reviewing the scholarship on the use of stories and images in legal education placing the Article within the context of current legal scholarship. Part III discusses current cognitive science on how memory and the two hemisphere brain work enabling the results of the studies to be explained. With this background in hand, Part IV explains how the studies were performed, the results, and how those results fit into our theories of memory and the brain. Finally, Part V discusses potential additional research to answer questions not answered by the current studies.

II. Legal Scholarship18

Law School’s enhanced efforts to provide state-of-the-art skills training to all students and to prepare them to be practice-ready upon graduation, we have increased the level of skills training available in our bridge semester”).

17 While it is not within the scope of this Article, an added advantage is that teaching with stories and images may help students learn to apply storytelling and visual explanation in practice providing students with an edge in persuasiveness and clarity.

18 While the discussion in this Article is limited to the legal literature on the use of stories in legal education, there has also been empirical research in other disciplines discussing the value of stories for education in general. The results have been wide ranging. Some have found that narrative material improves student learning. See, e.g., L. Dodge Fernald, Tales in a Textbook: Learning the Traditional and Narrative Modes, 16 Teaching of Psych. 121, 122-23 (1989) (finding in a study of undergraduate students that narrative texts were preferred over expository texts for testing purposes, that knowledge retention of narrative texts surpassed expository texts, and that narrative texts were more enjoyable and useful for learning than expository texts); L. Dodge Fernald, Of Windmills and Rope Dancing: The Instructional Value of Narrative Structures, 14 Teaching of Psych. 214, 215-16 (1987) (finding that undergraduate students at all capabilities preferred narrative texts over expository texts); Arthur C. Graesser et al., Advanced Outlines, Familiarity, and Text Genre on Retention of Prose, 48 J. Experimental Educ. 282, 286-88 (1980) (finding in a study of the effects of provision of outlines in advance and familiarity of material on learning, using college students, that narrative material had a statistically significant effect on learning). Others find there to be no statistically significant difference. See, e.g., Lawrence J. Cunningham & M. D. Gall, The Effects of Expository and Narrative Prose on Student Achievement and Attitude Toward Textbooks, 58 J. Experimental Educ. 165, 167, 171-72 (1990) (finding in a study of whether narrative material motivates greater learning because it is more interesting that there was no statistically significant difference in student outcomes between high school students provided history material in narrative format versus history material in expository format). Still others find that expository material is better for learning than narrative material. See, e.g., Donna E. Alvermann & Cynthia E. Hynd & Gaoyn Quian, Effects of Interactive Discussion and Text Type on Learning Counterintuitive Science Concepts, 88 J. Educ. Research 146, 146,151, 153 (1995) (finding in a study of whether ninth grade students could learn counterintuitive scientific concepts from discussing them in a social context that Stories underperformed expository material); Joellen T. Hartley, Reader and Text Variables as Determinants of Discourse Memory in Adulthood, 1 Psych. & Aging 150, 156 (1986) (finding in a study of variability of memory between older and younger subjects that narrative material was not remembered as well as expository material). Finally some studies find that each kind of material has its own set of benefits for different aspects of learning. See, e.g., Darcia Narvaez and Paul van den Broek, The Influence of Reading Purpose on Inference Generation and Comprehension in Reading, 91 J. Educ.
Almost all of the work on the use of stories in legal education is based upon anecdotal or theoretical considerations—not upon either an empirical study of existing data or of data created by experiment. The author has found one work discussing an empirical study of the andragogical aspects of the use of story for the teaching of law.19

A. Arguments for Using Stories to Teach Law

Stories have many pedagogical benefits. They can be used to broaden students’ understanding of the world and themselves by developing student empathy and compassion,20 build student insight into the oppressive nature of “the received wisdom” or current system,21 empower students who are members of out-groups22 while helping students who are members of in-groups see what they cannot see because of their “in” status,23 and expose students to the idea that the world is socially created.24

20 See, e.g., Gerdy, supra note 5, at 54-55; see also Van Praagh, supra note 5, at 129-31 (discussing the use of a fictional story about law students to help students empathize and identify with employees involved in a plant closure). The results of Tyler and Mullen also seem to bear this out. See Tyler & Mullen, supra note 5, at 314.
21 Delgado, supra note 5, at 2413 (noting that “[i]deology—the received wisdom—makes current social arrangements seem fair and natural. Those in power sleep well at night—their conduct does not seem to them like oppression.”).
22 Id. at 2437-38.
23 Id. at 2439-40 (contending that members of in-groups can enrich their realities by listening to the stories of the out-group members).
24 See, e.g., Blaustone, supra note 5, at 456 (arguing that “story-telling contextualizes the rules in ways that show that, in reality, facts are value-filled and not value-neutral”); Davis, supra note 5, at 242 (describing the use of a short story to aid students in understanding that the concept of “informed” in informed consent is subject dependent); Grose, supra note 5, at 48 (explaining how the use of stories “leads students to realize that The Law itself is a set of stories that have been adopted by decision makers and that those stories have been constructed by none other than lawyers”); Van Praagh, supra note 5, at 115-17 (contending that the introduction of student’s personal stories allows “students [to] question the authority that places value on certain constructions of information and truth, and [to] begin to envision alternative structures”).
For example, Davis notes that stories can give students a common point of reference enabling them to better communicate with each other and the professor. Others point out the power of stories to deepen law student understanding by providing students access to new and unseen perspectives. These views are supported by an empirical study of students in a general practice clinic at Columbus School of Law of the Catholic University of America. The study collected student, faculty, and client stories relating to the students’ cases to determine whether student storytelling could improve learning in a clinical setting. The authors concluded that student “understanding of the client story become clearer or deeper by crafting and telling the story,” that student “awareness of the importance of knowing the listener, and tailoring the story for the audience” improved, and that the formation of student professional identity was linked to the storytelling.

Finally, the use of stories has been recognized as overcoming the creativity-stifling effect of the traditional Socratic case method, improving persuasive power of written prose, and increasing retention of doctrinal material.

---

25 Davis, supra note 5, at 245.
26 Jean C. Love, The Value of Story in Legal Scholarship and Teaching, 2 Journal of Gender, Race and Justice 87, 97 (1998). See also Paul L. Caron, Back to the Future: Teaching Law Through Stories, 71 U. CIN. L. REV. 405, 419 (2002) (arguing that the use of legal archeology to uncover the stories behind the law “provide[s] us with a deeper understanding of a particular area of law”); Davis, supra note 5, at 242, 244 (arguing that using a short story, written from the feminist perspective, about a woman undergoing a hysterectomy improves or broadens students’ understanding of the fluidity and difficulty of pinning down the legal standard for the informed consent); Carrie Menkel-Meadow, Forward. Telling Stories in School: Using Case Studies and Stories to Teach Legal Ethics, 69 FORDHAM L. REV. 787, 793-94 (2000) (discussing that stories provide contextual knowledge which enables us to more fully and completely draw our legal arguments).
27 Tyler & Mullen, supra note 5, at 285, 301.
28 Id. at 301-03.
29 Id. at 312.
30 Due to the scope of this Article, discussion of Tyler and Mullen is limited to their discussion of student learning.
31 Tyler & Mullen, supra note 5, at 313.
32 Id. at 314.
33 Id. at 317.
34 McClurg, supra note 5, at 829.
35 See, e.g., Rappaport, supra note 5, at 274 (contending that “[l]iterature . . . must be incorporated into legal writing classes to awaken law students to storytelling’s persuasive power”). Foley & Robbins both argue for teaching storytelling to students to improve the design of the facts section of their briefs in order to provide a more powerful,
B. Arguments for Using Images to Teach Law

Like legal scholarship on the use of stories, the scholarship on the use of images in legal education is focused on theoretical and anecdotal considerations.\(^\text{37}\) For example, Merritt argues, in one of the strongest pieces, for the use of visual materials in teaching based on the idea that the left and right hemispheres of the brain process information differently.\(^\text{38}\) Traditional law school teaching over-emphasizes left brain thinking.\(^\text{39}\) By teaching to both hemispheres of the brain we tap into both the left brain’s ability to capture individual pieces of information and the right brain’s ability to synthesize the connections between those individual pieces of information.\(^\text{40}\) Teaching to both sides of the brain improves student learning because students “learn more deeply from words and pictures than from words alone”\(^\text{41}\) and improves student retention because “[t]he brain stores words and images separately, offering two independent avenues for recollection.”\(^\text{42}\) Block makes a related point when she argues for the position that cognitive science informs us that “[v]ision trumps all other senses”\(^\text{43}\) and that “[s]tudies have compelling, and persuasive argument and provide guidance to that end. Brian J. Foley & Ruth Anne Robbins, Fiction 101: A Primer For Lawyers On How to Use Fiction Writing Techniques to Write Persuasive Facts Sections, 32 Rutgers L.J. 459, 462-80 (2001).\(^\text{36}\) Blaustone, \textit{supra} note 5, at 483-84 (concluding that students who were “identified as showing difficulty in establishing a structural framework for doctrinal analysis” found the stories useful, some gifted students “enjoyed the ‘puzzle-like’ experience of unraveling the content of the stories,” and the stories were used as context by students during review sessions discussing multiple-choice questions).\(^\text{37}\) Unfortunately, it is also very limited. The author was only able to find a handful of relevant articles in the current literature. \(^\text{38}\) Merritt, \textit{supra} note 5, at 42.\(^\text{39}\) \textit{Id.} at 43.\(^\text{40}\) \textit{See id.} at 42-44.\(^\text{41}\) Merritt, \textit{supra} note 5, at 43 (quoting Richard E. Mayer, \textit{Cognitive Theory of Multimedia Learning, in The Cambridge Handbook of Multimedia Learning} 31, 31 (Richard E. Mayer ed. 2005)).\(^\text{42}\) Merritt, \textit{supra} note 5, at 44.\(^\text{43}\) Kate E. Block, \textit{Cognition and Star Trek: Learning and Legal Education}, 42 J. Marshall L. Rev. 959, 987 (2009)(quoting Dr. John Medina, Brain Rules, 2008, http://brainrules.net/ ).
shown that “the human cognitive system consists of two distinct channels for representing and manipulating knowledge: a visual-pictorial channel and an auditory-verbal channel.” 44

Others argue that teaching using images is necessary to foster visual literacy 45 because, in this new digital age, “[t]he practice of law – how truth and justice are represented and assessed – increasingly depends on what appears on electronic screens in courtrooms, law offices, government agencies, and elsewhere.” 46 In essence, the use of images in practice is growing and not being able to recognize the impact (on the jury or judge) of those images places attorneys in a weaker position:

Law students have to do far more than become acquainted with the new visual technologies being used in the law today. They need to understand how new (and more established) visual technologies change the ways that their uses and their audiences think. They need to develop a critical visual intelligence that enables them to anticipate the cognitive and emotional effects of visual and multimedia displays and to respond to their adversaries’ visual and multimedia presentations. They need to become conversant with the expanded toolkit of conceptual and technological resources that we have described . . . not simply in order to communicate and persuade more effectively, but also because this multidisciplinary toolkit is precisely what will inform their appreciation of how visual displays can affect legal thinking, judgment, and meaning-making as a whole. 47

Sherwin, Feigenson, and Spiesel conclude from this analysis that lawyers will have to expand their repertoire of visual displays to respond to this growing visual culture. 48

III. Cognitive and Brain Science: The Theoretical Basis for the Studies

It is difficult (and of limited value) to attempt to draw causal conclusions solely from a statistically significant correlation between two variables – a theory is needed to understand why

44 Id. at 987 (quoting Richard E. Mayer, Cognitive Theory and the Design of Multimedia Instruction: An Example of the Two-Way Street Between Cognition and Instruction, in APPLYING THE SCIENCE OF LEARNING TO UNIVERSITY TEACHING AND BEYOND 55, 60 (Diane F. Halpern & Milton D. Hakel eds., 2002)).
46 See Id. at 227.
47 Id. at 260-61.
48 Id. at 233-34 (discussing how lawyers are “[a]dding to their traditional demonstrative arsenal” of visual aids).
the correlation occurred. For example, showing there is a statistically significant correlation between exposure to a story and success on an exam, does not show that exposure to the story caused the success; it only shows that it was likely not mere random luck. The purpose of this section is to provide a theoretical basis for interpreting the results of the studies described. The key theoretical points to be drawn are:

1. To be learned, something must first be passed from sensory memory to short-term memory and then from short-term memory to long-term memory.

2. Sensory and short-term memory each has limited space.

3. Something will be passed on from sensory memory to short-term memory only if it is attended to.

4. Sensory, short-term, and long-term memory can be increased by placing the information to be processed into a recognizable structure—like memorizing the 10 digit sequence 2024561111 by converting it into the 3 numbers of a phone number: (202) 456-1111.

5. The brain has two hemispheres—one that is better at processing text information and another that is better at processing visual information.

6. Information that is presented both as text and as image has a better chance of being recalled and remembered because it is stored in two different channels for recollection and use.

---

49 See, e.g., DAMODAR GUJARATI, ECONOMETRICS BY EXAMPLE 3 (2011) (noting in discussing regression coefficients “that the causal relationship between Y and the Xs, if any, should be based on the relevant theory”) (emphasis omitted); DAMODAR GUJARATI & DAWN C. PORTER, ESSENTIALS OF ECONOMETRICS 22 (2010) (discussing how “[c]ausality must be justified, or inferred, from the theory that underlies the phenomenon that is tested empirically”) (emphasis omitted).

50 See, e.g., GUJARATI, supra note 49, at; GUJARATI & PORTER, supra note 49, at 22.

51 Statistical significance is usually measured in terms of the p-value of a statistical hypothesis. A p-value of 0.05 means that there is a one-in-twenty chance (or 5% chance) that the result occurred randomly. DAVID HENSHER, JOHN M. ROSE, & WILLIAM H. GREENE, APPLIED CHOICE ANALYSIS: A PRIMER 46-47 (2005). In general, a p-value of less than 0.05 is considered statistically “significant.” See, e.g., id; SCOTT E. MAXWELL & HAROLD D. DELANY, DESIGNING EXPERIMENTS AND ANALYZING DATA: A MODEL COMPARISON PERSPECTIVE 47 (2nd ed. 2004).

52 This is the current White House comments phone number. Corresponding with the White House, WHITEHOUSE.GOV, http://www.whitehouse.gov/contact/write-or-call#call (last visited Jan. 10, 2013).
A. Squeezing More Into Limited Memory

Memory is one of the factors limiting student learning. If a student cannot remember a rule or a process, then the student cannot utilize that rule or process. By structuring our teaching to respond to the way memory works we can improve learning and by ignoring the way memory works we can impede it.

Memory has three components: sensory memory, short-term memory (also called working memory), and long-term memory. At every moment in time our bodies receive vast quantities of sensory information while we notice only some small portion of it. Our sensory memory quickly sifts this mass of sensory information and passes on only the “important” information that will be processed further by our short-term memory. Sensory memory can be

---

53 WILLINGHAM, supra note 6, at 54-63 (discussing the role of memory in learning and teaching).
54 Id.
56 See COGNITIVE PSYCHOLOGY, supra note 6, at 24 (noting that “[s]ensory memory briefly processes a limited amount of incoming stimuli”); FOSTER, supra note 55 at 28 (noting that the sensory memory “receives information from the senses and holds it for about a second while we decide what to attend to”).
57 Sensory memory persists for only a very short period of time—between 0.5 milliseconds and 4 seconds. COGNITIVE PSYCHOLOGY, supra note 6, at 24 (concluding that “[v]isual registers hold about seven to nine pieces of information for about 0.5 second. [sic] Auditory registers hold five to seven pieces of information for up to 4 seconds.”)
58 Attending to sensory information is a necessary first step for something to become a long-term memory. The window for that information to get into working and long-term memory is extremely short and if students fail to attend to information, that window shuts quickly. See, e.g., COGNITIVE PSYCHOLOGY, supra note 6, at 17 (discussing the importance of perception for information to pass from sensory to short-term memory); FOSTER, supra note 55, at 28 (noting that sensory memory “receives information from the senses and holds it for about a second while we decide what to attend to”). Capturing attention is one of the ways in which stories might be useful at helping students learn. See, e.g., WILLINGHAM, supra note 6, at 69 (noting that “[s]tories are consistently rated as more interesting than other formats . . . even if the same information is presented”).
59 Id. at 27 (discussing how short-term memory “is responsible for active information processing rather than strictly passive short-term maintenance of information”).
60 See COGNITIVE PSYCHOLOGY, supra note 6, at 24 (noting that “[i]n the modal model . . . information is assumed to enter short-term memory once it has received initial processing in sensory memory.”); FOSTER, supra note 55, at 29 (noting that the “[p]laying attention to something transfers it to short-term memory.”).
augmented by long-term memory if we have prior knowledge that provides us with a structure into which the information can be placed.61

Short-term memory has a limited capacity for holding information at one time.62 If short-term memory is “full,” then the addition of new information will either be ignored or will displace information in short-term memory—making the lost information unusable.63 How we internally structure our information affects whether accessing that information uses more or less space in short-term memory.64

Through processes like attending to, turning over, and rehearsing the material in one’s mind, some short-term memories make their way into long-term memory65 where it is encoded (usually in terms of the meaning of the information66) “in a form that allows it to be readily stored and retrieved.”67

One way to ensure that information is stored and retrieved well is to “elaborate” the acquired knowledge by, for example, describing it in different ways or performing a task with it.68 One useful method for elaborating is to convert knowledge from one form into another—

61 See COGNITIVE PSYCHOLOGY, supra note 6, at 21.
62 Information held in short-term memory is generally described in terms of the amount of units of information stored (called “chunks”) and the total number of units of information that can be held in short-term memory (called “span”). See, e.g., COGNITIVE PSYCHOLOGY, supra note 6, at 25 (defining “chunks”); George A. Miller, The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information, 63 PSYCH. REV. 81, 90, 93 (1956) (describing “span” and “chunks”). Originally, memory span was described as being about seven chunks. Id. at 83-90. More recently, this has been refined to the “mean memory capacity in adults [is] three to five chunks, whereas individual scores appear to range more widely from about two up to about six chunks.” Nelson Cowan, The Magical Number 4 in Short-Term Memory: A Reconsideration of Mental Storage Capacity, 24 BEHAVIORAL AND BRAIN SCIENCES 87, 114 (2000). The amount of information that a chunk can hold is not static—by attaching meaning or structure (like converting a string of 10 digits into a sequence of 3 sets of digits—in a telephone number) to the material held in a chunk, a chunk can hold more material. See Miller at 93-95 (discussing recoding and explaining that “[s]ince the memory span is a fixed number of chunks, we can increase the number of bits of information that it contains simply by building larger and larger chunks, each chunk containing more information than before”).
63 COGNITIVE PSYCHOLOGY, supra note 6, at 25 (5th Ed. 2011) (discussing forgetting in short-term memory).
64 See Miller, supra note 62, at 93-95.
65 See FOSTER, supra note 55, at 30 (discussing long-term memory).
67 See REIF, supra note 55, at 88-9.
68 See REIF, supra note 55, at 94.
“[p]ictorial forms of description (visual encoding) may be particularly useful.”\textsuperscript{69} Elaboration (and improved retention) can also be achieved by organizing new information in a way that it is “systematically related to other knowledge in a coherent knowledge structure.”\textsuperscript{70} For example, it is often easier to recall a new kind of information by restructuring it into a story format because the brain has a built-in story structure for understanding the world.\textsuperscript{71} Because of the built-in story structure, when we are presented with raw information and do not have a specified structure to organize it, the brain attempts to use its standard story-telling, agent-based, causal/temporal structure to give the new information structure.\textsuperscript{72}

**B. Doubling Up With the Two Hemisphere Brain or 1 + 1 = 3**

The use of images as a supplement to textual material can also improve learning by taking advantage of the way the two hemisphere brain works. “[T]he left brain generally focuses on linear, sequential ideas” like predicting the next number or letter in a sequence, “while the right brain concentrates on patterns and connections” like identifying two identical graphic patterns out of a group of patterns.\textsuperscript{73} When we tap into both hemispheres, memory and learning can be improved\textsuperscript{74} “because the brain stores words and images separately offering two independent avenues for recollection” and providing “enriched memory stores [that] increase most learners’ access to material.”\textsuperscript{75} Because traditional text-based law school materials already do a fairly good job of tapping into the left hemisphere’s emphasis on linearity and discrete

\textsuperscript{69} Id. at 95-6.
\textsuperscript{70} Id. at 96-7.
\textsuperscript{71} See HAVEN, supra note 1, at 29-32.
\textsuperscript{72} Id. at 34.
\textsuperscript{73} Merritt, supra note 5, at 42.
\textsuperscript{74} See id. at 43.
\textsuperscript{75} See Merritt, supra note 5, at 44; see also COGNITIVE PSYCHOLOGY, supra note 6, at 20 (noting that “[g]iven the limits of students’ ability to hold information in their sensory registers, we would expect that information presented both visually and auditorially would have a higher likelihood of being perceived than information presented in only one format.”)
ideas we can improve learning by adding into the mix the right brain’s synthesizing preference through the can use of pictures or diagrams.

IV. Empirical Analysis

A. Summary of Key Findings

This Article discusses the results of three empirical studies conducted at Florida Coastal School of Law. In stage 1, a first-year Contracts class and an upper-level Article 2 Sales class were provided with supplementary material for some topics but not others. The results were quite striking:

1. For first-year students stories are 9% better than exposition at improving learning,
2. Cartoon-strip stories are best for first-year students outperforming the next best performer (flowcharts) by 53%,
3. For upper-level students exposition is 8% better than stories,
4. Flowcharts best for upper-level student learning outperforming the next best performer (movies) by 12%,
5. For first-year students visual supplementation is 30% better than text, and
6. For upper-level students visual supplementation is 50% better than text.

76 See Merritt, supra note 5, at 44.
77 See id.
78 Anonymized studies of students are not typically considered “human research” for purposes of institutional review board approval. See DeVito, supra note 19, at 296-299. Nonetheless, our obligations as law professors likely require us to engage in heightened scrutiny of experimentation when law students are the subjects of experiments. See id. at 309-12. Therefore, any empirical study using students should be conducted only after careful examination of the ethical implications of such a study. See id. at 292. In general, there are eight factors that should be examined to determine if a study is permissible: (1) sound research design, (2) benefit/harm consideration, (3) equity in treatment of subjects, (4) informed consent from subjects, (5) documentation of informed consent, (6) data monitoring, (7) protection of privacy and confidentiality, and (8) precautions for protection of vulnerable populations. Id. at 314. Before commencing on the studies described in this Article, a careful examination of all eight factors was undertaken and a determination was made that the study, as designed, met all ethical obligations to students.
B. First-Year and Upper-Level Students Learn Differently

i. The Study Design: Contracts, Sales, and Article 2

The first study used two classes: a second semester Contracts class with 79 first-year students and an upper-level class on Article 2 of the Uniform Commercial Code (“Sales”) with 54 second/third year (upper-level) students. Each class was divided into six sections and five topics: warranties, disclaiming warranties, statute of frauds, parol evidence rule, and unconscionability.\(^79\)

For each topic students were provided with supplementary material\(^80\) either in a story format or an expository format. The story format came in three genres: movie, cartoon-strip, and text. The expository format came in three genres: outline, flowchart, and hornbook section. Students in Contracts received the same supplementary material as students in Sales.

A week before a particular topic was to be covered in class each student was given a password to a folder on the class TWEN site. There were six folders—one for each kind of supplementary material. The day the class was to cover the material each student was required to turn in a trivial assignment that could only be answered if the student had looked at the materials assigned to them.\(^81\)

---

\(^79\) Initially there were to be six topics to be covered in both classes but, for logistic reasons, this was decreased to five before beginning the study.

\(^80\) For each topic the materials were created in the following manner. The outline was created first and was used to create a flowchart. The flowcharts were designed, where appropriate, consistently with a hierarchically clustered organization. See, e.g., REIF, supra note 55, at 145. A hornbook section was then located that covered the same material as the outlines and flowcharts in a relatively short amount of text (3-4 pages). With the expository material created/identified, a “script” was written for the stories. The doctrinal material covered in the script was limited to just that material also covered in the expository material. This script became the text story. The movie and cartoon-strip stories were built using this script. Because the movie and cartoon stories were created using free software from different companies, the movies and cartoons did not always utilize the same characters. The movies were created using free software on the xtranormal website: http://www.xtranormal.com. The comic-strip Stories were created using free software from the toondoo website: http://www.toondoo.com.

\(^81\) Students were required to turn in these assignments as part of their class grade. Students were further informed that no “quality” requirement would be imposed other than turning in the assignment and answering it in a way that indicated having looked at the material.
At the end of the semester, each topic covered by the supplementary material was tested in a multiple choice exam.\textsuperscript{82} The questions used in the exam were analyzed after the exam to ensure that only questions that were able to discriminate between top performing students and low performing students would be used in the analysis.\textsuperscript{83} For each study, the data was encoded into a regression formula which was analyzed using logistic regression analysis.\textsuperscript{84}

ii. Learning Improves With Visual Supplementation

In both groups visual formats filled the top-two supplement methods. For first-year students cartoon strips and flowcharts were most useful while for upper-level students flowcharts and movies were most useful. On its face, this supports the idea that supplementation with visual elements may synergize left and right hemisphere learning giving a boost to retention of information.\textsuperscript{85}

\textsuperscript{82} Each topic was tested using 3 multiple choice questions. Thus, on each exam there were 15 multiple choice questions relating to the material that had been supplemented. For the contracts class a control group of 15 multiple choice questions relating to material that was not supplemented was given. In the sales class the control included 45 multiple choice questions relating to material that was not supplemented.

\textsuperscript{83} This was accomplished through five steps: (1) sort the data based on overall grade from overall best to overall worst; (2) divide results into 10 groups (group 1 best, group 10 worst); (3) for each question find the average for each group; (4) calculate the slope of the best-fit line for each question using the average results as the Y-axis and the group number as the X-axis; (5) if the slope is zero or positive, identify the problem as a non-discriminating question. \textit{See}, e.g., THOMAS M. HALADYNA, DEVELOPING AND VALIDATING MULTIPLE-CHOICE TEST ITEMS 209-11 (3d ed. 2004) (discussing item discrimination methods).

\textsuperscript{84} For the contracts multiple choice exam three questions were eliminated: two relating to supplemented material and one relating to non-supplemented material. For the sales multiple choice exam four questions were eliminated: one relating to supplemented material and three relating to non-supplemented material.

\textsuperscript{85} Each data entry contained three columns: the dependent variable “result” (correct = 1, incorrect = 0) and the independent variables: “Story_or_Exposition” (1 = movie, 2 = cartoon, 3 = text, 4 = Flowchart, 5 = Outline, 6 = hornbook, 0 = no supplementation), and “Visual_or_Text” (visual = 2, text based = 1, no supplementation = 0). Using a program written in Stata this data was then encoded into an equation taking the standard regression form. \textit{See} GUJARATI, supra note 49, at 2 (describing the general form of the linear regression model). Because the dependent variable was binary, the data was run through a logistic regression using the Stata logit command to find the probability of succeeding at a question given the various iterations of the independent variables. \textit{See} GUJARATI & PORTER, supra note 49, at 368-88 (discussing the benefits of using the logit model as compared to the ordinary least squares model to find regression coefficients when the dependent variable is binary); \textit{see also} A. COLIN CAMERON & PRAVIN K. TRIVEDI, MICROECONOMETRICS USING STATA 462 (rev. ed. 2010) (discussing the logit command); SVEND JUL & MORTEN FRYDENBERG, AN INTRODUCTION TO STATA FOR HEALTH RESEARCHERS 171-75 (3d ed. 2010) (discussing logistic regression in Stata); STATA LIBRARY: UNDERSTANDING ODDS RATIOS IN BINARY LOGISTIC REGRESSION, \texttt{http://www.ats.ucla.edu/stat/stata/library/odds_ratio_logistic.htm} \textit{(last visited June 13, 2012) (discussing the use of the adjust command)}.

\textsuperscript{85} \textit{See} Merritt, supra note 5, at 43 (discussing how teaching to both sides of the brain improves learning).
For first-year students, the probability of success using material that was not supplemented was 0.536, the probability of success using material supplemented with visual media was 0.668, and the probability of success using material supplemented by text-based media was 0.637. Visual supplementation improved learning by 13% while text supplementation improved learning by 10%. Thus, visual supplementation was 30% better at improving learning than text supplementation for first-year students.

The value of visual supplementation for learning is even greater for upper-level students. The probability of success on material that was not supplemented was 0.611, material supplemented with visual media had a probability of success of 0.758, and material supplemented by text-based media had a probability of success of 0.711. Here visual supplementation improved learning by 15% while text supplementation improved learning by 10%. Thus visual supplementation was 50% better at improving learning text supplementation for upper-level students.

These results strongly support Merritt’s contention that supplementing the standard textual material in teaching with pictures or diagrams will improve student retention of material because it enables the student to utilize both the left and right hemispheres of the brain. The left and right brain focus on different things. Textual supplements mirror the standard law school study materials and therefore only reinforce the left hemisphere with its emphasis on linearity and discrete ideas. This produces some positive effect. But when we supplement with

---

86 These results were statistically significant with a p-value < 0.0005.
87 These results were statistically significant with a p-value < 0.0005.
88 Merritt, supra note 5, at 43.
89 Id. at 42.
90 See id.
pictures or diagrams that play to the right hemisphere’s strengths, we add something new, producing a cumulative effect.\textsuperscript{91}

iii. **Stories for 1Ls and Flowcharts for 2Ls and 3Ls**

The study of stories versus exposition tells a more nuanced story. For the first-year students, the probability of success using material that was not supplemented was 0.536, the probability of success using material supplemented by story was 0.656, and the probability of success using material supplemented by exposition was 0.649.\textsuperscript{92} Thus story supplementation improved learning by 12% while expository supplementation improved learning by 11% (as compared to no supplementation). While the overall improvement from each kind of supplementation was fairly close (stories improve learning 9% more than exposition), when we break down the results into story and exposition types we see important differences:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Type</th>
<th>Sub-Type</th>
<th>Probability of Success Given Sub-Type</th>
<th>p-value</th>
<th>Increase vs. no supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Story</td>
<td>Cartoon</td>
<td>0.739</td>
<td>&lt;0.0005</td>
<td>0.203</td>
</tr>
<tr>
<td>2</td>
<td>Exposition</td>
<td>Flowchart</td>
<td>0.669</td>
<td>0.001</td>
<td>0.133</td>
</tr>
<tr>
<td>3</td>
<td>Exposition</td>
<td>Outline</td>
<td>0.651</td>
<td>0.005</td>
<td>0.115</td>
</tr>
<tr>
<td>4</td>
<td>Story</td>
<td>Text</td>
<td>0.631</td>
<td>0.021</td>
<td>0.095</td>
</tr>
<tr>
<td>5</td>
<td>Exposition</td>
<td>Hornbook</td>
<td>0.628</td>
<td>0.025</td>
<td>0.092</td>
</tr>
<tr>
<td>6</td>
<td>Story</td>
<td>Movie</td>
<td>0.597</td>
<td>0.141\textsuperscript{93}</td>
<td>0.061</td>
</tr>
</tbody>
</table>

| None | N/A | 0.536 | N/A | N/A |

**TABLE 1**

Cartoon-strip style stories outperformed all other forms of Story by a wide margin. They increased performance over no supplementation by 20.3% while flowcharts, the next best performer increased performance over supplementation by 13.3%. Thus, cartoon-strip stories produced 53% greater improvement in learning than their nearest competitor.

\textsuperscript{91} See id.

\textsuperscript{92} These results were statistically significant with a p-value < 0.0005.

\textsuperscript{93} This result was not statistically significant.
For upper-level students, the probability of success on material that was not supplemented was 0.611, material supplemented by story had a probability of success of 0.730, and material supplemented by exposition had a probability of success of 0.739. Thus, expository supplementation improved learning by 13% while expository supplementation improved learning by 12% (as compared to no supplementation). Once again, while the overall improvement from each kind of supplementation was fairly close (expository material improves learning 8% more than exposition), when we break down the results into story and exposition types we see important features:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Type</th>
<th>Sub-Type</th>
<th>Probability of Success Given Sub-Type</th>
<th>p-value</th>
<th>Increase vs. no supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exposition</td>
<td>Flowchart</td>
<td>0.782</td>
<td>&lt;0.0005</td>
<td>0.171</td>
</tr>
<tr>
<td>2</td>
<td>Story</td>
<td>Movie</td>
<td>0.764</td>
<td>0.001</td>
<td>0.153</td>
</tr>
<tr>
<td>3</td>
<td>Exposition</td>
<td>Outline</td>
<td>0.762</td>
<td>0.002</td>
<td>0.151</td>
</tr>
<tr>
<td>4</td>
<td>Story</td>
<td>Cartoon</td>
<td>0.729</td>
<td>0.013</td>
<td>0.118</td>
</tr>
<tr>
<td>5</td>
<td>Story</td>
<td>Text</td>
<td>0.698</td>
<td>0.0729</td>
<td>0.087</td>
</tr>
<tr>
<td>6</td>
<td>Exposition</td>
<td>Hornbook</td>
<td>0.672</td>
<td>0.223</td>
<td>0.061</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>N/A</td>
<td>0.611</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 2

Flowchart exposition outperformed all stories. They increased performance over no supplementation by 17.1% while movies, the next best performer, increased performance over supplementation by 15.3%. Thus flowcharts produced 12% greater improvement in learning than their nearest competitor and outperformed cartoon-strip stories by 45%.

iv. Explaining the Results: The Interaction of Story and Image

The results of the analysis of stories versus exposition raise two questions. First, why is the amount of improvement gained by supplementing with stories so similar to the amount of

---

94 These results were statistically significant with a $p$-value < 0.0005.
95 This result was not statistically significant.
96 This result was not statistically significant.
improvement gained by supplementing with exposition? Second, why do first-year students benefit from different supplementary material (in particular cartoon-strip stories) than upper-level students (who benefit from flowcharts)?

We can explain the closeness in the level of improvement by exposition and story by the fact that each type of supplementary material contained textual and visual media. As we have seen, supplementation with visual media produces dramatic improvements in learning for both first-year and upper-level students. It is likely that the impact of the visual supplementation masked some of the differences between supplementation by story and exposition when we simply look at “story versus exposition.” In essence, there was a hidden variable (whether the story/exposition was visual or text driven) that altered the outcomes for the story versus exposition analysis.

This becomes apparent when we drill down and divide up stories and exposition into types (that can be easily identified as visual or textual) and see the true impact of supplementation by story and exposition. For first-year students, supplementation by cartoon-strip stories was, by far, the most valuable method of supplementation. This makes sense. First, cartoon-strip stories are a visual media and therefore they get a bump relative to text stories. Second, like all stories, they are engaging. Because of the information bottle-neck created at both the sensory and short-term memory levels, only what is attended to is remembered.97 Because stories are engaging they increase the probability that the material will be attended to as compared to exposition.

97 See COGNITIVE PSYCHOLOGY, supra note 6, at 17-20, 24 (discussing perception and the limited capacity of sensory and short-term memory).
Third, short-term memory can only process a limited number of “chunks” of information. While we cannot increase the number of chunks, there are ways that we can increase how much information each chunk holds. One way to do that is to re-organize different pieces of information into a single piece of information. Very few people can easily recall 10 digits (e.g., 2024561111) but most can easily remember those 10 digits if they are placed into a phone number structure: (202) 456-1111. The phone number example illustrates one way of putting more information into chunks—using an already known mental structure. Because stories utilize the “built-in” story-telling, causal-temporal structure, first-year students, who lack a well-develop structure to chunk legal knowledge, are able to digest more of the information in cartoon-strip format.

Fourth, the dialogue in the cartoon-strip stories expressly broke the rule elements into visually distinct logical bytes (each panel contained one element of the related rule). Thereby both pre-digesting the information and tapping back into the visual understanding.

No other genre had all four of these elements. Some exposition was visual, some textual. The expository material was dry and uninteresting. It also failed to link into a structure the students already had (the causal/agent driven story structure). Thus, for first-year students, exposition was less helpful. Text stories lack a visual element. Moreover, both text stories and movies do not divide the elements of the rule into visually distinct elements.

But if cartoon-strip stories have so much going for them, why are they a distant fourth in value to flowcharts for upper-level students? This too makes good sense. First, flowcharts are visual and thus get the benefit of two hemisphere learning. Second, upper-level students have

---

98 See, e.g., Cowan, supra note 62, at 104-107 (discussing the amount of chunks one can hold in short-term memory); Miller, supra note 62 at 90-93 (same).
99 See Miller, supra note 62, at 93-95 (discussing recoding and explaining that “[s]ince he memory span is a fixed number of chunks, we can increase the number of bits of information that it contains simply by building larger and larger chunks, each chunk containing more information than before”).
100 See id. (same).
spent (at least) the first year of law school developing law school patterns for understanding the law— in essence they have had a year of training in how to think like a lawyer. This gives them a self-built structure through which new legal information can be processed. Moreover, in terms of test taking, it is likely that that self-built structure—developed to succeed in law school—will have an edge over the general purpose story structure. Thus the benefit of linking the rule into the brain’s storytelling structure decreases. In addition, for those that can read them, a one-page flowchart gives a much simpler way of subdividing the elements and logical connections of a rule than does a 10 panel cartoon-strip.

C. Sophistication and Naïveté in the Law or Why Upper-Level Students Learn Better With Flowcharts

After completing these studies it became apparent that the Sales study had failed to fully account for the intricacies of one variable: sophistication of learner. First-year students are naïve learners—they are unfamiliar with both the material and how to learn the material. Upper-level students are sophisticated learners in the sense that they already know how to learn the law. But, depending on the class taken, the upper-level student may be either a naïve or sophisticated learner with regard to the subject matter. For example, Sales students are sophisticated learners both in terms of learning the law and in terms of the material because, respectively, they have had a year of learning how to learn the law and they were exposed to much of the Sales material, albeit at a lower intensity, in their year-long contracts class. On the other hand, Professional Responsibility (an upper-level class) students are only sophisticated with regard to learning the law because they have not previously been exposed to the subject matter of the class.

As a result, there is a problem with relying upon the results of the Sales study because we cannot be sure that the difference in learning was due to being sophisticated learners or due to being sophisticated learners who are also knowledgeable about the material. We do not know
whether we would get a different result if we were to study students who were sophisticated along only one of these dimensions: learning the law. To remedy this problem, a third study was conducted using students in an upper-level Professional Responsibility class. These students were sophisticated learners but not knowledgeable about the material. The results of this study fully supported the results of the Sales study.

i. The Study Design: Professional Responsibility

The students in the Professional Responsibility class were provided with supplemental materials posted on TWEN and accessible by all. This set of supplemental materials identified a set of readings in the text and also summarized the textbook material in three ways: providing the appropriate American Bar Association Rule of Professional Conduct section verbatim, providing a flowchart, or providing a cartoon-strip style story.

At the end of the semester, as part of the class final exam, the topics covered in the supplemental material were tested using an extra-credit portion of the final exam. The final exam consisted of 60 multiple choice questions covering the Model Rules of Professional Conduct and the Model Code of Judicial Conduct. The extra-credit portion of the exam included 18 additional questions relating to material on advertising based on readings identified to the students in the textbook.

---

101 Ideally we would look at four groups: novice as to substance and process, novice as to substance and expert as to process, expert as to substance and novice as to process, and expert as to substance and process. The study of the first year Contracts class gave us the first group: novice as to substance and process. The study of the Sales class gave us the fourth group: expert as to substance and process. The study described below using the Professional Responsibility class gives us the second: novice as to substance and expert as to process. Unfortunately it is not possible to find the third group (expert as to substance and novice as to process) in a law school. Thus such a group was not examined.

102 The study of the Professional Responsibility students did not revisit the issue of the value of supplementation with images because the results from the study of Contracts and Sales students did not conflict with each other on that issue.

103 The material was limited to flowchart and cartoon genres for simplicity and because of the stark differences between cartoons and flowcharts both at the experience levels (naïve and experienced) and as the experience levels changed. Each kind of supplementation (flowchart, cartoon, none) covered different parts of the advertising material.
As with the first study, the questions used in the final exam were analyzed after the final exam to ensure that only questions that were able to discriminate between top performing students and low performing students would be kept.\textsuperscript{104} All non-discriminating questions were then eliminated.\textsuperscript{105} For each study, the data was encoded into a regression formula which was analyzed using logistic regression analysis.\textsuperscript{106}

ii. Upper-Level Students Learn Differently Because They Interpret Law Within a New Framework

The study of the professional responsibility students was designed to determine whether students who are experienced legal-education-learners, but naïve as to the legal substance, will respond to supplementation differently than students who are experienced as to both the legal education process and the legal substance. The results of the study reject such a result. The professional responsibility students responded similarly to the sales students:

<table>
<thead>
<tr>
<th>Rank</th>
<th>Type</th>
<th>Sub-Type</th>
<th>Probability of Success Given Sub-Type</th>
<th>p-value</th>
<th>Increase vs. no supplementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Exposition</td>
<td>Flowchart</td>
<td>0.807</td>
<td>&lt;0.0005</td>
<td>0.432</td>
</tr>
<tr>
<td>2</td>
<td>Story</td>
<td>Cartoon</td>
<td>0.630</td>
<td>&lt;0.0005</td>
<td>0.255</td>
</tr>
<tr>
<td></td>
<td>None</td>
<td>N/A</td>
<td>0.375</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**TABLE 3**

Flowcharts improve learning by 43.2\% as compared to no supplementation while cartoon-strips improve learning by 25.5\%. Thus flowcharts improve learning 70\% more than cartoon-strip

\textsuperscript{104}See HALADYNA, supra note 85, at 209-11 (discussing item discrimination methods).

\textsuperscript{105}Only three questions, all for the supplemented material, were eliminated from the analysis because they were non-discriminating.

\textsuperscript{106}Each data entry contained two columns: the dependent variable “result” (correct = 1, incorrect = 0) and the independent variables: “Story_or_Exposition” (1 = cartoon, 2 = Flowchart, 0 = no supplementation). Using a program written in Stata this data was then encoded into an equation taking the standard regression form. See GUJARATI, supra note 49, at 2 (describing the general form of the linear regression model). Because the dependent variable was binary, the data was run through a logistic regression using the Stata logit command to find the probability of succeeding at a question given the various iterations of the independent variables. See GUJARATI & PORTER, supra note 49, at 386-38 (discussing the benefits of using the logit model as compared to the ordinary least squares model to find regression coefficients when the dependent variable is binary); see also CAMERON & TRIVEDI, supra note 86, at 462 (discussing the logit command); JUUL & FRYDENBERG, supra note 86, at 171-75 (discussing logistic regression in Stata).
stories. Clearly, flowcharts are a more powerful methodology for supplementation than cartoon-style stories for upper-level students. At the same time, cartoon-style stories are still powerful supplemental methods.

The results of the study of professional responsibility students supports the view that experience in terms of simply having been a law student changes how law students learn. Thus it is highly likely that upper-level students learn differently than first-year students simply as a function of being law students—and that upper-level students, in general, benefit most when provided supplementation with flowcharts.

V. Next Steps

While the results of the studies discussed in this article lay a strong foundation, they are only a first step. Additional studies should be conducted to clarify and refine these results. For example, students need to develop, at least, three test-taking/lawyering skills: issue spotting, rule knowledge, and application of rules. This study was not designed to correlate success as to issue spotting, rule knowledge, or application with supplementation by story, exposition, visual, or textual material. Examining such correlations might bear useful fruit.

In addition, given that first-year law students respond better to stories while upper-level students respond better to flowcharts, these teaching materials might be useful for identifying when students have learned how to think like a lawyer. In essence, when students transition for learning better from cartoon-strip stories to flowcharts, we may be able to infer that they have internalized a law-school structure for analyzing the law. Determining whether this is true (and how to test it) would be of great service because it would enable us to identify students who are lagging behind as well as methods for helping students make the transition.
VI. Conclusion

The sun was just going down. Jamie slumped into the seat of his car. The leather felt cold and unforgiving. He was not sure how he was going to tell his fiancé the news. Pulling out his phone, he texted: “got the job – personal injury firm: $80K. dinner on me at Maxes.”

The three empirical studies discussed in this article demonstrate the relative value of supplementation with stories versus exposition and images versus text. For all students supplementation with images produced substantial gains in learning. Because of the different learning characteristics of first-year and upper-level students, different storytelling and expository material produced maximal benefits. First-year students, because they have not yet developed their own structure for processing law school material, benefited from the use of cartoon-strip stories. Upper-level students, on the other hand, find considerably less benefit from the use of cartoon strips and benefited most from the visual exposition of a flowchart—likely because this is both visual and because it fits comfortably into the law-school-structure the student has developed during his or her first year of law school.