

# The Narrative Imperative: Creating a Storytelling Culture in the Classroom

Glenda A. Gunter, Robert F. Kenny, and Samantha Junkin

**Abstract** One who studies the history of learning recognizes that story is the one of the oldest and most elemental forms of knowing. Story and storytelling precede the art of writing, with the earliest forms of story consisting of the combination oral speech, gestures, and facial expressions. For thousands of years, storying has "... evolutionarily rewired the human brain to be predisposed to think in terms of story and to use story structure to create meaning and to make sense of events and other's actions" (Haven K (2007) *Story proof: The science behind the startling power of story*. Greenwood Publishing, Westport, p.27). Unfortunately, the use of story as a knowledge acquisition tool has declined significantly in many Western cultures during what had become known as the "modern period" and has given rise to a shifting away from story and replacing it with a focus on scientific inquiry Boa-Ventura et al. (2012). Many attribute this transformation to Gutenberg's printing press when story (especially oral story) as a way of becoming "learned" was perceived to be inferior or backward and a primitive form of entertainment fit only for children, the illiterate, and the uneducated (Bradt KM (1997) *Story as a way of knowing*. Sheed & Ward, Kansas City; Ong W (1982) *Orality and literacy: the technologizing of the word*. Methuen, London).

Initiated, perhaps, by early successes in psychotherapy and aided by the advent of digital media technologies, we seem to be entering a postmodern era in which story has begun to re-elevate itself from an art form into an emerging change agent that can transform imagination into action (Coles, 1989). Story is enjoying a modest revival with educators because it relates well to constructivist ideas about teaching and learning. Educators who are somewhat reluctant to change are beginning to understand that story is a valid way of knowing things – a "narrative epistemology" as Bradt (*Story as a way of knowing*. Sheed & Ward, Kansas City, 1997, p. xi)

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referred to it. Many educators correlate story constructs to Bruner's ideas about situated cognition, where embedding context in situational (i.e., story) environments helps learners retain and understand information for longer periods of time and with deeper meaning (Bruner, 1990). Situating what is to be learned in terms of story helps learners select, arrange, and organize things in manageable chunks Riessman (1993). Because story requires one to suspend his or her beliefs in order to buy into a premise, a learner is already conditioned to accept change – a necessary precondition to learning. As suggested by some, evaluating story as a valid learning engine is much more complex than simply situating content (Haven K (2007) *Story proof: The science behind the startling power of story*. Greenwood Publishing, Westport).

**Keywords** Story and cognition • Digital narrative • Story culture • Integrating Integrating story into STEM

## Environmental Scan

One who studies the history of learning recognizes that story is the one of the oldest and most elemental forms of knowing. Story and storytelling precede the art of writing, with the earliest forms of story consisting of the combination oral speech, gestures, and facial expressions. For thousands of years storying has "...evolutionarily rewired the human brain to be predisposed to think in terms of story and to use story structure to create meaning and to make sense of events and other's actions" (Haven, 2007, p.27). Unfortunately, the use of story as a knowledge acquisition tool has declined significantly in many Western cultures during what had become known as the "modern period" and has given rise to a shifting away from story and replacing it with a focus on scientific inquiry. Many attribute this transformation to Gutenberg's printing press when story (especially oral story) as a way of becoming "learned" was perceived to be inferior or backward and a primitive form of entertainment fit only for children, the illiterate, and the uneducated (Bradt, 1997; Ong, 1982).

Initiated, perhaps, by early successes in psychotherapy and aided by the advent of digital media technologies McLuhan (1965). we seem to be entering a postmodern era in which story has begun to re-elevate itself from an art form into an emerging change agent that can transform imagination into action (Coles, 1989). Story is enjoying a modest revival with educators because it relates well to constructivist ideas about teaching and learning Clandinin & Connelly (2000). Educators who are somewhat reluctant to change are beginning to understand that story is a valid way of knowing things – a "narrative epistemology" as Bradt (1997, p. xi) referred to it. Many educators correlate story constructs to Bruner's ideas about situated cognition, where embedding content in situational (i.e., story) environments helps learners retain and understand information for longer periods of time and with deeper meaning (Bruner, 1990). Situating what is to be learned in terms of story helps learners select, arrange, and organize things in manageable chunks. Because story

requires one to suspend his or her beliefs in order to buy into a premise, a learner is already conditioned to accept change – a necessary precondition to learning. As suggested by some, evaluating story as a valid learning engine is much more complex than simply situating content (Haven, 2007).

## Introduction: What a Story Is

There exists a standardized testing description of a story – a character; a plot; a scene; a conflict; a beginning, middle, and end; a “rising action”; and a resolution ([corestandards.org](http://corestandards.org)). This description helps make students better consumers of stories but is nowhere near an operational one that enables students to learn how to tell/create or learn from. The descriptive definition makes a story a thing. In order to get the reader to buy into our premise that integrating story/narrative into the curriculum is a valid exercise, we suggest that one agrees with the idea that a story is not a “thing” but a process – a way of thinking, internalizing, and eventually learning. The concepts of story and literature are equivalent, but are not the same and are often confused. Certainly, literature is mostly made up of stories. Conversely, stories can (and do) exist outside of literature. For example, one can tell his or her personal story. A story is often the backdrop for effective history lessons and can even be related in small bits and pieces using as little as 144 characters as has been shown repeatedly on frameworks such as Twitter.

In short, one cannot avoid talking about how the various forms of media have influenced what a story is, considering the fact that story should not be thought about in terms of it being a *thing* but a *process of thinking*, communicating, and learning. If one agrees with the premise that story equals learning, then it follows that the media that one uses to communicate a story plays a significant role in and affects that process. Various forms of storytelling (we use this term in order not to confuse its method of delivery from story constructs in their purest form) are presented in order to better make the case for one’s buying into the premise that story is a process and is infused in many aspects of one’s life and is utilized as a learning tool to teach and contextualize – from Aesop’s Fables to the Bible. This is why it is so unfortunate that fiction and literature have been downplayed and confused in many of the implementations of Common Core State Standards in the United States.

We suggest strongly that people have a deep-rooted intuitive sense for story and that story is a contextualizer and a learning engine. In this chapter we intend to demonstrate how story is useful in many disciplines, including those that might not seem as obvious, namely, math, engineering, and science, among others.

## Story Generation

Most students have learned the basic descriptive elements of a story. While these help describe what it has in it (again using the “story is a thing” analogy), they are not prescriptive in that they do not demonstrate how a story is actually generated. First, there is the basic character, plot/themes, and setting (background scenery) triad that is often taught in schools Tobias (2012). They need no further explanation except to say that often what is not taught about these is that there are standard constructs for each.

## Story Elements

Perhaps a more precise argument for using story as a learning tool revolves around the foundational enablers that push story from being a thing into it being a framework that can be applied to teaching and learning. Branigan (1992) explored the basic concepts of narrative theory and its relation to film and in conjunction with literary analysis. He brought together theories from linguistics and cognitive science and applies them to the screen *to describe the story invention process*. According to Branigan story invention boils down to *four basic elements*:

1. *Time and place* – As noted previously, all lists of essential story elements almost always describe a setting or background in which in the story takes place. This is the means by which the author organizes temporal and spatial data. The main character’s life appears to be moving along, and his or her background is explained. Time must always pass. In short films and narratives, only those moments that create the crucial “test” or pose the essential conflict to the main character are shown so that the storyline/through line does not become overly complicated and confusing. In a classical story, the “disruption” occurs in the second act, but sometimes it occurs immediately, and the scenarios/backgrounds are described through a series of flashbacks. This is known as the Goddard effect (Wakeman, 1988).
2. *Cause and effect* – This is that important moment in which the disruption occurs. This aspect sets the plot. The central character usually faces a decision, whether to succumb to the conflict or to fight. In other words, a conflict is not a conflict unless the character notices it and makes some type of *judgment* about it. Most often, this conflict/challenge cannot be overcome unless the character goes through a transformation or change and that requirement may also compel the character to go against his or her natural inclinations or morals. In storytelling parlance this is often referred to as the disruption. Recall that moment in the song by John Lennon (*Beautiful Boy*) that describes life as that which happens while you are making other plans.

This is the key difference between introducing the elements of story in the abstract and teaching students how to actually construct/create/invent stories.

According to Laycoff (1996) every language in the world has a way in its grammar to express direct causation – a local application of force that has a local effect in place and time. For example, when one drinks a glass of water, the direct causation of it being gone is that you did it. Direct causation is also that element that provides the teachable moment. Once students understand this concept, they begin to learn the importance of critically reading/viewing/listening for causation, which helps transcend story into any genre, whether fiction or nonfiction and making it a useful element in multiple disciplines.

Indirect causation is less discernable and implies a higher thinking skill. Discovering causation on either level can be intimidating and makes comprehension more difficult if there is more than two or three being implied in a storyline. Causation is a significant element that needs to be embedded in the story in conjunction with two additional constructs that will provide a means to effectively measure the relative teaching efficacy of a story.

3. A central character is the one who notices the cause/disruption and is the one required to make some *judgment* (to create the reaction or “effect”). To borrow a term from the video game industry to describe how developers program their characters, each “allowable action” is limited to the main character’s personality strengths/flaws, which makes central conflict and serves to limit (or expand upon) the amount of transformation that needs to take place. A story is not a story without developing a confrontation between life and the main character’s limitations/strengths. In order for a story to teach judgments about the cause and effect correlations and their impact on a known circumstance and/or a main character type needs to be clearly demonstrated because it is what makes a story outcome more or less predictable. Predictability is key to a story becoming a teaching engine.
4. Because all stories need both a teller and a listener, storytellers need to decide on how they are going to *communicate the story*. This is crucial and leads to the *credibility* of the story and demonstrates how it is possible to know these events and acts in a supporting role in the audience suspending its disbelief (Laurel, 1993).

## ***Establishing Significance***

Mandler (1984) describes schema theory as a system of thinking about something in terms of organized patterns that group information into related categories so it can be analyzed. Schemata can also be described as preconceived ideas as demonstrated through organized pattern recognition. The mental structure surrounding one’s preconceived ideas is what creates a framework that represents some aspect of the world and a means to perceive it, collect it, and finally organize it as new information. Story schema adds a bonus of also influencing attention to motivate the learner to transform that information into knowledge. Jean Mandler (1984) supports

this notion of knowledge acquisition through an analysis of story schema using three prescriptive, semantic elements.

- A *proposition* refers to Kintsch's schema analysis – a method that involves breaking down a text/narrative into its most basic elements to make meaning (the so-called predicate-argument schema (Kintsch & Keenan, 1973); Kintsch & van Dijk, 1978). In semantic linguistics this suggests that an argument is more likely to be retained if the outcome is predictable. It is the framework by which Branigan's (1992) judgment occurs. The character predicts what he or she must do in response to the conflict or disruption based on his or her personality (i.e., "allowable actions" in gameplay parlance). Given that the main character is able to overcome his or her shortcomings/emotions, etc., the outcome is predicated on a personal prediction as to the best possible actions. A tragedy occurs when that character is unable to overcome his or her weaknesses or circumstances.
- A *causal chain analysis* like that described by Branigan is a predictable outcome that is based on the principles/elements of nature or circumstances. In the classroom, this principle directly relates to the academic principles that are being taught for the scientific disciplines, or an ethical argument, and is what helps to map immediate recall. In a story this is often referred to as the "moral." While there are often unintended, random consequences, these, too, can become "teachable moments." In many disciplines casual chain analysis correlates to critical thinking or to brainstorming.
- A *story constituent* is the part of the construct Mandler refers to as "story grammar" that connects causality through context and provides long(er)-term recall because it is the tool that provides the reader/audience the ability to filter out nonessential "sentences" scenes (i.e., to read critically). This also directly relates back to Branigan.

People are more likely to notice things that fit into a schema and reinterpret contradictions to the schema as exceptions (or distorting them to fit), as long as the subject-predicate is strongly correlated as noted by Kintsch and van Dijk (1978), making the ending of the story or the results of the through line believable or credible, as noted by Branigan (1992), and helps search for (and create) meaning even when the subject-predicate is not initially obvious. Credibility and predictability are at the core of the so-called teachable moments and endings presented in a story, even those epic finishes where outcomes may not fit what was predicted to happen.

Schemata can help in understanding the world even in rapidly changing environments. People can often organize new perceptions into schemata if those situations do not require too complex of a thought process. Even the more complex situations can be quickly internalized when using schema, once thought becomes more automatic through repetition, as is demonstrated in the redundancy that often accompanies children's stories and fables. Examples of schemata include academic rubrics, social schemas, stereotypes, social roles, scripts, worldviews, and archetypes (which explain their use in film school). In story the standard (i.e., archetypical) constructs

of plot, character, genre, adding causal chain analysis, and tight propositional analysis are the building blocks of story as a teaching engine.

To take this further, Mandler's (1984) combining Kintsch & Keenan (1973) and Kintsch & van Dijk (1978) semantic analysis and Branigan's (1992) and merged with Ifenthaler's later ideas about cognition (2011) story components appears to suggest that if the above three elements "...could be amalgamated into a comprehensive system, it should provide a [learning] theory of great predictive power" (p. 73). In short, we are suggesting that a well-thought-out curriculum based on these three story creation elements has unlimited potential in the classroom.

Unless a story contains the elements as described above, it may fall into a story category but not necessarily one of educational value. The truth is that not all stories are created equal nor are they all good stories. Most have some of the necessary elements but not all. We intend to build these elements into a story validation index that classroom instructor can utilize to assess the educative value of a story. In other words, we are moving from describing a story to quantifying their efficacy as a teaching medium using finite terms.

## Character Development and Transformation

A significant part of creating a properly conceived learning environment is motivating the learner. While some stories are intrinsically motivating (such as personal stories about "self"), we recognize that even properly formatted stories are not universally inspiring. A significant element in drawing in listener/viewer/reader into story is to create empathy for its main character(s). This important aspect makes a story more credible. There are certain criteria used to develop a character's profile that need to be present to create this sense of self-identification. These are referred to as the transformational aspects of the character's development. This same function is directly related to a storyteller making the story's cause and effect element come alive and become believable to enhance the listener/viewer/reader's ability to suspend his or her disbelief (Laurel, 1993).

Through the use of a non-example, the idea of transformation can easily be explained. While the concept of time passing is present (first you do this, then this, etc.), a recipe is not a story because the sequence is not based on cause and effect, nor is there an element of character development. In this respect there is no need for the reader to suspend any disbelief. A recipe is a good example of a catalog. In a story some person or objectification of a person undergoes a measurable change or transformation based on his or her judgment about how to react to a causal event. It is the struggle that the character goes through that is at the core of the story creation. This moment in the story equates to the concept of the "moral of the story" – shorthand for its teachable moment, and an evaluation of the result or consequence of the decision that the character makes. Cause and effect and value judgments can strongly correlate to a classroom experiment in a science, a formula math class, or a historical event in a social studies class. Effective transformations tend not to be



random but planned and need to tie back to the story's through line. The transformation can be overtly stated or implied, based on the storyteller's creative decisions.

As has been shown above, a story can become a powerful tool in the acquisition, transferal, and/or sharing of knowledge, especially when it is tied to short-term and long-term cognition. Jerome Bruner (1990) describes narrative as a non-neutral (i.e., personalized) account of experience that is based on a person's natural desire to communicate meaning. We suggest that Bruner's definition of narrative curriculum is narrower than what we are implying. We ascribe Bruner's approach to being a particular branch of storytelling within a broader construct. Bruner's approach does meet one of the key requirements of Branigan's (1992) tetrad: It places the narrative on a timeline and assumes "an experience of time" (emphasis on "experience") rather than just referring to time in a historical sense. This is the basic difference between cataloging events and narrating them using judgments/analyses about causal chains. Bruner's approach does capture the emotion of the moment, making the event (and the learning of it) active rather than passive, which is an essential element for motivating the learner to acquire knowledge. While Bruner's ideas are certainly tied to narrative storytelling, what appears to be missing are the causal chain (Mandler) analysis and a story's predictive components.

## Science Meets Fiction: Theory into Practice

As stated earlier, there has been a shift away from story in all areas of education but especially in the areas of STEM and those academic areas that are based on scientific inquiry. The question is why? Some correctly understand that STEM is really about focusing on processes, not specific disciplines. Science, math, and engineering are based on finding solutions to problems. Educators are beginning to understand the importance of story as a perfect partner for innovating and building science and math solutions.

Papadimitriou (2003), a distinguished professor and engineer at University of California – Berkley, stated two reasons why using narrative in learning situations is fundamental. First and foremost, "...narrative richness is an essential precondition for the self (i.e., there can be no narration without narrator)." This is because we think of ourselves almost exclusively in terms of our mental autobiography. Second, stories are in a certain intrinsic sense interesting in that they are attractive fodder to stimulate memory. Everything else being equal, we are much more likely to remember a story than a logical argument.

Stories combined with other engaging learning strategies create content that is difficult to forget. We suggest that integrating storying into lessons adds the dimension of design that proponents of STEAM are asking to be included. Narrative becomes the "art" aspect of science and technology teaching. We agree with those who suggest that one reason so many students may be turning away from the STEM is the lack of embedding artistic empathy in the disciplines. Initiatives such as the World Science Festival have renamed events to address this, adding titles such as



“Science & Story: The Art of Communicating Science across All Media.” Some scientists have recognized that science is a story, and intertwining it into STEM provides the motivation for and conceptualization of the need to dig deeper.

## Situated Demonstration Cases

We make our point about story and STEM through a couple of case studies. In both examples we assume that the teacher/instructor has first taught the basic elements of story creation, story schema, and character development. While the specific examples were randomly directed at STEM topics, their construct as problem-based learning cases is representative to any interdisciplinary area.

### Situated Case #1 Embedding a Story into an Engineering Class

The following story is an example of embedding story into an engineering class in which the protagonists are faced with design decisions. The story situates the problems and attempts to create the need. The story and related lesson contain all three elements found in our story index: the story constituent, a causal chain, and a proposition.

The teacher/instructor begins by presenting the class with a backstory to contextualize a series of problem-solving *design challenges*:

In 1931 in the midst of the Great Depression, Roger Wilson headed out west by train with his mom and sisters in search of work. He had been working with his father, Herman, who had recently passed away from a fatal fall off the roof of a house. Like many people, he could not find work as a bricklayer in rural Alabama but was encouraged because he had heard about a new government project that was located on the border of Nevada. The local Blount County newspaper posted an advertisement from the Bureau of Reclamation calling for “practical engineers” to help create one of the largest structures in the world. The Bureau was one of the few agencies that were offering jobs. The local newspaper said that the proposed structure would control the massive floods and retain the water supply for many different areas and use the massive power of water flow to create electricity with water using something called hydroelectric power. Roger was fascinated with this since he had heard that hydroelectric power could create electricity from something called hydropower. He considered himself a “practical engineer.” While he had no formal education in engineering, he did know that if you could control flowing water, you could create waterpower or hydropower. Many criticized the government for this venture stating that, first, it was an impossible task and the entire initiative was not even based on limited formal engineering design but rather on trial and error and, second, because no project of this size and scope had ever been attempted before.

For Roger and his family, this meant food on the table and generally a better life. They made the long trip to Black Canyon on the Colorado River only to encounter many others who had the same idea. To stand out, he quickly learned that he must work hard and demonstrate that he learned something new every day. He was hired on as a mason. As most of the men were not trained engineers, they were forced to learn brand new skills to understand the construction process and to solve what turned out to be thousands of problems almost daily. The Hoover Dam is still considered one of the most comprehensive examples of the practicing trial and error methods for testing out engineering theories and putting them into

practice. No one knew, for example, the best method for diverting water flow, or if concrete could support a structure of this size and scale, or which physical shape for the dam would best suit the need.

The solutions to the myriad of problems presented while building the dam are classic examples of using feedback loops in engineering brainstorming sessions. It also ties directly with state standard and others provided for the engineering industry.

### *Design Challenge #1* [Rationale: Storytelling as a tool for knowledge sharing]

The Colorado River was one of the most powerful water flows – it was massive. One of the first things the practical engineering group had to deal with was how to divert the water flow and use its power.

Students are broken into groups and are asked to decide on the best possible solution to the water diversion problem. Through math and physics algorithms, they predict which solution works best; then using examples they “try out” their solutions. The groups get back together and present their possible alternatives. The class then is able to read the rest of the story that explains what the actual solution was and then note the “deltas” in their solutions as compared to the actual one. In this case the students are able to, through the storyline, correlate the problem and its predicted results.

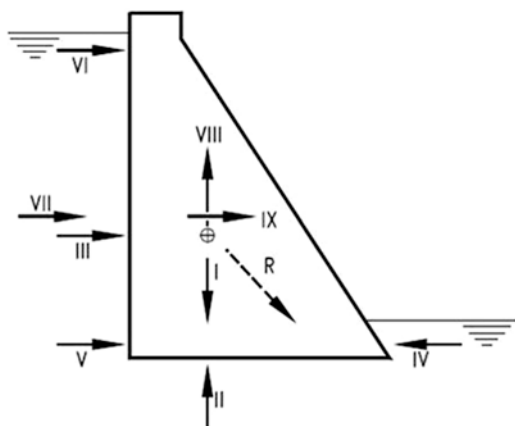
### *Design Challenge #2* [Rationale: Comparing and contrasting]

The story continues...Once the teams of men successful developed strategies and diverted the water flow, there were other issues to overcome and many problems to solve. Among the many other challenges included determining the best physical shape to use in building the dam. Roger and his group brainstormed various alternatives. After much trial and error, they discovered that a shape similar to the trapezoid would work best.

This time the instructor allows the students to see the final result. The storyline helps them “connect the dots.” Their task would be to create an explanation as to why the trapezoid would work best. Knowledge building is hierarchical and is revealed through the resolution of the story. Abstract knowledge derived from within one particular context may be found to explain phenomena in other areas. In this case the students are asked to prove an abstract theory that demonstrated the physical characteristics of physical shapes that have since been proven to work in a specific applied situation which uses evidence-based practices (Smith, 1998).

The teacher/instructor then asks the student to integrate in narrative format using story through lines examples of the impact the hypothetical failures might have on the main character’s situations. In short they would alter the story based on the proposed solutions that did not work. Each student group investigates the characteristics of each shape and consensus is reached. The idea is to provide a continuum of theories that are commensurate with/corresponding to others. When possible, explanation and contexts of the problems should be unified and explanatory frameworks used for the subsequent story-based solutions. It is well known in instructional design that developing knowledge in a horizontal fashion offers opportunities that serve as clues and help to personalize the inquiry Fig. 1.

**Fig. 1** Final design drawing for the dam



The storyline continues, and stopping points are determined with the idea that each challenge is created based on the level of students in the class.

### **Situated Case #2 Mathematics in Action**

The lesson starts with a teacher/instructor who notices that their students are enthusiastic about the Hunger Games books and movies and recognizes the motivational opportunity that this phenomenon presents and decides to integrate the story to teach some abstract math that the students were struggling with. Several mathematical lessons are developed.

The Hunger Games is a series of American adventure novels that have created a complete franchise grossing over \$2.9 billion worldwide through its movies, books, and merchandise. This captivating story is about 12 districts that were a part of the fictional country of Panem – the ruins of what was once North America. Every year the government forced each of its 12 districts to send one teenage boy and girl to compete until only one survivor remained in the Hunger Games: a nationally televised event.

The story follows a teenager named Katniss Everdeen who volunteered to replace her sister, who was chosen for the 74th Hunger Games. Katniss soon finds herself in the arena fighting for her life while becoming entangled in a love story.

Each lesson looks at the games from a different perspective, and the students are asked to use their mathematical skills to answer questions and problems that are posed to help them formulate an opinion. In some cases, the students are asked to rewrite the episodes' endings based on mathematical calculations. Each lesson starts with a brief background about what happened and direct quotes from the book to help set the stage for the mathematical concepts being introduced.

When the students watched the movie, the lessons are presented at certain critical moments. For example, as soon as Katniss gets on the train in the movie, it is paused, and a lesson on distance is introduced. Students use data from the book to plug into a mathematical formula to calculate the answer. The lessons are very straightforward, and the students do not have to think very critically about the problems.

Students are challenged to use their critical thinking skills to find answers to more complex questions, and they are asked to formulate *opinions and inferences* – one of the State Standards for ELA and geometry. For example, while teaching the distance lesson, using quotes from the book, students are asked to figure out how far away from the Capitol the games take place from their own hometown using the variables of rate and time. Once students find the distance, they are asked to determine where on the globe the Capitol of Panem was located if the train hypothetically started out in their home city. Students are asked to research and make calculations to formulate their answers.

Students are then asked to put themselves in Katniss's position and determine whether they would risk running away from the Capitol to get back to her home district (District 12) and to explain their response. Students use their mathematical calculations to decide a risk/reward factor (using percentages) to help Katniss overcome her fear of being caught. Based on their decisions, the students are asked to rewrite the ending of the episode to determine the credibility/predictability of the one actually written by the author.

Each lesson requires students to challenge the propositional conclusions of the story episodes. The propositional elements of a story are the *allowable actions* based on the descriptions of the main character's previous actions and personality. Propositional analyses provide some predictability in terms of argument Kintsch and van Dijk (1978). Instead of using Katniss's character traits, students use mathematics to determine possible outcomes. These comparisons help students critically analyze the literary value of the storyline. More often than not, Katniss's decisions will be the same as the mathematical calculations the students make. In the lesson about slopes, in the book Katniss states:

The ground slopes down. I don't particularly like this. Valleys make me feel trapped. I want to be high, like in the hills around District 12, where I can see my enemies approaching. But I have no choice but to keep going.

At this particular point in the story, Katniss had just begun to participate in the games and was looking for water. She had to constantly be self-aware and try to stay hidden. While working together, students have to calculate what kind of possible slopes Katniss and her enemies (called *tributes* in the story) would scale while she looked for water and the kind her pursuers would use when chasing her.

In essence, this lesson becomes gamified in that the students are asked to make the same decisions as if they were taking on the role of Katniss inside a role playing game. Students are required to assume that Katniss would end up at the bottom of the slope to find water, making her an easy target. Students are provided two different slope problems to determine the angle of the slope, the position of Katniss and that of her pursuers, and whether she would be safe. After graphing various slopes, students begin to recognize that horizontal slopes are the safest when trying to stay hidden. Students are then asked to explain how it is different from what Katniss intended and why their responses were safer. The lesson demonstrates that if Katniss thought out the process mathematically, she could have a better chance at surviving, which would actually change the propositional conclusion of the storyline. All of

these calculations demonstrate mathematically Kintsch and van Dijk's (1978) propositional analysis as well as the predictability of the results that enhance the story's construct as a teaching tool.

The class is then asked to extend the storyline using some hypothetical scenarios. What if Katniss did not pay attention to the slope while searching for water? They are asked to hypothesize what might happen in the story. The students are able to provide various answers like "the other tributes would see her" or "someone could throw something to kill her." Last, they are asked whether at the beginning of the games and Katniss did not have her bow and arrow to protect her and if another tribute saw her, how would she defend herself and what are her chances of living?

Again based on Mandler's story constituents, students are able to observe how this hypothetical scenario might change the outcome of the book. Using these scenarios students are changing the story schema – the mental structures consisting of sets of expectations about the way in which the story proceeds. The story schema enables the reader to form a coherent representation of the storyline. The story they create is in concert with Mandler's principles. Through mathematical equations the students learn probability and predictability and adjust the story through lines in the process.

## Conclusion: Story and Cognition

Most would agree that today's educational system (and society in general) is often described using the term *information overload*. Nathan Shedroff (2001) describes the hierarchical differences among data, information, and knowledge – with the latter as the process of making what is observed meaningful and useful. While we pay attention to all three, what is most significant is to discover that story is one of the most useful tools to share knowledge because of what is retained and enduring. Until recently, story has been shown as a tool that is most used for sharing simpler and more general information. In Western cultures, traditions in managing knowledge until recently have been shaped by a line of thinking that gives preference to our working with knowledge in an abstract form rather than that gained from direct experimentation or observation. Most personal experiences are immediately intellectualized and transformed into the abstract. This is demonstrated by the preference/desire of some of our youth to live in virtual worlds rather than actually deriving experiences from reality (Kimura, 2000).

Educators are beginning to realize that not all information can be abstracted and correctly categorized into knowledge for long-term memory through deduction alone. Of the two types of processes, we use to transform information into useful knowledge (i.e., direct observation and correlating with previous experiences), the former is not always the most efficacious means because our logical, deductive powers cannot always be trusted and are less enduring even though they appear to have the most power because we are often more able to express them using words (Sole & Wilson, 2002). Intuitive knowledge, on the other hand, while more enduring,

is less transparent and controllable. Sharing knowledge through story often appears to rely upon intuition and experience and is, therefore, less obvious as a learning tool in educational settings.

What we have attempted to demonstrate in this chapter through our presentations, background “story proof” research, and situated cases, is that once we discovered that a story construct and culture actually exist, we were able to conclude that story can be clearly and empirically demonstrated as a useful tool to share even more abstract forms of knowledge. In brain research it is often noted that story tends to simultaneously activate multiple regions of the brain and multiple sensory memories, making learning and knowledge acquisition more meaningful and enduring (Sole & Wilson, 2002). Our *story-teaching index* is our attempt to quantify and qualify those constructs to effectively evaluate their use in specific and finite terms and to add credibility to our push to change the culture in our classrooms to include story as a foundational instructional tool.

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