

## Using Stories to Facilitate Learning

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### ABSTRACT

Stories represent a fundamental way by which we interpret our experiences. They tap into our natural predispositions of seeking pattern, perceiving agency, simulating and connecting events, and imputing meaning into what we experience. Instructors can take advantage of this predisposition and facilitate student learning by viewing stories from a broad perspective and intentionally connecting stories and storytelling principles to the concepts and principles they want students to learn. Instructors can capture students' attention, nurture a more social atmosphere, and engage their students' emotions and cognitive abilities. Previous work on using stories to teach has highlighted four types of story-based instruction: case-, narrative-, scenario-, and problem-based. I extend this work by offering practical suggestions for incorporating stories into the classroom. I list possible objectives, discuss methods, and share examples that range from simply sharing a relevant story or anecdote or incorporating storytelling methods, to using a story framework to undergird an entire course. I then discuss various costs and benefits in the use of stories to facilitate learning. The methods I discuss can be used in a wide range of courses, and I encourage instructors to consider how they incorporate a broader, more intentional use of stories into their teaching.

### KEYWORDS

Anecdote; pedagogy;  
narrative; storytelling

### Introduction

It was the second day of my insect biology class when I described to my students a letter I had received. The letter was signed "Twisted in Tallahassee," and the writer spoke of insufferable pain he had experienced from a lifelong identity crisis. He described feelings of isolation, low self-esteem, and a poor body image. He simply did not fit in with others of his kind, and to be perfectly honest, few could disagree. He was a very strange sight indeed. As a twisted-wing parasite, he is one of the most bizarre-looking insects one could imagine.

Fictional letters from hypothetical insect authors represent one way I have intentionally incorporated stories into my teaching, along with a little humor. Each letter depicts a personified insect character and a predicament with which it is struggling. I pair a letter with each broad topic in my course (e.g., internal anatomy, evolution of insects) and revisit key components of the letter as we proceed with lecture and class discussion. We seek to better understand insect biology by clarifying the character's predicament. The letters provide an emotional element, engage the students, and provide my lectures with a framework that taps into the natural human disposition for story (Boyd 2009; Gottschall 2012; Bruner 1990). Each insect's

story might be viewed as scaffolding the students can use to connect the concepts, principles, and facts we study.

Using stories in the classroom is not a new idea. There are many specific examples of how an instructor has used stories and narrative in his or her teaching. Stories have been used widely in the K-12 classroom and also in professional training (Egan 1989; Hamilton and Weiss 2005; MacDonald, Whitman, and Whitman 2013). Case studies have long been used in professional programs such as law (Dorf 2004), business (Ellet 2007), and medicine (Churchill and Churchill 1989). For example, some medical programs have adopted "narrative medicine," whereby doctors and nurses train to acquire narrative competence, skills that allow them to interpret and respond to stories, particularly those of their patients (Alderson and Bateman 2002; Charon 2001; Baker and Clark 2008). Students might also share a story as part of a class assignment, such as through learning journals or digital storytelling (Rossiter and Garcia 2010). Stories have also been used with a wide variety of learners, including adult learners (Clark and Rossiter 2008), prospective teachers (Dolk and den Hertog 2008), counselors-in-training (Myers, Tolerud, and Jeon 2012), and low-proficiency students (Mokhtar, Kamarulzaman, and

Halim 2012). Stories have even been used to facilitate communication and efficiency among members of an organization (Gargiulo 2005). And stories have been used in a wide range of subjects, such as economics (Colander 2000), history (Wills 1992), chemistry (Kitson 2005), foreign languages (Mokhtar, Kamarulzaman, and Halim 2012), nursing (Lordly 2007), and mathematics (Borasi, Sheedy, and Siegel 1990). Despite numerous specific examples and particularly broad use in K–12 and in professional training, stories can nurture student learning further if we view stories from a broader perspective.

Stories are useful in the classroom because humans have a natural disposition for interpreting our experiences as stories. For example, in a famous experiment, Heider and Simmel (1944) showed that when shown a movie depicting a series of geometric shapes moving around on a screen, student observers attributed motives and intentions to the shapes. Rather than interpret the movements merely as a series of spatial shifts, students saw individuals in conflict, with most interpreting the movements as two men competing for a woman's attention. We also experience stories not just in a novel or a movie, but they also form the basis of dreams, marketing pitches, songs, jokes, political commentary, legal cases, gossip, dinner-table conversations, and more. Stated simply: humans are “storytelling animals” (Gottschall 2012). Interpreting our world through a lens of characters, action, and interaction is a fundamental part of our neuropsychology (Mar 2004, 2011; Boyd 2009). We naturally detect agency, be it as an opportunity or a threat. We comprehend events before we can even speak. We naturally recognize and discriminate among individuals and evaluate relationships. And we are particularly attuned to faces, emotions, and interactions. Neurons in our premotor cortex called mirror neurons fire not just when we perform an action but when we see another perform the same action or even part of the action (Rizzolatti and Craighero 2004). Quite literally, we see ourselves in others. When presented with autobiographical information, or when we attribute intentions and emotions to characters, what psychologists call “theory-of-mind,” we engage our hippocampus and much of our cerebral cortex (Mar 2004; Rabin et al. 2010). Even just experiencing the act of storytelling can engage our brain. Our brains can be activated with metaphorical language (Lacey, Stilla, and Sathian 2012). Stories can increase brain connectivity (Berns et al. 2013) and synchronize the brains of storyteller and listener (Stephens, Silbert, and Hasson 2010). They also allow us to simulate our social experiences (Mar and Oatley 2008).

Our predisposition for story was likely adaptive for our evolutionary ancestors. Living in small social groups, they undoubtedly relied on social information. An

individual's success would have been predicated on predicting the behavior and intentions of those with whom they interact repeatedly. Boyd (2009, 134) discusses how our minds “exist to predict what will happen next. They mine the present for clues they can refine with help from the past—the evolutionary past of the species, the cultural past of the population, and the experiential past of the individual—to anticipate the immediate future and guide action.” Further, he argues that story, like art, represents a form of cognitive play with patterned information we experience. Stories work our “mental muscles” analogous to the way that physical play behavior sharpens neurological and motor functions (Bekoff and Byers 1998). Gottschall (2012) further suggests that stories act as cognitive flight simulators that help us practice without consequence navigating human and social life (Gottschall 2012; Mar and Oatley 2008). Our brains constantly and unconsciously play out scenarios that hone neural pathways and allow the real action, if it is ever taken, to be sharper and more efficient. Although our current environment is based less on repeated interactions in small social groups, our craving for social information remains, just as we retain our craving for sweets and fats despite its selection in an ancestral environment. Teaching with stories means we can be more deliberate in giving purpose to our craving for story. Instructors can facilitate student learning by conveying material through story, a format students are predisposed to interpret.

### **Clarification of terms and aims**

What do we mean by “story”? How does it relate to “narrative”? Broadly construed, both story and narrative involve an ordered sequence of events from which meaning can be derived. As Rust (1999, 370) notes, stories and narratives are “acts of meaning ... [that provide] opportunities for discovery, learning, and sense-making.” Of course, this is not to suggest story and narrative are synonymous. For example, Halverson, Goodall, and Corman (2011) describe a narrative as a “coherent system of interrelated stories.” In this article, I will focus more on the term “story” than “narrative,” and I will do so mostly from the perspective of a character experiencing a struggle or dilemma. It is instructive to note that stories and narratives may be viewed in other insightful contexts, such as for emphasizing counter-narratives (Bamberg and Andrews 2004) or as a way to focus on action, freedom, and identity (e.g., Lindemann Nelson 2001, Oliver 2001). More specific than an ordered sequence of events, I view story as a depiction of a real, fictional, or personified character experiencing an event or events that act as barriers to the character's pursuit of his or her goal. This

might be represented structurally as story = character + predicament + attempted extrication (Gottschall 2012, 52). I employ this more general focus of story for several reasons. A character- and resolution-driven perspective comports with the general view offered by Boyd (2009) and Gottschall (2012), who discuss evolutionary explanations for the human predilection for story. It also corresponds with the view often taken by cognitive psychologists and neurobiologists who study the neuropsychology of stories. As Mar (2004) describes, the basic elements of a story include an agent (character) that experiences impediments and/or assistance toward a particular goal. It is this evolutionary and neuropsychological predisposition that provides a broad foundation for using stories to facilitate learning. Finally, taking a general view of story simplifies the language and focuses the aims of this article, which I intend for a broader audience. I assume a broader range of readers will have a general sense of what is meant by “story” rather than “narrative.”

Given our predisposition for stories and their potential as a universal teaching tool, my goal in this article is to offer a general, interdisciplinary “how-to” article for using stories in the college classroom. When viewed in a broader, more general context, stories may be applied in more creative ways to a wider range of disciplines than is currently appreciated. I build from the work of Andrews, Hull, and Donahue (2009), who provide a helpful condensation of four instructional methods instructors might use to incorporate stories into his or her teaching (Table 1). These methods include case-, narrative-, scenario-, and problem-based instruction, and each highlights a way that students might interact with a story. For example, in problem-based instruction, the problem inherent in the story is provided to students, but its

**Table 1.** Four broad types of story-based instruction (after Andrews, Hull, and Donahue 2009).

Method	Explanation
Case-based	Stories depict concrete events with a fixed problem and solution. The learner acts as an outside observer whose decisions do not affect the story's outcome.
Narrative-based	Involves a linear depiction of events (not necessarily chronological) with a fixed problem and solution. Learner is situated within the story and has control of information.
Scenario-based	Stories involve an interactive experience with a variety of solutions. Solutions have fixed criteria or objectives, but are not themselves fixed. The learner is situated within the story.
Problem-based	The story has a poorly structured problem with no pre-formed solution criteria or parameters. The learner is positioned as director of learning activities.

solution is not defined in advance. Students interact with the problem to gain a better understanding of the issues and problem described. In what Andrews, Hull, and Donahue term “narrative-based instruction,” the problem and solution in the story are pre-determined, and the student is placed within the context of the story and given control of information. The goal with narrative-based instruction is to entertain students and engage them emotionally. While these methods are very insightful, it is not immediately intuitive how an instructor might translate them into practical use. Therefore, here I wish to extend the work of Andrews, Hull, and Donahue (2009) and offer a variety of practical methods by which instructors might incorporate stories into his or her teaching. While it can be very effective to have students be the storytellers (e.g.’s, Mokhtar, Kamarulzaman, and Halim 2012; Pio and Haigh 2007), my primary focus will be on the instructor as the storyteller. In addition to offering a variety of practical methods, I will also offer possible objectives for using stories and highlight benefits and potential challenges. Ultimately, I hope that educators will consider a broader view of stories and be more creative and purposeful in their use.

### How to use stories: It’s not just, “once upon a time ...”

Stories are everywhere. They can come from history, current events, personal experience, research, classic literature, folklore, popular media, fiction, or even from a colleague. Similarly, there are many ways that stories might be used in the classroom, from sharing a simple anecdote to using a story or stories to frame an entire course (Table 2). One of the more broadly effective ways to use stories is to focus on and accentuate the key elements of good stories and effective storytelling (Table 2; McDonald 2009). A good story is one that makes an emotional connection. Learning is enhanced when students are emotionally engaged (Immordino-Yang and Damasio 2007). An instructor might nurture emotional investment by using students’ personal experiences to guide the objective and choice of story. For example, an instructor might assign a brief, anonymous writing reflection at the beginning of the course and then emphasize common themes from those reflections as the course progresses. I have used this method in my evolution course. On the first day of class, I have surveyed students’ experiences with evolutionary theory and have become aware of several students who were anxious to learn about this topic. On those occasions, I would then intentionally share with the entire class stories of past

**Table 2.** Practical methods for teaching with stories.

Method	Explanation
Focus on a story's basic elements and incorporate storytelling principles	Intentionally incorporate elements of a good story, which is authentic, personal, and entertaining. Stories are emotional, with good and/or bad characters that experience conflict, mystery, suspense, and surprise. (Example: McDonald 2009)
Case studies	Case studies are specific instances with a fixed resolution that are used to demonstrate principles or concepts. Widely used in law, business, and medicine, many are also available for the sciences through The University of Buffalo collection ( <a href="http://sciences.lib.buffalo.edu/cs/">http://sciences.lib.buffalo.edu/cs/</a> ).
Incorporate an historical element	Share historical developments in a particular field or biographical information of an important figure. Deliberately incorporate drama and personal elements. For example, by focusing on personality quirks, surprising results, struggles or competitive interactions between persons or factions. (Example: Wills 1992)
Anecdotal interludes	Share brief stories of current events, recent research, or your own experiences as they relate to course content. Focus on discussing these as a story, with characters trying to achieve a goal and any struggles or drama associated with their pursuit. (Example: Kitson 2005)
Use stories as links between broadly-related concepts	Find a study system or body of research that can convey multiple concepts, providing a 'story,' or a common thread of understanding. (Example: White et al. 2013)
Use a story or stories as the framework for a course	Create a course entirely out of stories, use a companion text, or treat a course as a semester-long "story" in which lecture topics focus on "characters" and "events" of that story. (Example: Wills 1992)

students who had overcome similar discomfort. My objective was to reduce their anxiety and provide a greater opportunity to learn. Abrahamson (1998) also stresses this point when he suggests that getting to know students personally is a crucial ingredient for instructors to use stories effectively.

Another way to affect an emotional connection and to enhance the utility of a story is to focus on its most basic elements. This might be done by focusing on one or a few key characters, highlighting their personal qualities

and quirks, clarifying or accentuating the drama or conflict the characters experience, and/or incorporating mystery or suspense. A key character might be a historical figure, important researcher, an individual from a case study or current news, or simply a personified or hypothetical character. Their story can be used as a link to teaching a particular concept, as I do with my letters from fictional insect authors. Characters and their struggles need not be real. Our brains can simulate events without us experiencing them directly, yet we still feel emotionally connected to those simulated experiences (Gottschall 2012; Mar and Oatley 2008). Purposeful use of drama, conflict, mystery, suspense, or surprise can also tap into this predisposition by providing students the opportunity to fill in gaps, thereby connecting them to the material. To enhance mystery, add suspense, or build surprise into a story, instructors might purposely withhold information, foreshadow dramatic events, or highlight challenges and complications. Lordly (2007) expresses the key elements of story in a slightly different way, stressing that a story's utility is maximized by including: (1) a contextual introduction; (2) a challenge, or some form of dissonance; and (3) a climax, or final lesson. For the more adventurous instructor, good storytelling might also include the use of dramatic voice or theatrics. I still remember vividly one of my undergraduate ecology instructors who calmly explained the complexities of thermoregulation while on all fours on a lecture table. He was acting out the struggles of how a particular lizard species tries to stay warm by orienting broad-side toward the sun. I also knew an instructor who would occasionally teach her lecture dressed up either as a literal character relevant to the current topic or dress to represent a concept metaphorically. For example, once, she dressed as a queen on the day she explained the complex topic of the Red Queen Hypothesis in evolutionary biology, named after the character in Lewis Carroll's *Through the Looking-Glass*. Finally, as with any good story, a clear objective helps to ensure its success in facilitating learning, even if an instructor just shares what happened on his or her drive to campus. In that case, the instructor is the character who perhaps experienced an interesting dilemma, and the objective might be to create a more relaxed learning environment, show a more personable side, or to get students engaged.

Another method for incorporating stories involves the use of case studies, or "stories that teach" (Table 2). These are one of the more common ways an instructor can incorporate stories into their teaching (Andrews, Hull, and Donahue 2009). Case studies have been used for many years in medicine, business, law, and more recently in STEM-related disciplines (Herreid 1994; Lynn 1999). A good case study directly follows the

general formula of a character, dilemma-, and resolution-driven story. Cases tell a relevant story, create empathy with characters, and incorporate drama through issues that must be resolved. The story elements may be real or fictional, the cases detail a problem or issue with which the students interact, and students think critically to a fixed resolution. Case studies are one of the more concentrated and deliberate examples of intertwining story and pedagogy.

One of the easier ways to add story to a classroom is to incorporate an historical element to a subject (Table 2). An instructor might discuss a famous experiment, biographic information of an important historical figure, or a significant cultural or sociopolitical event (Morcos and Soldan 1998; Wills 1992). However, to be maximally effective, instructors should again focus on the key elements of story. If discussing an important event, focus the story around a key character or a single issue, and highlight personal and emotional elements. In teaching a history course, Wills (1992) found that after teaching several important concepts his students would only remember a particular story he shared. So he created an entire history course composed of the personal stories of historical figures and their struggles. Or if an anthropology instructor wanted to explore the role of violence in primitive societies, the Yanomami tribe in the Amazon might provide insightful subjects. But rather than focus on the tribe in a broad sense, a more effective use of story would suggest the instructor focus on a particular individual, such as a male struggling to gain experience and climb the sociopolitical hierarchy. Again, this individual need not be real for the story to be effective. Another example: a genetics or ethics class might use as a backdrop the gripping story of Henrietta Lacks, a woman who unknowingly became the source of an “immortal” cell line widely used today in medical research (Skloot 2010).

Historical elements can make powerful, personal connections. Recently, I started one of my introductory biology classes by showing my students an image of a handwritten letter. I then shared that this single, handwritten letter had recently sold at an auction for six million dollars! With that deliberate incorporation of shock and surprise, I had my students hooked. The letter was written by Francis Crick to his 12-year old son, Michael. Along with James Watson, Crick published a 1953 paper describing the structure of deoxyribonucleic acid, or DNA, and how it could encode the information for life (Watson and Crick 1953). Crick wrote the letter one month before he and Watson would publish their discovery and share it with the rest of the world. They would later go on to win the Nobel Prize in 1962 with Maurice Wilkins. In class, we read the entire seven-page

letter. In it, Crick writes with obvious excitement and beautiful sincerity. He encourages Michael to read the letter carefully. He shares excitement over the beautiful three-dimensional model he and Watson had built. Some of Crick’s statements are so profound yet innocent: “In other words, we think we have found the basic copying mechanism by which life came from life. . . . You can understand that we are very excited.” Crick signs the letter, “Lots of love, Daddy.” Rarely have I seen my students so focused and enthralled, or heard so many unsolicited “ooohs” and “wows.” As we discussed each new layer of complexity of the DNA molecule during the lecture, I related our discussion back to Crick’s handwritten letter and even to some of the simple, hand-drawn figures Crick included in his letter. By connecting a lesson on DNA to a fascinating personal story, students were more connected to the actual facts and concepts I wanted them to learn.

Similar to sharing a historical element, an instructor might share a brief anecdote (Table 2). Here I consider an anecdote to be an abbreviated story, a brief, often humorous or dramatic depiction of a character and / or an event or events. Due to its relative brevity, an anecdote may not fully emphasize all the events or the resolution of a fuller story, but it may still incorporate other basic elements, such as a character experiencing a struggle or conflict. Many instructors have likely shared anecdotes or stories of their own work. The key is to be more purposeful in their use: consider objective and assess their effectiveness. Students always respond favorably when I share anecdotes in my own classes. As a field researcher in biology, I might share an anecdote of a wild animal encounter or the extreme labor involved in acquiring the most basic data, only to answer a fairly simple research question. As the character involved I am well positioned to emphasize any drama, conflict, emotions, humor, or struggles. And my anecdotes always have an objective. For example, I might share a humorous anecdote on my struggles dealing with massive clouds of biting insects in the sub-arctic. I might pair this with our study of the importance of massive insect emergences as food supplies for arctic bird populations. Or if I was afforded the opportunity to meet or work with a researcher whose work we encounter in class or in the text, I might share an anecdote of my interactions, or the researcher’s quirky personality. Other ways to incorporate anecdote is to discuss current events or new research. However, as with incorporating an historical element, I recommend focusing on the key elements of story. Focus on a central character and/or issue, and/or accentuate any elements of surprise or mystery. Kitson (2005) even suggests that anecdotes need not relate to course material. They merely serve to engage students

and provide a human element for them to associate the day's material. He argues that such "interest interludes" add relevancy and increase the interest level for his students, particularly in non-majors and introductory courses.

When construed more broadly stories can also be used to link broadly-related concepts (Table 2). When teaching a particular concept, many of us likely share an illustrative example, perhaps from the textbook or an example from the primary literature. For example, if discussing how genes are important in the evolutionary process I might discuss research on the pocket mouse. If discussing a related concept, such as the role of ecology, I might then use an entirely different example, maybe research on Anolis lizards. What if we could use a single example, or "research story," that could highlight multiple concepts? White, Smith, and Heidemann (2013) discuss a novel approach to teaching evolutionary theory by using complete evolutionary "stories" that use the same research system. To best understand evolutionary theory, students must mentally incorporate concepts spanning various levels of biological understanding (e.g., molecular, cellular, organismal, and population-level). When White, Smith, and Heidemann (2013) used research from the same study system, such as the pocket mouse, to illustrate concepts from all these levels, students demonstrated a stronger understanding of the underlying concepts. In essence the researchers used the complete "story" of research on a single "character" (e.g., the pocket mouse) to help connect a variety of difficult concepts. This idea can apply to any course in which an instructor uses separate illustrative examples to highlight different concepts and for which there exists a single example that could span multiple concepts. One need only fashion this into a "story." How many concepts might be linked in a computer science course by focusing on the success and struggles of the founders of Microsoft, or Apple? Or consider a long-term study, such as the Child Development Project, currently a 27-year collaborative study between faculty at Auburn, Indiana and Duke (Dodge et al. 2016). Researchers have followed 585 children since the year before they entered kindergarten and published numerous papers on a vast range of topics. A psychology, sociology, or child development instructor might use these data to link such concepts as bullying, adolescent identity, parenting behavior, and more, perhaps even focusing on a single individual, even if he/she is hypothetical. Stories, when broadly construed, can serve as a link to otherwise disparate concepts.

Finally, stories may be used as a framework for an entire course (Table 2). This may be done in a variety of ways. I described in the introduction how I use fictional

letters from insects for my entomology course. Another example comes from my Biodiversity course. Biodiversity is an introductory, majors-level biology course where we survey the diversity of living organisms on Earth, from bacteria and fungi, to plants and animals. I frame the entire course as a broad "story"—a history of the diversity of life on Earth—and this story is filled with the most amazing characters and their struggles. The characters are representative organisms that we will be studying, and some are absolutely fascinating: animals without a head (i.e., sponges), plants that live thousands of years (i.e., bristlecone pines), or animals that can liquefy their bodies (i.e., sea cucumbers). We study the struggles these various organismal groups had to overcome in their evolutionary history, be it breathing oxygen, supporting their bodies on land, reproducing, or coexisting with friend and foe. Throughout the semester, we even guide our study with repeated reference to an evolutionary tree that shows broad relationships among the various organisms, the way someone might reference a family tree to study Tolstoy's *War and Peace*.

A story-like framework spanning an entire course could also work well in several other courses. It would work particularly well in a history course, as already noted by the work of Wills (1992). An economics course might follow the rise and fall of a tycoon. Or courses might incorporate companion texts that are framed as a story or series of stories. An anthropology class might incorporate one of Malinowski's classics (e.g., Malinowski 1922), a philosophy or political science course might use Plato's *Republic* (Bloom 1968), while a religious studies course might incorporate Marsh's stories related to the civil rights movement (Marsh 1997). A story-like framework could also work well in a wide range of science courses, such as any that focus on a particular group of organisms (e.g., microbiology, plant biology, entomology, ornithology, mammalogy, vertebrate biology, etcetera). These courses might use the evolutionary history of their taxonomic group as the broad "story." Or an ecology class might incorporate into their assignments a reading that focuses on the changes over time of a single location, like Thoreau's *Walden Pond* (Thoreau 1854) or Dillard's *Tinker Creek* (Dillard 1974). The focus on seasonal changes at a single location broadly represents a story on its own, but an instructor could also personify the organisms and highlight their struggles.

### Benefits and challenges of using stories in teaching

There are costs and benefits any time an instructor modifies a course or adopts a new teaching method. Incorporating stories into your teaching is no exception.

**Table 3.** Possible learning objectives for using stories to teach.

Learning Objectives
<ul style="list-style-type: none"> <li>• Entertain or capture student attention</li> <li>• Engage students using elements of surprise or awe</li> <li>• Personalize instructor, enhance classroom atmosphere, and/or reduce stress and anxiety</li> <li>• Personalize content and facilitate understanding</li> <li>• Associate a concept or theme to a memorable story</li> <li>• Facilitate problem-solving</li> <li>• Provide vocational or professional training</li> <li>• Communicate facts in a more accessible way</li> <li>• Connect a broad range of concepts</li> <li>• Represent exceptional, underrepresented, or unique perspectives</li> <li>• Present a problem or dilemma (e.g., ethical, moral, personal, cultural)</li> </ul>

Challenges vary depending on the story used, how it is used, and its relationship to course content. First, to ensure a story has pedagogical utility, it should have a clear objective, of which there could be many (Table 3). Is it meant to entertain, connect to a broader trend or concept, create an engaging element of surprise, or provide a problem-solving opportunity? Failing to consider a story's objective does not rule out a story being beneficial, but it likely increases the risk it is ineffective. Students may become disengaged and perceive the story as being an invaluable use of time. Similarly, what if a chosen story has an objective but is just plain boring? As with a story that is poorly linked to its objective, the potential problem is that the stories might seem irrelevant and disconnected from the course material. As a consequence, students can become disengaged and lose the ability to make meaningful connections to the material. Here communication with students and assessment of the efficacy of the story becomes important. Considering a story's objective also does not rule out the possibility that it meets additional objectives, or even has unanticipated benefits. For example, an instructor might share a story that illustrates how to solve a problem (primary objective), yet in that story, students might also see a character in conflict (secondary objective) and an instructor with a sense of humor (unintended benefit).

Of the many objectives that stories can have, they can be useful in presenting a problem or dilemma, be it ethical, moral, personal, or cultural. Often this is a benefit, as it allows us to identify and empathize with heroic characters and identify with their strengths and failings. But what if the character is one with whom we do not want our students to empathize? Given our inherent tendency to see a story through a character's perspective, instructors should be aware that stories can create sympathy and empathy with amoral/immoral characters. In these instances it may be useful to provide ample opportunity for discussion and critique.

Another potential concern with story choice occurs when the story's objective is to demonstrate a broader trend or concept. Suppose an economics instructor uses a story about an immigrant worker to discuss concepts on American capitalism, or a physiology instructor chooses a story about an elderly woman to discuss the physiology of osteoporosis. Effectively, these stories represent a single data point, but they are being used to represent broader, more complicated concepts. In such situations, there is a risk of "story bias." Story bias implies that a single story may be unrepresentative of broader trends, relationships, concepts, or populations the story is meant to represent. While not a problem in itself, story bias could be problematic in professional training (Alderson and Bateman 2002). For example, if an instructor uses a story to represent common practitioner behavior but then shares a story that depicts unusual or exceptional practice, trainees might be misled or confused. This concern can be offset by explaining to students the broader trends or relationships and urging caution in drawing conclusions from a single anecdote or story. Generally speaking, it is useful to stress caution in drawing conclusions regardless of whether story bias is a concern. Students are likely to derive conclusions or make inferences from any story. Boyd (2009) discusses how our brains are so predisposed toward interpreting stories that we do not patiently wait for additional information before drawing conclusions. Rather, we derive conclusions and inferences from incomplete information. If these conclusions and inferences are incorrect, they could conflict with the instructor's true intent of the story. One way to ameliorate this potential issue is to leave time for follow-up discussion and analysis, asking students to articulate the issues raised by a story. Hopefully, the instructor can then immediately correct any potential misconceptions.

Finally, one inevitable cost with using stories in the classroom is that an instructor will have to part with one of their most precious and limited commodities: their time. While the methods I have suggested differ in the time required for their use, some time investment in and out of class is necessary, just as it is with any course modification or adoption of a new teaching method. Some might argue that time spent on a story during class is time that could be better spent on more factual content or teaching students how to think more critically. Lordly (2007) and Kitson (2005) mention how others have raised such concerns. But this is a false dichotomy, because there is no inherent tradeoff between the effectiveness of time spent on a story and time spent on content; stories can be useful to convey factual content (Alderson and Bateman 2002), and they certainly facilitate learning. Furthermore, many of the challenges that

come from using stories can be avoided or mitigated with ongoing assessment.

For any assessment to be effective, it must align with the story's objective (Table 3). If the objective is simple, such as to entertain or personalize the instructor, assessment might come in the form of a simple, Likert-style survey of student opinion. If the goal is to represent a unique perspective, assessment might come from assigning a brief reflective essay. Or if the objective is to facilitate problem-solving, the instructor might give students the opportunity to apply their skills to a novel problem. In my own classes I have used stories as links to certain concepts and themes. I assessed this link at the end of the semester by giving students a list of character names and their predicaments, and asked them to recall the concept or theme to which it was linked. In addition to assessment, challenges are ameliorated further by a suite of benefits.

The most immediate benefit of using stories in the classroom comes from the fact that, as discussed in the introduction, we are predisposed to remember stories rather than facts, concepts, relationships and theories. When we use stories to teach, we are shaping our teaching methods to work with our cognitive predispositions rather than attempting the opposite. Stories are concrete and specific rather than a generalization or an abstraction. Therefore, tying stories to what we really want students to learn can facilitate learning. For example, Kelemen et al. (2014) describe how they used a picture storybook of a fictional character to successfully teach young children challenging concepts on evolutionary theory. Or recall how Wills (1992) was stimulated to create a history course based entirely on personal stories after discovering how students always remembered them, instead of the facts and concepts he was trying to teach. We all interpret our experiences as stories. Stories are part of our evolutionary history and define who we are (Boyd 2009; Gottschall 2012). As Gottschall (2012) aptly stated, "our mind was shaped *for* story, so it could be shaped *by* story." Stories are inherently engaging, particularly when the elements of surprise, confusion, mystery, or shock are accentuated. For this reason, they can be beneficial in recapturing lost attention. They can interrupt a student's usual way of thinking and provide an opportunity for them to assimilate new knowledge (Abrahamson 1998). The shock or surprise initiates an unconscious search for new associations, new ideas, or a new framework.

Good stories are also inherently personal, emotional, and social enterprises. From detecting agency to stimulating our mirror neurons, we identify with the characters in a good story. Recall my example of Francis Crick's letter to his 12-year-old son. We also identify with the storyteller. Recall how the brains of storyteller

and listener can become synchronized (Stephens, Silbert, and Hasson 2010). In this way, stories can help to humanize the instructor and make him or her more approachable (Lordly 2007). The emotional element is intimately tied to our ability to reason (Immordino-Yang and Damasio 2007). As a social experience, stories can also enhance classroom interactions, create a sense of community, improve discussion, and nurture respect among students and educators (Clark and Rossiter 2008; Pio and Haigh 2007). The engaging, personal nature of story further makes their message more relevant and accessible, whether you are sharing a case study or recent news (Alderson and Bateman 2002; Kitson 2005).

Finally, as mentioned in the introduction, storytelling can be useful with particular learners and settings. The widespread use of stories in professional training highlights how they can link theory and practice, highlight how professionals act in a certain field, or highlight rare or atypical cases. They might also be particularly useful for adult learners (Clark and Rossiter 2008). As highlighted by Abrahamson (1998), stories are more effective when they are tied into the personal experiences of learners. Adults likely have a greater depth and breadth of experience from which they can draw. Stories can also be particularly useful in non-major or introductory classes, where there exists less pressure to cover a more extensive and fundamental range of material in sufficient depth.

## Conclusion

Stories have been part of our history at least since archaic humans rubbed pigments on rocks and cave walls. As social creatures, our brains have evolved to interpret our experiences using stories as a framework. If this is how we all interpret our experiences of the world around us, then a more intentional use of stories should bring obvious benefits. Stories are inherently emotional, social experiences. They can add relevance to what we teach, connect teacher and learner, and can provide practical benefits to a wide range of learners. Using stories can provide a stark contrast to a weakness likely all of us have experienced: delivering content devoid of context. When we do little more than deliver content, it is as though we are providing students pieces of a puzzle that we expect them to assemble into a coherent whole after leaving the classroom. Stories facilitate each student's ability to connect pieces before they leave, and to keep those pieces connected thereafter (Abrahamson 1998).

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