Chapter Title:

The Narrative Imperative: A Case for Integrating Story into the Curriculum

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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). Yet, it would appear that many (including many educators) have been trying for the past hundred years to rewrite history. Unfortunately, the use of story as an knowledge acquisition tool has declined significantly in many western cultures century during what had become to be known as the modern period and has given rise to a shift away from story and replaced by a focus on scientific inquiry. Many attribute this transformation to Guttenberg's printing press when story, especially oral story, as a way of becoming 'learned' began to be perceived to be inferior or backward and little more than 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 more than likely aided by the advent of digital media technologies; we seem to be entering a post-modern 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 can be somewhat reluctant towards 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. The works of such scholars as Walter Ong, Eric Havelock, Millman Parry, Albert Lord, Jack Goody, and Ivan Illich have done much to reclaim the dynamics of story as a primary mode of communicating, thinking, knowing, and relating (Havelock, 1986). Bradt (1997) suggested that stories "…effect a change in consciousness, a surrendering of defenses, and creative engagement with the imagination" (p. viii). Many educators correlate story to Bruner's ideas about situated cognition; where it has been shown that embedding context in situational (i.e., story) environments helps learners retain and understand information for longer periods of time and with deeper meaning (Bruner, 1986). Situating what is to be learned 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 pre-condition to learning. As suggested by some, evaluating story as a learning engine is much more complex than simply situating content (Haven, 2007).

Introduction: What a Story Is

We all know what a story is or at least we all THINK we know. There is always the standardized testing description of a story –a character, a plot, a scene, a conflict, a beginning, middle and

end, 'rising action', and a resolution. This descriptive definition 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. Secondly, the descriptive definition makes a story a thing. In order to understand and, hopefully buy into the premise about integrating story/narrative into the curriculum we suggest that one first consents to the idea that a story is not a 'thing' but a process –a way of thinking, internalizing, and eventually learning. The truth is that there may be just as many definitions of story as there are people – meaning everyone has his or her own personal definition based on how they were taught in school and/or through their personal experiences.

The definitions used in this chapter have been greatly influenced by several individuals who have spent their entire careers studying story, media, and their influence on humans.

Among them are:

- Roger Schank (1990) argued that the road to understanding humans and human intelligence is built upon the story premise. His ideas begin with the notion that the process of developing increasingly complex levels of stories applied in increasingly complex ways is one way we can actually map intelligence. Throughout this chapter we will discuss what we (and others) believe is a strong correlation between (all forms of) literacy and intelligence and intellectual thought.
- Marshall McLuhan (1965) originally focused on the medium is the message, which helps to crystallize one's ideas about story is influenced by media one uses and brain-based learning in general. McLuhan came along long before current evolution of technology but was able to talk about it as if it already existed. His work influences greatly the use of media when teaching and motivating students about the power of story.
- Janet Murray (1998) authored *Hamlet on the Holodeck* a seminal work in which she describes story in the digital age took the classical line of thought and developed a view of story as a process, again influenced by the digital age. Her work correlated real world technology to the world of science fiction, giving rise to the term: 'science meets fiction'.
- Walter Ong (1982) was a disciple and student of Marshall McLuhan. Ong discusses story and media and constructive differences among stories in their various mediated forms. Text-based media is delivered and interpreted differently than oral story telling and has its own impact on how people learn. Media brings to the table a phase in human development that he refers to as a period 'secondary orality' in which many of the elements of early oral cultures that disappeared in the age of Gutenberg. The digital era, according to Ong is both forward and back looking and causes one to re-position how we think about things and subsequently learn.
- Eric Havelock (1986) was a contemporary of Walter Ong and McLuhan (they all taught at the University of Toronto). He followed Ong's thinking but also developed a line of his own about how text-based communications had an actual influence on story and how people thought about things that was an extension of Ong's concepts.

One needs to point out that 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, 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 (or in 1240 characters on Facebook for that matter). Further, when one investigates the results of a role-playing game, a story can evolve through the use of recording and editing techniques such as Machinima. Machinima can be defined literally as creating a cinematic production. The most usage is for players to record themselves as they play a role playing game and then edit it down into a narrative. The game provides the setting and the main characters and game play actions become the "plot'. We suggest that story is a process that can be infused in most all disciplines and is often shaped by the media that is utilized to delivery it (i.e. the medium is the message).

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 storying (we use this term in order not to confuse it 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. This confusion/confound may partially account for the deprecation of the latter's use as a foundation to curriculum development.

We suggest that one unintended consequence resulting from these efforts to avoid integrating story into curricula is the fact that many individuals may be so far removed from using story that they have forgotten how its construct can be a premise for learning and retaining knowledge at a deeper level. We further submit that it may also be a contributing factor in the educational system in this country is perceived as having fallen behind others. Later in this chapter we will reference how story has continuously remained an integral part of the educational systems of those countries that are touted as being those that we should emulate. We reject the notion that people no longer have stories to tell. To the contrary, 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.

The value of contextualization and situating are best demonstrated through a series of examples (Haven, 2007). In the activity a list of events is presented to students who are asked to retell them first without contextualizing:

- The fat one bought the padlock
- The skinny one purchased the scissors
- The toothless one plugging in the cord
- The kind one opened the milk, etc.

After orally recounting the list (which can be longer), it is then reread with the addition of a goal or outcome:

- The fat one bought the padlock to place on the refrigerator.
- The skinny one purchased the scissors to take in her bag.
- The toothless one plugged in the cord to the food processor.
- The kind one opened the milk to give to a hungry child. Etc.

Few would argue that the second list is easier to remember because the end goals create relevance and situates the statements. This certainly helps make clearer how story can become the contextualizer, but to completely understand story as a process requires a few more steps.

What a Story is Not

Demonstrating a concept can also be accomplished through the use of non-examples (i.e., what something is not). To that end, Branigan (1992) developed a set of story 'non-examples'. A partial list is presented below:

- a CATALOG is a simple list of events that are similarly related at their core. For example, a simple chronology of one's life such as a listing of names, places, things, and dates ordered most often by their year of occurrence. Often when one is asked to tell his or her story this is the resulting answer. It is very often how a history course is taught.
- an EPISODE is a collection of consequences, things that occur, etc. While this has partial elements of a story (as will be shown later in this chapter), this also in not a story as we choose to define it.
- an UNFOCUSED CHAIN of events is just that −a list of causes and effects without any sort of focus or context (or any judgments made by the protagonist). Again, this is not a story but a series of random thoughts..
- a FOCUSED CHAIN is a series of episodes. Their relationship is to each other, not a central character or do they contain any stated or implied judgment.

Each of the constructs listed above is not the same as a story because one or more of the elements presented later are missing. Developing a fuller understanding of story is best shown through examples and non-examples for comparative purposes and has (correctly) become a common intervention in the implementation of Common Core State Standards.

Story Generation

Most students have learned the basic descriptive elements of a story. While these help describe what 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. They need no further explanation except to say that often what is not taught about these is that there are standard constructs for each. Anecdotally, when the authors surveyed its students how many characters types are there and how stories exist, the answers always varied from a few to thousands. Then when it is noted that the actual number of standard (i.e., archetypical) characters ranges from

nine (Wisehart, 2015) to forty five (Schmidt, 2012) and that the number of standard 'master' plots ranges in number from seven (the Russian Wonder Tales, n.d.) to twenty (Tobias, 2012) students could not answer the follow-up question as to why it is that the total number of stories that exists can be so varied.

- Some of the things that are often missed in the teaching of story are the idea that <u>plot, story, and theme</u> are in effect <u>the multipliers</u> that make possible an exponentially higher number and/or types of stories. A story's theme is its main idea or an underlying meaning of the narrative, which may be stated directly or indirectly. A theme provides the context/premise, as well as another significant multiplier for the interactions of the main character(s) with the world around them. There seems to be three major types of themes that can be added to our emerging definition: A point of view – this is what the author (through his or her main characters) believes.
- A <u>call to action</u> and/or an attitude change based on the author convincing the reader.
- A <u>propositional conclusion</u> (something happens, therefore a judgment is/needs to be made).

These elements add to the complexity of the context and also help students understand what needs to be present to make a story. But this is only the beginning. The next step is to identify what is often referred to as through lines.

Generating the Through Line

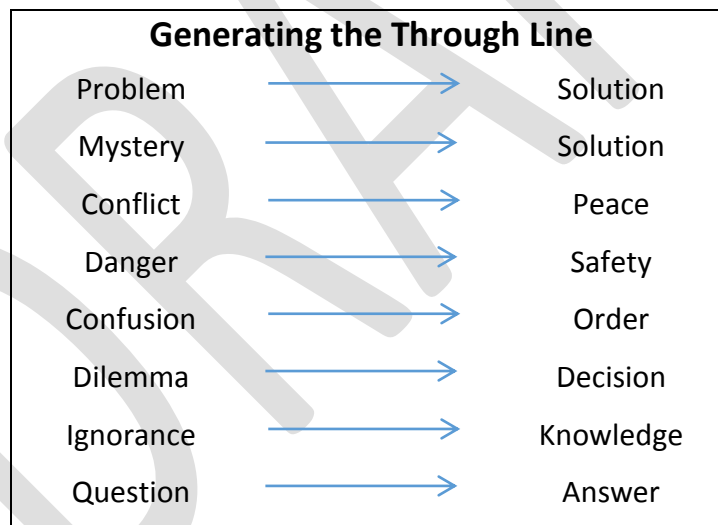| Problem | → | Solution |
Mystery	→	Solution
Conflict	→	Peace
Danger	→	Safety
Confusion	→	Order
Dilemma	→	Decision
Ignorance	→	Knowledge
Question	→	Answer

Figure 1: Story Throughline

Through lines are what the reader/viewer looks/reads for in a story – what reaches out to them. This is the goal of the story and often serves as the foundation for the propositional conclusion described above. While many of the concepts are self-explanatory; what they actually represent is a standard means or methods that are used to draw in the reader/viewer/listener. The answers provided for the problem, mystery, conflict, etc. make the difference between a comedy and a tragedy, the resolution, feedback, and especially based on any judgments that are made by the main character.

At this point we have presented several variables (number of characters, plots, points of view and through lines, etc.) so as to make up very complex range of stories. Add in the concept of genre (i.e., placing each one of these in different settings, eras, etc.) and the assortment becomes exponentially large. Making the use and integration of story into academic disciplines a valuable tool in support of teaching content at a deeper level.

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 is occurs immediately and the scenarios/backgrounds are described through a series of flashbacks. This is known as the Goddard effect (Wakeman, 1988).

2. **CAUSE & 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 is 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 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 non-fiction and making it a useful element in multiple disciplines. It is also that element that helps demonstrate to non-readers how to have that all-important

'movie' play in their heads and/or contextualize a lesson that is being taught. This is an important differentiator between a story from a heap (a list of unrelated facts) or a catalog (a list of related facts a simple chronology of events, etc.).

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 are 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'). Recall that there is only a finite number of character archetypes. Standardization of characters, plots, genres, etc. both limits and expands variables in controlled circumstances and also goes to support the development of a relatively valid metric for determining the teaching efficacy of a particular story. 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, as it will be shown later is also key to a story becoming a teaching engine.

4. Because all stories need both a teller and a listener, a storyteller needs 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). This suspension correlates directly with a student's buying into the lessons that are being taught in the story. In the script, this can be done visually, through a close-up look on the character's face, a series of metaphoric images, in a voice-over, or as a part of a dialog/monologue within a scene. Shakespeare often did this in the form of asides in which the main character actually spoke directly to the audience

Establishing significance

Based on Branigan (1992) we discover that a key to differentiating a particular story as being a valid and effective, cross-curricular contextualizer is *'cause and effect'*. In her seminal work on analyzing story constructs, Jean Mandler (1984) further describes story schema in terms of three prescriptive, leveled, semantic elements:

- A **PROPOSITION** is different than the propositional storyline that was described previously. Proposition in this sense actually 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, 1973; Kintsch & van Dijk, 1978). In semantic linguistics this suggests that an argument is better retained because the outcome is likely to be predictable at the micro level. It is the framework by which Branigan's (1992) judgment (predicate) occurs. The character decides what he or she must do in response to the conflict or disruption based on his or her "allowable actions' (i.e., those that are predicated on a personal prediction as to the best possible alternatives/outcomes).

- A **CAUSAL CHAIN ANALYSIS is** the globally predictable outcomes based on principles/elements of nature or circumstance and relate academically directly to those principles that are being taught in the classroom in specific disciplines, such as science experiments, an ethical argument, for example and is what helps the student map immediate recall. In story this is often referred to as the 'moral'. While there are often unintended consequences, these, too, can become 'teachable moments. In teaching many disciplines casual chain analysis is also referred to as critical thinking. In engineering it is referred to as 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 non-essential 'sentences' scenes (i.e., to read critically). This is where Mandler's analyses directly correlate with Branigan's.

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, and/or organized patterns behavior. It is that mental structure of preconceived ideas that create a framework that represents some aspect of the world, a way to perceive it and then collect it, and finally organize it into newly acquired information. Schemata influence attention so that this new information can be and absorbed and transformed into knowledge.

People are more likely to notice things that fit into a schema, and re-interpret contradictions to the schema as exceptions (or distorting them to fit), as long as the subject–predicate is strongly correlated as noted by Kintsch & 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 are not initially obvious. For example,

- He: Where's Jack?
- She: Well, I didn't want to tell you but I saw a yellow VW parked in front of Susan's.

These two sentences introduce four characters He, She, Jack, and Susan. Unless some type of correlation is established beforehand one can only imply the relationships; which is an excellent story building activity that students can easily do once they learn the process and elements of story. For example, Jack went to Susan's to study and his father (He) doesn't want him to get good grades. Susan could be a fast food restaurant and He (the father) was concerned that Jack

was becoming an indulgent eater. This scenario is both an example of Kintsch & van Dijk's (1978) semantic analysis and an exercise to use to teach effective storytelling. 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 explains 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.

Like that for with archetypes and master plots there is most likely a fixed set of causes and a finite number of them that can be stated/implicated into a single story (i.e., lesson/experience). Branigan (1992) suggests a maximum of two to three because of plausibility and belief suspension. Not blocking out the rest can lead to confusion or amoralistic outcomes and indirectly impact plausibility (which may be the storyteller's intent but makes the story less likely to reach a significant learning outcome).

To take this further, Mandler's (1984) combining Kintsch et al (1973; 1978) semantic analysis and Branigan's (1992) story components appears to suggest that if the 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 a proper implementation of story based on these creation elements has unlimited potential in the classroom. Teaching story creation creates a foundation for scientific inquiry, reading comprehension, and a useful learning engine for multiple disciplines.

Further, we also believe that we would be able to create a measurable model/rubric to assess the relative teaching value of a particular story. In other words, we are move from simply describing a story to being able to quantify it into finite terms according its relative teaching index.

Character Development as a Motivational Factor

A significant part of using an intervention for creating a properly conceived learning environment is the concept of properly 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 so. One way to draw a story listener/viewer/reader into story is to create empathy for its main character. It is this important aspect that makes a story credible (relating directly back to the fourth element in Branigan's (1992) tetrad: credibility). There are certain criteria in character development that need to be present to create that sense of identification. This same function is also directly related to the storyteller being able to make cause and effect come alive and believable so the listener/viewer/reader is able to suspend his or

her disbelief (Laurel, 1993). These are also known as the transformational aspects of the character's development within the story.

Again, through the use of a non-example, the idea of transformation can be easily 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. To the contrary, a recipe is a good example of a catalog. In a story some person or objectification of a person undergoes a measurable change/transformation based on his or her judgment about a causal event. The change could be a positive or negative one. It is that struggle that is at the core of the storyline equating to the concept of the 'moral of the story" –shorthand for the teachable moment, the result or consequence of the decision that the character makes. Cause and effect and value judgments correlate to an 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 author's/storyteller's decisions.

As has been shown above narrative, when properly implemented, can be a powerful tool in the acquiring, transferring, and/or sharing of knowledge; especially when it is tied to cognitive issues related to short term and long term memory. 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 somewhat narrower than what we are implying. Rather, we ascribe Bruner's approach to being a particular branch of storytelling within a broader narrative method or 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 cataloguing events and narrating them using judgment and causal chain analysis. 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.

A Teachable Story Creation Framework

To summarize, we suggest that a consolidated framework can be constructed that does two things: First, when utilized as an entry point of instruction, teaching student how to construct story using these elements will also help them become critical thinkers that is useful in other disciplines. The parallels to scientific inquiry, for example they are almost identical. It is our belief that the main goal in STEM education, in order to reach the most number of children, is not to necessarily create more scientists and engineers (although many more are certainly needed) but to make all children, regardless of academic discipline to learn how to think and look at the world more critically. Second, placing learning inside a story helps to contextualize and personalize the circumstance and helps make the learning more applied in nature.

Our framework is a combination of those elements of story schema as presented by Branigan (1992) and Mandler (1984):

STORY CONSTITUENTS – This includes the elements that are usually taught in schools comprised of the usual descriptives: characters, settings, a time continuum, genres, etc. Although most children do not naturally understand this, usually there is a finite set of each and can be taught in terms of archetypes, adding to the idea of a set story construct. This is also known as the *back-story* where the information begins to be contextualized. Papadimitriou (2003) describes three principal techniques of using storytelling to teach in technical areas such as STEM: (1) provide historical situation (context) to a topic; (2) embed story into the concepts to explain content; and (3) entrench educational material into the story. These techniques or strategies are also applicable in any area but especially STEM.

CAUSAL CHAIN ANALYSIS – This is the predictable outcome of the effect based on Kintsch et al's (1973; 1978) analyses. Is the outcome likely based on the actual interaction of the cause to the situation? Some examples: Is a fire likely to be set when I light this match? Is the area/land likely to flood if the dam breaks? To take this further we could even make estimates, for example based on the where the dam breaks which land will be effected by breakage? (This is an important aspect of cause and effect that plays into our examples noted below). Is the water likely to stay behind the dam if it is built correctly? Which shape should the dam be built in? Is John likely to lose weight if he goes on a diet? Am I likely to arrive at this destination on time if I drive 50 mph? If a car crashes at 50 mph are the occupants likely to get injured? If I quit school am I more likely to be homeless or poor, looking for a job. If I do not have a purpose in my life am I more likely to quit and perhaps wander from job to job? The predictability on the chain is key to making the storyline a teachable moment.

PROPOSITIONAL ANALYSIS – The conditions/variables that allow the carrying out of the conflict to occur (for example, a match will not light in wind or if wet). This is the modifier what Kintsch & van Dijk (1978) refer to as the *predicate*-argument schema. What effect do the variables play into the arguments? Are the conclusions rational? For example, how does that effect whether I arrive at my destination on time? Is Mr. Spock likely to cry when he sees something bad happen (his character flaws /allowable actions in a game)? Does john the kind of person with no perseverance so his diet won't work? If I wear seat belts does that modify the outcome? If the main character is a racecar driver is he more likely to survive a crash? If the student who quits school, has a talent for something (like he was really good at math but was bored)? How does that help him in a situation that he encounters while he is wandering around the country hitchhiking?

JUDGMENT – If an incident occurs one must observe it happening and make some decisions and sometimes determines the outcomes and whether a transformation in the main character occurs. The question is how do these judgments affect the outcome /effect?

COMMUNICATION – How credible a job does the authors do in setting up the premise? Is it possible that the storyteller is in the proper position to observe these events and are they recalled correctly? This is also the determinant of the story's credibility. Also is modified by the type of media that s utilized to communicate the best. Is there a difference in meaning based on the media utilized?

Narrative as a Research Methodology

Once one understands/grasps the idea of story as a learning engine, it follows that narrative is also a useful research tool. With all the known research on the efficacy of story as a learning tool, its use in the classrooms in the USA has been limited. What is common is the use of personal narratives in pre-service teacher training and professional development for in-service teachers. Story has also manifested itself in the form of *narrative inquiry*, a discipline within the scope of qualitative research that emerged in the early 20th century (Boje, 2001; Clandinin, & Connelly, 2000). Narrative inquiry uses (such as stories, journals, notes, and letters, among other things) as its base to study and evaluate the way people create meaning in their lives.

The two basic schools of thought related to research methodology are the quantitative and qualitative domains. Narrative inquiry concentrates more on organizing human knowledge acquisition than the mere collection, processing, and reporting of data. This focus implies that episodic and semantic knowledge are considered valuable and noteworthy regardless of how many participants comprise the sample pool. Qualitative researchers often argue that collecting purely objective data fails to tell the whole story or situate them properly to provide context. Many researchers suggest that solely reporting numbers does not reveal the complete story. In others words, numbers may indicate that something interesting may have occurred but the qualitative analyses reveal and explain the backstory of what happened. Unfortunately, qualitative data collection and research efforts are often criticized for not being theoretical enough (Snowden, 2010), implying that narrative/qualitative research are to be considered a 'soft science' We suggest that it is possible that using story in the classroom may suffer from the same deprecated reputation that is ascribed to qualitative research.

Embedding Story in Pedagogy Outside of the USA

We all know that in some circles, the educational system in the USA is under attack. Many cite the relative poor performance of schools in the USA as compared with those that rank higher on the list. Some lists place the USA as ranking lower than many developing countries. In a recent ranking the USA faired even lower. According to Pearson (2015) the United States has a "cognitive skills and educational attainment" score of 0.39, which makes the United States rank fourteenth out of forty countries ranked in that category. Pearson has rated the top ten countries thusly:

1. South Korea
2. Japan
3. Singapore
4. Hong Kong
5. Finland
6. United Kingdom
7. Canada
8. Netherlands
9. Ireland
10. Poland

A common theme in the top ranked countries is the relative importance that these nations place on an enculturation of story and how it remains firmly embedded in their educational systems. Fairy tales, folklore and mythology play an important part of European and far eastern education, especially in the younger grades. It is practiced mainly as a part of protecting and passing along oral cultures and constitutes a significant part of their educational materials (McMurray, 2015). In Finland, for example, narrative learning is utilized to develop motivation and personality, sense making, imagination, and emotional involvement. The method is applied in different mixed-age groups. Play world and imaginative education are used to create "narrative imaginative environments" in the classroom or schoolyard. Different variations are utilized for different age groups, and can be oriented on subject or personality development. Continuous plots are used to connect different events and subject matters. The use of narratives as tools in mathematics education course as one of the innovations in Finnish teacher education that is also taking place. Narratives are increasingly used as a methodological approach in research of educational experience, but also as pedagogical tools for facilitating students' views. (2010, November). Another example is the British Council's Continuing Professional Development (CPD) Frameworks reflected on the British Council Website that provides rationale for using storytelling to teach content with guided examples, strategies, and techniques for teachers to implement in their classrooms.

It is also well known by those who study Japanese culture that the concepts of *kankei* (interrelationships), *kizuna* (bonds), and *kizuki* (with-it-ness) are firmly ensconced in their sense of story and play an ever-larger role in modern preservice and inservice educational practices (Howe & Arimoto, 2014). These are important, integral elements of Japanese teachers' practices because they embody the Japanese concept of mind and heart of their personal and practical sense of knowing things.

Digital storytelling practices in both formal and informal learning across different European educational systems, such as Norway, Portugal and the UK have evolved using examples of collaborative writing, integration with social networks, visualization, and geocoding. In conjunction with the methodology developed by the Center for Digital Storytelling (CDS) in Berkeley, CA by Joe Lambert, Nina Mullen, and Dana Atchley, the methodology evolved into the development of training packages that illustrate to educators, the value of digital stories, the digital tools available to tell these in new ways, and the importance of publishing them using new distribution platforms. The CDS the process of storytelling is empowers individuals and turn the individual processes of learning into communal ones. Their main focus follows threads of identity, cultural identity, interpersonal relationship through the use of media, immigration and democratic practices, 'engaged listening', and integration of ICT (Boa-Ventura, Lopes, Jamissen, Jenkins, & Ribeiro (2012).

Relevant to this discussion is how Canada and the USA have been looking to cooperate in improving teacher education. Recommendations from the subcommittee that was set up were threefold. First it was suggested that a common language (i.e., definitions) be created to describe, analyze and improve teaching. Second, researchers need to look beyond the cognitive demands of teaching to focus on teaching as cognition, craft and affect (relational (i.e., cause and effect)

aspects of teaching. Third, teacher education should be the interconnection of multiple contexts such as "teacher candidate attributes, policy contexts, the institutional context, and the teacher education program, as well as the district context and the context of the schools and communities in which teachers teach" (Grossman, & McDonald, 2008, p. 192). Canada decided to address setting their individual contexts within the bigger picture of using a story model that covers ideas on culture, change management, and context (Drake et al., 1992).

Story Proofs: Story Across the Curriculum

We recognize that one may wonder whether story is a framework that can carry over into other academic disciplines outside of literature and art. In order to understand this better one must first recognize the differences in terminology that exists between a scientist/mathematician/engineer and an artist (whether he or she be a filmmaker, a fine artist, or a writer) when one refers to the concept of *brainstorming*. To the latter it is a creative activity. In the STEM disciplines, the concept of brainstorming is quite different (or is it??) and is more in line with scientific thinking that involves feedback control theory) that can be diagramed:
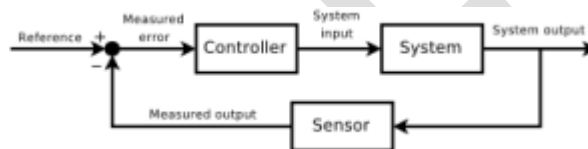
.

Figure 2: Feedback Loop

This diagram visually describes the concept of a feedback loop that controls the dynamic behavior of a system. In this case, brainstorming comes in to play when it involves the learner receives feedback so he or she can then adapt the variables to find a more correct solution. In the sciences this process can be mapped out using mathematical equations. With story, the 'brainstorming' part that comes into play with the sociological/psychological aspect of the storyline. Often the story reader/viewer/listener makes observations about the central character and evaluates whether he or she reacts sensibly/predictably to the conflicts that arise. In role-playing games, the character reacts based on his or her 'allowable actions". Perceptual Control Theory (PCT) is a model of behavior based on the principles of negative feedback, and is equally important to both engineering control theory and well as appropriate story creation. This parallelism is what ties scientific inquiry and story creation together.

In PCT theory, organisms (i.e., protagonists in a story) control their own behavior, but not always the external environmental variables surrounding them. Mostly they can only control their own perceptions of those variables. Actions are not 'controlled'(i.e. always identical), but varied. According to the standard catch phrase of the field, *behavior is the control of perception*. This fundamentally contradicts the classical notion of linear causation of behavior by stimuli in which environmental stimuli are thought to cause behavioral responses, mediated (according to Cognitive Psychology) by intervening cognitive processes. In a story, when main characters make judgments about their perceptions of their environment, often they make (mis)judgments due to misconceptions that shield the real causes. This is also where the moral of the story comes and where we can translate them into the so-called 'teachable moments' and when learning can

take place. These moment s are made more memorable when empathy with the main character is created (similar to the concept of 'relevance' in Keller's ARCS motivation theory).

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 areas that are based on scientific inquiry. The question is why? Some correctly understand that STEM is really about focusing on processes. Science, math and engineering are based on finding solutions to problems. Educators are beginning to understand the importance of reading and writing as perfect partners for innovating and building science and math solutions based on story constructs.

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, high-priority memory fodder. Everything else being equal, we are much more likely to remember a story than a logical argument.

One of the most important strategies for an effective teacher is to be able to take the most complicated concepts and break them down to where they are easy to understand. Story constructs add the logical understanding of environmental impact. A properly developed story can break the monotony of the one-way transfer /communication of information. Stories combined with other engaging learning strategies create content that is difficult to forget and much easier to remember. We believe integrating storying into lessons not only connects the content specific areas of STEM to each other but to the real world for better comprehension. We agree with those who suggest that one reason so many females may be turning away from the STEM is the lack of embedding empathy based on story characterization. Events have been initiated such as the World Science Festival that started adding areas like "Science & Story: The Art of Communicating Science Across All Media." Some scientists have recognized that science is a story and intertwining all areas of STEM provide the needed conceptualization to dig deeper for understanding.

Story Creation Formulae in Action

In civil engineering, our entire infrastructure including both that which has been naturally created and that made by man focuses on the design, construction, and the maintenance of our environments. Story creates a situated time continuum using various cause and effect scenarios where a judgment needs to be made by the learner/receiver. While one can define something by way of showing what it is not, few would argue that the best way is through the use of appropriate examples. The following two 'proof statement" illustrations demonstrate how story can be utilized in two unlikely areas: science/engineering and math. In both cases we assume that the teacher/instructor establishes the premise by teaching the elements of story creation using the story schema that we have introduced.

Action Case Study #1: Embedding a story into an Engineering Class

The following is an example of using story embedded lesson that includes problem(s). In this scenarios, the teacher/instructor presents to the class a backstory to contextualize the 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 workers to create one of the largest structures in the world. The Bureau was one of the few agencies that was offering jobs and was known for managing large-scale projects of this nature. 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 did know about using the power of water for many uses and things. Roger knew that if you could control flowing water you could create waterpower or hydropower. Many criticized the governments for this idea stating that it was an impossible task but believers thought it could be done with proper engineering design. For Roger and his family this meant food on the table, a roof over their heads, and generally a better life.*

> *They made a long trip to Black Canyon to the Colorado River only to encounter many others with the same dream. Roger learned quickly he must work hard and learn something new every day. He was hired on as a mason. The men had to learn brand new skills to understand the construction process and to solve what turned out to be thousands of problems that they encountered almost daily. Although the Hoover Dam is still considered one of the most comprehensive example testing of engineering theories this kind and scale of project never had been attempted before and everyone was learning literally 'by the seat of their pants'. No one knew if concrete could support a structure of this size and scale nor which kind of shape it would best suit the need. Roger had been a farmer and he understood the land, water, and flooding. His background eventually got him a position on the practical engineering group,*

> The solutions to the myriad of problems presented while building the dam were classic examples of using feedback loops in engineering scenarios.

> *Roger knew that trial and error was an everyday occurrence. "Many times we would built something wrong, but we learned to better understand how to try something else and create detailed and complex solutions to multiple issues.*

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

In any enterprise sharing knowledge is important to knowledge acquisition. When we present information, two main areas of the brain are effected language processing and comprehension, and language production. If all that is relied upon in a classroom is the lecture, cognitive psychologists submit that the brain is unable to process information effectively after a short time. On the other hand, by embedding these concepts into a story, a number of areas of the brain get activated such as sensory cortex, aimed at processing text and sensation; motor cortex; olfactory for memories of smells; visual cortex for color and shape and auditory cortex for sound. Multiple brain regions are engaged (Smith, 1998). Stanford's d.school (Institute of Design at Stanford) is an example of using storytelling as a core methodology in the sciences. Turns (2006) and her colleagues developed a Website to support engineering educators. On the narratives supporting

EXcellent Teaching (NEXT) Website, stories serve as a device to demonstrate to engineering faculty challenging situations and describe how they were resolved.

> *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.*

At this point the teacher/instructor introduces a problem for the class to solve. After breaking the class into groups, the instructions ask for the groups to come up with ways to divert the water flow around the work area so that the work on the dam could start and continue. One strategy could be to provide a possible final solution and have the groups determine why other alternatives were either rejected or disproved. Another instructional method could be to have the groups come up with their own ideas/solutions and present them to the class and after the final decisions are determined, they would be shown.

> *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 what shape needed to be used for the dam. Roger and his group brainstormed various alternatives.*

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

This technique demonstrates how using story in science helps to connect the dots in knowledge acquisition. It also ties directly with Common Core State Standards and other standards provided for the engineering industry by IDEO (https://www.ideo.com/). In other non-scientific disciplines, such as sociology, for example, often eras are presented in a stand along atmosphere or vacuum and not cross-referenced neither as reactions to one another or connected in some way. I physical knowledge building is hierarchical and can be easily revealed in this manner through the evolution of the story. Integrating knowledge acquisition hierarchically similar to that of Blooms taxonomic framework. Abstract knowledge derived from within one particular context may be found to explain phenomena in other areas. In this case one moves from an abstract demonstration of physical shapes to their use in applied situations (Smith 1998).

In this case, the teacher/instructor introduces several alternative shapes and asks the class groups to determine which of them is the best alternative shape. Each student investigates the characteristics of each shape and consensus is reached. Another way to do this would be for actual artifacts be produced and using experimental processes determine which one is the best through observation. By creating a flow of water students can create and test different types of structures to control the flow of the water based on their scientific guess.

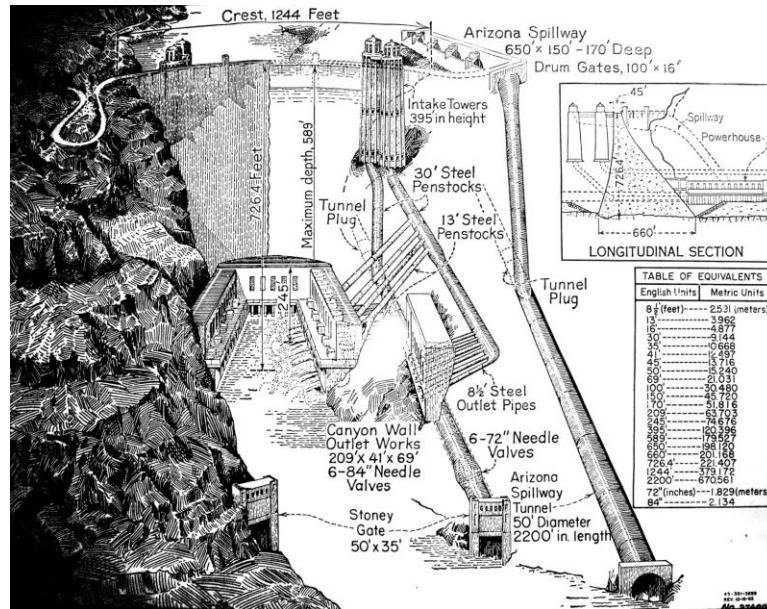The following picture is shown of the final design drawing for the dam:

Figure 3: Final Shape Design of the Hoover 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. The idea is to provide a continuum of theories are commensurate/corresponding others. Where possible explanations/contexts of the problems should be unified and explanatory frameworks for the next ones. It is well known in instructional design that developing knowledge in a horizontal fashion offers opportunities that serves as clues and help to personalize the inquiry.

Alternatively, instead of presenting the backstory the teacher/instructor could the class to create their own by providing some of the story elements (characters, setting, etc.) plus the learning concepts (such as water flow and shapes, problems associated with bringing people and materials to the site, scaling, calculating the volume of the concrete, etc.) and then ask the groups to construct the story that introduces and contextualizes the lessons.

Action Case Study #2: Mathematics in Action

The lesson starts with a teacher/instructor who notices that their students are enthusiastic and ecstatic 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. In all, seven 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 twelve districts that were a part of the fictional country of Panham –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 one 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 about the storylines. In some cases, the students are asked, based on mathematical calculations, to actually rewrite the episodes' endings. Each lesson starts with a brief background about what happened that is supplemented by direct quotes from the book. The background and quotes help set the stage for the mathematical concepts being introduced. Both the book and the movie are used because the movie did not always provide the necessary data for student to utilize in their calculations.

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. As a sidebar, one of the things occurs is that the students begin to notice the differences between the ways that the storyline is presented in the book versus the movie. There are key elements in the story that were not in the movie that made a huge mathematical impact on various decisions that needed to be made. These became critical *teachable moments* in literacy that adds value to the lessons.

During the viewing some of the aspects of the lessons are changed. 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 that, if the train hypothetically started out in their home city, where on globe the Capitol of Panham was located. Students are asked to research and make calculations to formulate their answers.

At the lesson 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.

In short, each lesson requires students to challenge the propositional conclusions of the story episodes. The propositional element 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 & 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 became gamified in that the students had to make the same decisions as if they were taking on the role of Katniss inside a video 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 & van Dijk's (1978) propositional analysis and its value to story creation.

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? Students were able to observe how this hypothetical scenario might change the outcome of the book.

Using these scenarios students are changing the story schema –mental structures consisting of sets of expectations about the way in which storylines proceed. The story schema enables the reader to form a coherent representation of the story as a whole. A single experience can create expectations for the future. By having students question the proposition of Katniss they are changing the story schema. While using mathematics to help student readers understand probability and predictability the story simultaneously becomes less predictable and more exciting.

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 many 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, design challenges, and lesson examples is that, once we discovered that an observable, story creation construct actually exists, we could only conclude that story can be a very useful tool to share not just general information but 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 experiences so that stories can be effectively evaluated in finite terms. The next step is to create a useable rubric for this purpose.

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