IJPBL
http:// ijpbl.org

Interdisciplinary Journal of Problem-Based Learning

Volume 3 | Issue 2 Article 3

Published online: 10-26-2009

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IJPBL is Published in Open Access Format through the Generous Support of the Teaching Academy at Purdue University, the School of Education at Indiana University, and the Educational Technology program at the University of South Carolina.

Recommended Citation

Andrews, D. H. , Hull, T. D. , & Donahue, J. A. (2009). Storytelling as an Instructional Method: Definitions and Research Questions. *Interdisciplinary Journal of Problem-Based Learning*, *3*(2).
Available at: https://doi.org/10.7771/1541-5015.1063

Storytelling as an Instructional Method: Descriptions and Research Questions

Dee H. Andrews, Thomas D. Hull, and Jennifer A. Donahue

Abstract

This paper discusses the theoretical and empirical foundations of the use of storytelling in instruction. The definition of *story* is given and four instructional methods are identified related to storytelling: case-based, narrative-based, scenario-based, and problem-based instruction. The article provides descriptions of the four instructional methods, describes several research issues, delineates foundational work and theories, and proposes a research agenda.

Keywords: storytelling, problem-based learning, scenario-based instruction, case-based instruction, narrative

For thousands of years societies have taught key principles through storytelling (Brady, 1997; MacDonald, 1998). In some cultures without written language, storytelling was the only way to convey a society's culture, values, and history (Egan, 1989). Great leaders of all types (e.g., religious, political, educational, and military) have used stories as instructional tools in the form of parables, legends, myths, fables, and real life examples to convey important information (Benedict, 1934; Brown & Duguid, 1998; Davenport & Prusak, 1998; Leonard-Barton, 1995). Fictional and nonfictional examples have always been powerful teaching tools. Storytelling as an information medium is heavily used today in education and training of all types. We see evidence of this in dentistry (Whipp, Ferguson, Wells & Iacopino, 2000), the military (Cianciolo, Prevou, Cianciolo & Morris, 2007), aviation (Cohn, 1994), general medicine (Churchill & Churchill, 1989), law (Dorf, 2004; Rhode & Luban, 2005), and business (Ellet, 2007; Forbes Magazine Staff & Gross, 1997). These are just a few groups which rely heavily on storytelling as a method for teaching key principles of their discipline, and to help build analytical prowess in students and trainees.

Philosophical shifts related to the nature of learning are encouraging the return of less structured and less directive forms of training and teaching. New media technologies make it much easier to bring stories to life and have become an increasingly significant part of participatory, popular culture (Jenkins, 2006). Instructional storytelling is increas-

http://dx.doi.org/10.7771/1541-5015.1063

ing in frequency (Jonassen & Hernandez-Serrano, 2002), making it an important topic for more thorough and collaborative study. This article seeks to address some possibilities for further research on storytelling for instruction and to suggest a way to parse data, focus inquiry, and to establish a common language.

The Four Types of Story-based Instruction: Descriptions and Research Foundations

There are many definitions of what constitutes a story or narrative. Many center around the following definition that we have found useful for our analysis. Labov (1972) defines a narrative "as one method of recapitulating past experiences by matching a verbal sequence of clauses to the sequence of events" (p. 359-60) and at a minimum a "sequence of two clauses which are temporally ordered" (p. 360). A story, then, facilitates instruction directly through verbal or linguistic means and indirectly by aiding in the mental construction of a sequence of events enacted for or by the learner. The semantic structures and temporal ordering of information in a story act as an attention-focusing mechanism (Gerrig, 1993) that aids in inquiry, decision-making, and learning. Specific focusing mechanisms include plots (O'Brien & Myers, 1987; Trabasso, van den Broek, & Suh, 1989), problems (Savery & Duffy, 1995; Merrill, 2002), and contextualized situations (Sacks, 1995; Salas, Wilson, Priest, & Guthrie, 2006). The purpose of a story may range from entertainment to instruction, but all stories share a similar experiential (as opposed to abstracted) approach to encapsulating information. This, then, is the central characteristic of the analysis in this article. This characteristic is used in selecting four instructional methods that seek to engage the learner through context in order to provide a simulated experience.

The four major instructional methods that are informed by, embedded in, or organized around a story structure are case-based, scenario-based, narrative-based, and problem-based instruction. Each method presents learners with a temporally ordered sequence of information and employs an attention-focusing mechanism. Uniting these methods through a common characteristic enables researchers to draw on one another's work for insights into the learning process.

There are all manner of publications about how best to formulate and implement instruction using the methods above. Many publications (Gershon & Page, 2001; Harries, 2003; Hill, Gordon & Kim, 2004; Merrill, 2002; Preczewski, Hughes-Caplow & Donaldson, 1996) even offer prescriptive guidelines to those who teach using storytelling. However, there is not a great deal of theoretical foundation or empirical evidence behind the storytelling technique. The key questions are: why does it work so well? What are the features and characteristics of stories that make them work?

The remainder of this paper will:

1. Describe each instructional method and provide an example of the method within an instructional setting.
2. Identify research foundations and relevant theoretical literature.
3. Propose research questions and agendas for further study of the use of storytelling in instruction.

This synopsis is not intended to be a comprehensive overview of the work happening within any of the scenario-, case-, narrative- or problem-based domains. Rather it is meant to identify some of the current projects and relevant literature that serve to lay a groundwork for further research. Although several of the examples are taken from the military domain, the principles and practices described by the methods are relevant to other kinds of training contexts.

Descriptions

Case-based instruction. In case-based instruction, the problem and the solution are fixed and the learner is positioned as an outside observer relative to specific situations in the past (Barnes, Christensen, & Hansen, 1994). While still an interpretive act, cases seek to detail concrete events and a series of descriptive facts as they actually happened, making it very historical in nature (Wieviorka, 1992). Cases have a known outcome and are not interactive in the sense that learners' decisions do not have an effect on the outcomes. Cases carry significant authority, whether they should or not, by virtue of their specific factual content (Abbott, 1992). An example of how they are used in education follows.

The U.S. Department of Defense Personal Security Research Center (PERSEREC), U.S. Secret Service, and Carnegie Mellon University's Computer Emergency Response Team (CERT) have collected several hundred cases of cyber crime throughout the United States. These document in detail the actual incidents leading up to the detection, investigation, and prosecution of cyber crime. The results of this research led Cappelli, Desai, Moore, Shimeall, Weaver, and Willke (2006) to create the Management and Education of the Risk of Insider Threat (MERIT) workshop to provide a medium for instructing managers on the implications of their findings.

As described in Greitzer, Moore, Cappelli, Andrews, Carroll, and Hull (2008), ongoing work at CERT attempts to find effective mechanisms for communicating the results of this research to practitioners in government and industry through integrative models of the problem, case studies and assessment of best practices, and interactive instructional cases and games in which players are challenged to identify insider threat risks and take steps to mitigate them.

The MERIT workshop focuses on insider IT sabotage and has the following structure:

- overview of empirical research on insider threat
- interactive discussion of the instructional case of insider IT sabotage
- general observations from case data
- system dynamics model (problem, prevention, and mitigation)
- recommendations for countering threats

The overview of empirical research is intended to show the learners how major trends of insider dangers and threats are identified and linked to the practices of the victimized companies. The research gives a scope of the problem and the average damage inflicted by the criminal. This helps to preface the case to be considered and establishes a broader context for case interpretation.

Instructional cases serve to aide the learner in creating a mental model of targeted lessons derived from the body of empirical research done by MERIT. Potential solutions and alternative approaches are considered by the group as they work through the case. Each case is centered on a handful of key concepts and system vulnerabilities. From this exercise participants generate and compare observations of maladaptive behaviors demonstrated in the case.

MERIT is currently working on using the resulting system dynamics model as a background for designing an interactive learning environment in which a prototypical case can be experienced by workshop participants in real time.

Narrative-based instruction. In narrative-based instruction the problem and solution are also fixed but the learner is positioned within the narrator's context and control of information (Cobley, 2001). Emotional engagement or entertainment is a central purpose of narrative and sets it apart from the other methods. A narrative is multifunctional in the sense that it attempts to appeal to emotions, as well as recount facts and events (Martin, 1986). It need not be a real or actual experience (Chatman, 1978). Although it attempts to illustrate the causality of a linear series of events, it does not necessarily have to relate the events in chronological order (Cobley, 2001).

Karen DeMeester (in press), provides a clear example of how narrative can be used in instruction, as well as in therapeutic practice. Experiences in war disrupt the normal schemata used to manage daily life and can diminish a soldier's performance and reliability upon returning home causing a need for medical and psychological treatments. Stories provide both preventative and therapeutic measures for helping soldiers identify existing schemata, obtain more resilient scripts, and reconstruct damaged beliefs and assumptions that, left unattended, would otherwise be difficult and destructive for their civilian lives.

Programs are being designed that use a variety of multimedia and computer technologies that place soldiers in environments where they will encounter stressful narrative

structures experienced by others in similar situations. Designers begin by asking combat veterans to remember and describe the sensory and emotional content of a traumatic event in a therapeutic setting. Memories often return as fragments and require some piecing together on the part of the designer to create a coherent and complete narrative. The narratives are then embedded into virtual reality software, graphic novels, or other media where the patient or trainee will experience the emotional and physical settings of combat. Several programs of slightly different content are in development and examples follow.

The Virtual Reality Medical Center in California is examining stress inoculation training. A two part approach, combining simulations and live training, uses stories to develop techniques for helping soldiers understand and control their fear and anxiety during tactical decision making tasks (Kaplan, 2005). The Marine Corps Combat/Operational Stress Control (COSC) Program has developed Awareness Projects heavily reliant on narrative and storytelling. The Graphic Novel Project, for example, creates comic-style novels in conjunction with artists at DC Comics™ that depict stories of soldiers returning home, their successes and failures in adjusting to civilian life, and the effects of their choices to accept or reject treatment. The Army's Battlemind Program uses film to show that understandable behaviors in combat are often inappropriate upon the soldier's return home.

Successful programs help the trainees 1) remember the details and timing of events, 2) couple the sensory and emotional responses to these events, 3) conceptualize the events to identify the relevant assumptions and beliefs influencing their interpretation of the experience, 4) articulate the meanings that can be garnered from the event that will aide oneself and others, and 5) compile the story in a way that will make sense to a listener.

DeMeester concludes her discussion of this approach to narrative-based instruction by pointing out that soldiers often compare their actions and feelings in warfare against prevalent heroic archetypes. In mythic and cultural traditions, the hero serves as a paragon of moral and social excellence, pitted against great and clearly identifiable evil, and willing to sacrifice all for the greater good. Modern war, however, fails to provide such clear demarcations for moral choices. It can be difficult to connect the outcomes of specific missions with service to one's country, suggesting that perhaps supplanting more specific and realistic accounts of heroism for the more widespread mythic models would aide soldiers in avoiding disillusionment.

Scenario-based instruction. In scenario-based instruction the problem is characterized by fixed solution criteria and the learner is positioned in an interactive, real-time experience that allows for a variety of solution paths (Salas, Wilson, Priest, & Guthrie, 2006). Scenarios are constructed using information from cases or instructor experience and are creatively authored to measure specific performance outcomes (Baker, Kuang, Feinberg, & Radtke, 2004). Records of individual and team trainee responses can be used in a sto-

rylike debriefing for generalization to future decision making. Improved performance is emphasized over declarative knowledge, although history and content are central to a scenario's function (Ross, Phillips, Klein, & Cohn, 2005).

The goal of scenario-based training in the military is to develop cognitive templates such that military personnel experience as many combinations of battlefield variables as possible while in training. Following is an example of a military training scenario. In this scenario, the trainees are four F-16 fighter aircraft pilots, each in his or her own aircraft. The focus of the training is on a new flight lead who is in charge of planning and conducting the four-ship mission. The flight lead must maintain situational awareness of the entire battle area in the sky, including the current status and tasking of each of the other three pilots.

Training a flight lead to proficiency is a difficult task because of all the variables that are changing in the air to air battle at an extremely rapid pace. A typical training scenario, that might be used regardless of whether the four pilots are training in simulators or on the range in actual jets, would establish a mission objective and identify a threat (enemy aircraft and ground to surface missiles) against which the trainees must fly. A scenario might be a defensive counter air mission that has the enemy aircraft coming to bomb a friendly airfield, and the F-16 pilots must defend the airfield.

First, the scenario designer would work with the training or instructional designer to determine what the learning objectives are for the flight lead. These objectives, including the standards by which performances are measured, drive the design of the scenarios. The scenario designer would develop a plausible story about the mission. A major task of the scenario designer is to lay out the constraints of the scenario. For example, how long it will take for reinforcements to arrive on scene, or how much fuel is available to the F-16 flight.

Once the designer-storyteller has answered the questions above, plus a host of others, he or she would lay out a basic intelligence briefing that would be given to the flight lead who is planning the mission. The intelligence briefing typically gives some context for the scenario (e.g., what is the strategic situation, what does this particular mission have to do with the larger war). Using the intelligence data, the flight lead develops a plan for the mission taking all objectives and constraints into consideration. The plan is briefed to the rest of the flight, and to any other personnel who might be involved in supporting the flight. The mission is flown, and whether the scenario is conducted in simulators or on the training range, as much measurement as possible is made of the many activities that happen during the scenario play.

Finally, the flight lead and their flight reassemble to debrief what just happened. If the capability is available at that training site, a recorded replay of the mission is shown on bird's-eye view screens that let the trainees look down on the mission as it unfolded.

The flight lead and the instructor, who has watched the entire scenario from planning to debrief, explain to the flight what went right and what went wrong and document lessons learned from the mission. The instructor makes a judgment about how the flight and the flight lead did in comparison to training standards.

Air-to-air missions are always fluid. There typically are no single right solutions to the problem. The scenario design should allow for many different approaches to reaching the objective, which is the successful defense of the airfield. If we refer back to our storytelling theme, the scenario designer and the instructor must be prepared for a huge number of plot twists during an air to air scenario. The key is to train using enough different scenarios so that the trainees build cognitive templates that can be referred to in any new situation the pilots encounter in the future.

Problem-based instruction. In problem-based instruction the problem is ill structured with no preformed solution criteria or parameters (Hmelo-Silver, 2004; Savery, 2006) and the learner is positioned as the director of learning activities (Barrows, 1980). The problem is used as a tool for understanding declarative and abstract knowledge (Wood, 2003) in a context to improve transfer to practice (Barrows, 1980). The method is embedded in a collaborative team environment (Boud & Feletti, 1997; Hmelo-Silver, 2004) where independent learning is brought back to form the collective ideas of the group (Savery, in press; Wood, 2003). The teacher or tutor may take on the role of facilitating the discussion but will refrain from providing declarative facts or knowledge, to help the learner maintain responsibility for his or her own solution and learning (Savery, 1998; Savery & Duffy, 1995). Barrows (n.d.) and Savery (2006) provide detailed overviews of the characteristics of problem-based learning.

The U.S. Air Force Research Laboratory in Mesa, Arizona is pursuing programs that use problem-based instruction to teach decision making processes to aeronautical management technology students. In emergency situations it can be difficult to draw on training and knowledge stores. It is also difficult to create a comprehensive set of procedures for complex and subtly unique dilemmas that are encountered by pilots. This line of research seeks to establish problem-based teaching and learning practices that assist pilots in gaining broad analytical and action-focused generative skills for use in novel situations.

Students begin by receiving an overview of problem-based practices. The roles of the facilitator are defined and the demands of problem-based learning are identified. This helps to avoid confusion or comparison of the instructional method against more traditional forms of teaching. Learners are divided into small groups of 4 to 5 people. The facilitator and the learners then read through an actual account of a pilot managing an airplane malfunction together. The story provides meaningful details about prelaunch activities, destination, dialogue with Air Traffic Control, and thoughts and opinions as voiced by the narrator of the story.

Students only read to the event where the malfunction or problem is detected. At this point, the story is set aside and each group is asked to discuss possible courses of action, identify additional information needed to make an informed decision and take note as much as they are able of the inquiry process they are going through. A member of the group records ideas, comments, and questions as voiced by the others discussing the situation.

After some debate the groups are then asked to review the notes taken by the scribe to detail a research plan. It is here that the learners consider what questions are the most important to answer, what resources would be the most valuable, what possible solution sets would look like, and what criteria are necessary for determining when they have reached a reasonable solution. Over several sessions, students reconvene to present their findings, share additional information, and discuss old and new ideas for solutions. The facilitator assists the students in identifying gaps or limitations in their thinking processes and helps them to formulate new lines of inquiry as necessary without providing information or solutions.

The session ends when each group presents their solution to the class and a discussion of important similarities and differences is facilitated by the tutor or instructor. The facilitator finishes reading the original story and debriefs the session by identifying and revoicing the process that the learners followed in developing a workable plan, emphasizing the process over the specific content for this situation itself.

This practice provides learners with a problem-based learning environment from which to imagine and research potential outcomes and conclusions. Participants create their own community stories as they consider together the actions and events needed to resolve the problem. A large variety of "plots" and alternatives are constructed around the single problem situation presented at the beginning of the session. This enables learners to draw on a decision process tied to issues of working through complex events with high stakes outcomes.

Research Foundations

Each of the four methods has a rich history of literature. One of the advantages of grouping them together under the umbrella of storytelling is that connections can be made between the various theoretical and methodological traditions, thereby informing our understanding of the relationships between storytelling and the processes of the mind. None of what follows is to be taken as the final word on the matter. Many of the philosophical, theoretical, empirical, and practical undercurrents of teaching and learning continue to shift at an ever increasing rate. We have identified some major bodies of research that have been used as lenses in approaching storytelling theory and that inform its practice.

At the base of storytelling approaches to instruction is a theory of mind as a pattern recognizer (for several perspectives on this see Bechtel & Abrahamsen, 1990; P.M.

Churchland, 1995; P.S. Churchland & Sejnowski, 1992; Clark, 1993, 1997, 2003; Elman et al., 1996; Gee, 1992; Hofstadter and the Fluid Analogies Research Group, 1995; Minsky, 1985; Margolis, 1987, 1993; Nolan, 1994; Rumelhart, McClelland, and the PDP Research Group, 1986). Far from being primarily an analytical, context-free, information-processing unit, the mind seeks to identify and organize mental life by associating similar structures, events, or contexts into a meaningful whole. It is suggested that this aides our ability to prepare for and act in future contexts (Hawkins & Blakeslee, 2004). Moreover, much of the pattern recognition done by the mind remains at the tacit level and can be very difficult to make explicit (Polanyi, 1983; Sternberg, 2000). These findings are the reason for interest in the temporal and purpose-driven nature of storytelling. It is through the mind's encounter with a procession of contextually ordered stimuli that it can sense and then apply information about the patterns of events and effects that exist in the world. Furthermore, that explicit approaches to eliciting this understanding may never achieve the effectiveness desired for instruction. This is especially true of higher order cognitive skills such as problem solving, creativity, and leadership. We do not, however, want to minimize the ongoing role of information processing models in designing and researching learning environments, but merely to stress that our theoretical approach to instruction can not rest there. In fact, some work is already seeking to merge pattern recognition and information processing models as co-mechanisms of thought (Armstrong et al., 1983; Marcus, 1999; Pinker, 1997).

Building on this theoretical approach to the mind are more specific foundational texts and current research aims organized around each instructional method presented in the paper.

Case-based instruction. Theoretical approaches to the role of cases in thinking, reasoning and problem-solving rest in a few different strains. Craik and Lockhart's (1972) pattern recognition and depth of processing model and Klein's (1989, 1997) primed decision making help explain how cases are used to help novices recognize patterns for generalization to future decision making. This process is also described by Kolodner (1993) in her work on problem solving processes.

The goal of case-based instruction and the value of situated learning as given by these models and by Brown, Collins and Duguid (1989) is to help the learner gain expertise within a specific domain of action. Associative networks (Hinton, McClelland & Rumelhart, 1987) and analogical reasoning (Klein & Whitaker, 1988; Shinn, 1988) explain how connections are made between similar cases, cognitive objects, thoughts or perceptions. Schank (1999, 1988) proposes that a dynamic memory network assists in the recall and comparison of aspects of experience enabling the mind to form analogies and sense patterns.

Narrative-based instruction. Foundational literature in narrative as a tool for understanding how we organize meaning in the world draws on Bruner's (1991, 1990, 1986)

discussion of the narrative construction of reality. Bruner details ten features of narrative that contribute to this process and outlines the next steps in completing the model. Gerrig (1993) organizes accounts of narrative experience around two metaphors, namely, transportation into the narrative environment and performance of meaning making activities. We see here the embodied, contextual, and active dimension of work on the relationships between stories and our navigation of the world.

In addition to the cognitive and experiential dimensions of narrative research is work on the importance of emotion in storytelling. Daniel Goleman's (2005) studies on emotional intelligence appeal to researchers who look at the entertainment and motivational aspects of narrative. Ledoux (1996) also discusses the neurological centers of emotion and the subconscious processing of stimuli that creates emotional experiences. Sarason (1999) relates the emotional impact of stories and teaching to the performing arts and suggests artistic expression be increasingly emphasized in teacher education.

Scenario-based instruction. Literature on scenario-based instruction and training refer often to many of the theoretical publications listed under case-based instruction above. However, the method is extended to include the training of teams (Cooke, 2002; DuBois & Gillan, 2000; Oser et al., 1999; Salas et al., 2001; Van Berlo, 2005) and strives to develop highly elaborate measurement structures (Baker et al., 2004; Spiker et al., 2006; for a review of the levels of evaluation see Kirkpatrick, 1987). Completing tasks, real or synthetic, are central to the design and objectives of scenarios (Cooke, in press).

The approach of learning-by-doing is investigated by Schank et al. (1994) in the discussion of goal-based scenarios. Other theoretical frameworks that reflect the benefit of active learning are the Adult Learning Model (Dean, 1994; Prevou & Colorado, 2003), as well as constructivist frameworks (Bruner, 1966, 1996; Jonassen, 1998).

Problem-based instruction. The theoretical support for problem-based instruction often begins with Howard S. Barrows (1980, 1996) and his colleagues' work at McMaster University (Donner & Bickley, 1993) in learning management and problem-based learning. Boud and Feletti (1997) identify principles and practices prescribed by the instructional philosophy. A good overview of definitions and characteristics of problem-based instruction is given by Savery (2006). The problem acts to focus group discussion, meaning making, and primes learners for active implementation of what is learned.

Lev Vygotsky's (1978) zone of proximal development is often cited in research on problem-based instruction. It is one approach for understanding and identifying problems that are best for different levels of learners and in providing understanding of how skills progressively build on each other. Vygotsky recognizes, as does constructivist appraisals of problem-based learning (Savery & Duffy, 1995; for an overview of constructivist design see Jonassen, 1998), that the learner brings his or her experiences, goals, desires, and attitudes into the learning environment and that connecting new information to current understandings is key in gaining any type of real competence in the new material.

Research Agenda

Case-based instruction. There are two main research issues for cases. The first involves finding methods for selecting the most instructive cases, especially as the number of available cases grow. Secondly, there is a need to establish ways of extracting the important principles from a variety of cases while retaining the context rather than simply producing piles of facts.

- What should be learned from a case?
- What is the role of the instructor in facilitating the desired interpretation of the case?
- When a case is written, how does the author choose what to summarize and what to detail? How does this affect the authority and usefulness of the case?
- What should determine when cases are used in instruction? How often are they used merely out of habit?
- Is it possible to assess the effectiveness of the case-based method? If so, how?

Narrative-based instruction. Issues in narrative-based instruction center first on how to structure the narrative itself. Once a narrative is created, consideration has to be given to its use and what, if any, additional instructional practices should supplement it. Many of the questions related to case-based instruction above apply to narratives as well, but there are some additional considerations.

- How do differences in culture, gender, interest, prior knowledge, language ability, and motivation affect the interpretation of the narrative?
- How much of the narrative should be written for emotional effect? How much should just address the objectives? How immersive should it be?
- Should learning objectives be discussed before the presentation of the narrative?
- What can and cannot be taught with narrative?
- What questions are best to ask after a narrative is presented? What can be done to promote reflection?
- Is interrupting the narrative for teaching moments more or less effective than playing it through?

Scenario-based instruction. Improved measurement is the central issue for research in scenario-based instruction. The goal is for training to be measured so accurately that trainers can expect a predictable and constant gain in performance as the result of running an exercise. There are questions as to how many scenario elements can actually be measured and the extent to which new tools will broaden that ability.

- How can instructor observation and assessment be improved?
- Is it possible to measure the training value of a scenario before it is delivered?
- Assuming everything cannot be measured, what are the critical elements to measure?

- How much time should a trainee be engaged in a scenario? How long can a trainee remain engaged and still learn effectively?
- How can designers anticipate novel actions in a highly interactive and adaptive environment? At what point should trainees and trainers be involved in the design process? What level of detail or fidelity is most effective?

Problem-based instruction. Seeking methods for structuring problem-based curricula, establishing standardized practices for measuring the effectiveness of the instruction, and defining the roles of the participants engaging in the process are all part of further research efforts in PBL.

- What role should the instructor play? The learner? The environment? What arrangement of characteristics between the three is the most efficient?
- How should problems be structured? How should they be posed to the learner?
- How are learning outcomes established? How are they measured?
- How will learners be motivated? What happens if learners get "stuck"?
- When is problem-based instruction appropriate? If, and when, is it to be avoided?

Conclusion

The goal of this paper was to provide a brief introduction to the current research activity in the areas of storytelling and instruction. Much of the work and connections identified here were made by participants from settings in academia, government, and industry at a Storytelling as Instructional Method workshop held in Mesa, Arizona in 2007. Methods and research in case-, narrative-, scenario-, and problem-based learning uncover a wealth of resources, applications and challenges common to this mode of instruction.

Interest in storytelling as instruction continues to build for at least two reasons. First, technological advances are such that communication and interactivity are easier to facilitate (Jenkins, 2006), high-fidelity and media rich learning environments are becoming more and more common (Gee, 2007), and this contributes to the belief that life and learning in the Information Age will differ significantly from that of the Industrial Age (Reigeluth, 1999). Second, research into learning continues to indicate the value and effectiveness of the four methods of storytelling in general. While there is still some disagreement (Kirschner, Sweller, & Clark, 2006), many are finding that learners embedded in contextual, authentic, real world problems are more engaged, draw on more resources, and transfer learning more effectively (Barnes, Christensen, & Hansen, 1994; Davis, Sumara, & Luce-Kapler, 2008; National Research Council, 2000; Prevou, & Colorado, 2003). It is our hope that future research will continue to uncover why exactly this is so and how we can more effectively harness the power of more appropriately designed stories and instructional environments.

Acknowledgements

This work was sponsored in part by Dr. Jerome R. Busemeyer of the Air Force Office of Scientific Research and by an appointment to the Student Research Participation Program at the US Air Force Research Laboratory administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the US Department of Energy and USAFRL/HEAT. It was hosted by the Cognitive Engineering Research Institute of Mesa, AZ.

References

Abbott, A. (1992). What do cases do? Some notes on activity in sociological analysis. In C. C. Ragin, & H. S. Becker, (Eds.), *What is a case? Exploring the foundations of social inquiry* (pp. 53-82). Cambridge, UK: Cambridge University Press.

Armstrong, S. L., Gleitman, L. R. & Gleitman, H. (1983). What some concepts might not be. *Cognition, 13*, 263-308.

Baker, D. P., Kuang, D., Feinberg, E., & Radtke, P. (2004). Linking performance measures and measurement purpose in scenario-based training. *Proceedings of the 48th Human Factors and Ergonomics Society*, 2596-2598.

Barnes, L. B., Christensen, C. R., & Hansen, A. J. (1994). *Teaching and the case method: Text, cases, and readings.* Boston: Harvard Business School Press.

Barrows, Howard. Generic problem-based learning essentials. *PBLI*. Retrieved October 12, 2009, from http://www.pbli.org/pbl/generic_pbl.htm

Barrows, H. S. (1996). Problem-based learning in medicine and beyond: A brief overview. *New Directions in Teaching and Learning, 68*(Winter), 3-12.

Barrows, H. S., & Tamblyn, R. (1980). *Problem-based learning: An approach to medical education.* New York: Springer.

Bechtel, W. & Abrahamsen, A. (1990). *Connectionism and the mind: An introduction to parallel processing in networks.* Oxford: Basil Blackwood.

Benedict, R. (1934). *Patterns of culture.* Boston: Houghton Mifflin.

Boud, D., & Feletti, G. (1997). *The challenge of problem-based learning* (2nd ed.). London: Kogan Page.

Brady, M. K. (1997). Ethnic folklore. In T. A. Green (Ed.), *Folklore: An encyclopedia of beliefs, customs, tales, music, and art* (pp. 237-244). Santa Barbara, CA: ABC-CLIO.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Brown, J. S., & Duguid, P. (1998). Organizing knowledge. *California Management Review 40*(3), 90–111.

Bruner, J. (1966). *Toward a theory of instruction*. Cambridge, MA: Harvard UniversityPress.

Bruner, J. (1986). *Actual minds, possible worlds*. Cambridge, MA: Harvard University Press.

Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Bruner, J. (1991). The narrative construction of reality. *Critical Inquiry, 18*(1), 1-21.

Bruner, J. (1996). *The culture of education.* Cambridge, MA: Harvard University Press.

Cappelli, D. M., Desai, A. G., Moore, A. P., Shimeall, T. J., Weaver, E. A., Willke,

B. J. (2006). Management and Education of the Risk of Insider Threat (MERIT). *Proceedings from ISDS Netherlands 2006: 24th International Conference of the System Dynamics Society.* The Netherlands: Radboud University of Nijmegen. Retrieved July 29, 2008, from http://www.systemdynamics.org/conferences/2006/proceed/papers/MOORE333.pdf.

Chatman, S. B. (1978). *Story and discourse: Narrative structure in fiction and film.* New York: Cornell University Press.

Churchill, L. R., & Churchill, S. W. (1989). Storytelling in medical arenas: The art of self-determination. *Journal of the American Medical Association, 262*(11), 1541-1541.

Churchland, P. M. (1995). *The engine of reason, the seat of the soul.* Cambridge, MA: MIT Press.

Churchland, P. S. & Sejnowski, T. J. (1992). *The computational brain*. Cambridge, MA: Bradford/MIT Press.

Cianciolo, A. T., Prevou, M., Cianciolo, D., & Morris, R. (2007). Using digital storytelling to stimulate discussion in Army professional forums. *Proceedings from The Interservice/Industry Training, Simulation & Education Conference (I/ITSEC)*. Retrieved July 29, 2008, from http://www.iitsec.org/documents/Edu.pdf.

Clark, A. (1993). *Associative engines: Connectionism, concepts, and representational change.* Cambridge, UK: Cambridge University Press.

Clark, A. (1997). *Being there: Putting brain, body, and world together again.* Cambridge, MA: MIT Press.

Clark, A. (2003). *Natural-born cyborgs: Why minds and technologies are made to merge.* Oxford: Oxford University Press.

Cobley, P. (2001). *Narrative.* New York: Routledge.

Cohn, R. L. (1994). *They called it pilot error: True stories behind general aviation accidents.* New York: McGraw-Hill.

Cooke, N. J., & Shope, S. M. (in press). Designing a synthetic task environment. In S. G. Schiflett, L. R. Elliott, E. Salas, & M. D. Coovert (Eds.), *Scaled worlds: Development, validation, and applications.* Surrey, UK: Ashgate.

Cooke, N. J., & Shope, S. M. (2002). The CERTT-UAV task: A synthetic task environment to facilitate team research. *Proceedings from ASTC: The Advanced Simulation Technologies Conference: Military, Government, and Aerospace Simulation Symposium* (pp. 25-30). San Diego, CA: The Society for Modeling and Simulation International.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11,* 671-684.

Davenport, T. H., & Prusak, L. (1998). *Working knowledge: How organizations manage what they know*. Boston: Harvard Business School Press.

Davis, B., Sumara, D., & Luce-Kapler, R. (2008). *Engaging minds.* New York: Routledge.

Dean, G. J. (1994). *Designing instruction for adult learners.* Malabar, FL: Krieger Publishing Co.

DeMeester, K. (in press). Enhancing soldiers' resiliency to combat stress injuries through stories. In D. H. Andrews & T. D. Hull (Eds.), *Storytelling as an instructional method: Research perspectives*. Netherlands: Sense Publishers.

Dorf, M. C. (2004). *Constitutional law stories.* New York: Foundation Press.

Donner, R. S. & Bickley, H. (1993). Problem-based learning in American medical education: an overview: Highlighting problem-based learning and medical libraries. *Bulletin of the Medical Library Association 81*(3)*,* 294-298.

DuBois, D. A., & Gillan, C. A. (2000). Cognitive training initiatives: A case study of aircrew training. *Proceedings from I/ITSEC: The 21st Interservice/Industry Training Simulation and Education Conference* (pp. 473-483). Arlington, Va.: National Training Systems Association.

Egan, K. (1989). *Teaching as story telling*. Chicago: University of Chicago Press.

Elman, J. L., Bates, E., Johnson, M. H., Karmiloff-Smith, A., Parisi, D., & Plunkett, K. (1996). *Rethinking innateness: A connectionist perspective on development.* Cambridge, MA: MIT Press

Ellet, W. (2007). *The case study handbook: How to read, discuss, and write persuasively about cases.* Cambridge, MA: Harvard Business School Publishing.

Forbes Magazine Staff & Gross, D. (1997). *Forbes greatest business stories of all time.* New York: John Wiley & Sons.

Gee, J. P. (1992). *The social mind: Language, ideology, and social practice.* New York: Bergin and Garvey.

Gee, J. P. (2007). *What video games have to teach us about learning and literacy.* New York: Palgrave Macmillan.

Gerrig, R. J. (1993). *Experiencing narrative worlds.* New Haven: Yale University Press.

Gershon, N. and Page, W. (2001). What storytelling can do for information visualization. *Association for Computing Machinery. Communications of the ACM, 44*(8), 31-37.

Goleman, D. (2005). *Emotional intelligence: Why it can matter more than IQ*. New York: Bantam Books.

Harries, C. (2003). Correspondence to what? Coherence to what? What is good scenario-based decision making? *Technological Forecasting and Social Change, 70*(8), 797-817.

Hawkins, J. & Blakeslee, S. (2004). *On intelligence.* New York: Times Books.

Hill, R. W., Gordon, A. S., & Kim, J. M. (2004). Learning the lessons of leadership experience: Tools for interactive case method analysis. *Institute for Creative Technologies University of Southern California.* Retrieved July 29, 2008 from http://people.ict.usc.edu/~gordon/ASC04A.PDF

Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review, 16*(3), 235-266.

Hofstadter, D. and the Fluid Analogies Research Group (1995). *Fluid concepts and creative analogies: Computer models of the fundamental mechanisms of thought.* New York: Basic Books.

Jenkins, H. (2006). *Convergence culture: Where old and new media collide.* New York: New York University Press.

Jonassen, D., Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *ETR&D, 50* (2), 65-77.

Kirkpatrick, D. L. (1987). Evaluation. In R. L. Craig (Ed.), *Training and development handbook: A guide to human resource development* (3rd ed, pp. 294-312). New York: McGraw-Hill.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*(2), 75-86.

Klein, G. A., & Peio, K. J. (1989). The use of a prediction paradigm to evaluate proficient decision making. *The American Journal of Psychology, 102*(3), 321-331.

Klein, G. A., Whitaker, L. A., & King, J. A. (1988). Using analogues to predict and plan. *Proceedings from CBRW: The Case-Based Reasoning Workshop* (pp. 224-232). Clearwater Beach, FL: Defense Advanced Research Projects Agency.

Klein, G. A., & Zsambok, C.E. (1997) *Naturalistic decision making: Expertise-research and applications*. Mahwah, NJ: Erlbaum.

Kolodner, J. L. (1993) *Case-based reasoning*. San Francisco, CA: Morgan Kaufman Publishers, Inc.

Labov, W. (1972). *Language in the inner city: Studies in the black English vernacular.* Philadelphia: University of Pennsylvania Press.

LeDoux, J. (1996). *The emotional brain: The mysterious underpinnings of emotional life*. New York: Simon & Shuster.

Leonard-Barton, D. (1990). A dual methodology for case studies: Synergistic use of a longitudinal single site with replicated multiple sites. *Organizational Science, 1,* 248–266.

MacDonald, M. R. (Ed.). (1998). *Traditional storytelling today: An international sourcebook*. Chicago, IL: Fitzroy Dearborn.

Marcus, G. F. (1999). *The algebraic mind.* Cambridge, MA: MIT Press.

Margolis, H. (1987). *Patterns, thinking, and cognition: A theory of judgment.* Chicago: University of Chicago Press.

Margolis, H. (1993). *Paradigms and barriers: How habits of mind govern scientific beliefs.* Chicago: University of Chicago Press.

Martin, W. (1986). *Recent theories of narrative.* New York: Cornell University Press.

Merrill, D.M. (2002). First principles of instruction. *Educational Technology Research & Development*, *50*, 43-59.

Minsky, M. (1985). *The society of mind.* New York: Simon & Schuster.

National Research Council (2000). *How people learn: Brain, mind, experience and school.* Washington D.C.: National Academy Press.

Nolan, R. (1994). *Cognitive practices: Human language and human knowledge.* Oxford: Blackwell.

O'Brien, E. J. & Myers, J. L. (1987). The role of causal connections in the retrieval of text. *Memory and Cognition, 15,* 419-427.

Oser, R. L., Gualtieri, J.W., Canon-Bowers, J. A., & Salas, E. (1999). Training team problem solving skills: An event-based approach. *Computers in Human Behavior, 15*(3), 441-462.

Pinker, S. (1997). *How the mind works.* New York: Norton.

Polanyi, M. (1983). *The tacit dimension.* Gloucester, MA: Peter Smith Publisher Inc.

Preczewski, S. C., Hughes-Caplow, J. A & Donaldson, J. F. (1996). *Educating and motivating leaders for the 21st century*. (ARI Research Note 96-31). United States Army Research Institute for the Behavioral and Social Sciences.

Prevou, M., & Colorado, J. (2003). Simulations in education: Creating an experiential learning environment. *Proceedings from I/ITSEC: The 24th Interservice/Industry Training, Simulation, and Education Conference*, Orlando, FL. Arlington, VA: National Training Systems Association.

Reigeluth, C.M. (1999). What is instructional design theory and how is it changing? In C.M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2). Mahwah, NJ: Lawrence Erlbaum.

Rhode, D. L. & Luban, D. (2005). *Legal ethics: Law stories.* New York: Foundation Press.

Ross, K. G., Phillips, J. K., Klein, G., & Cohn, J. (2005). Creating expertise: A framework to guide simulation-based training. In *Proceedings of the 26th Interservice/Industry Training Simulation and Education Conference*, Paper No. 2221. Arlington, VA: National Training Systems Association

Rumelhart, D. E., McClelland, J. L., and the PDP Research Group (1986). *Parallel distributed processing: Explorations in the microstructure of cognition.* (Vol. 1). *Foundations.* Cambridge, MA: MIT Press.

Sacks, H. (1995). *Lectures on conversation* (Vols. 1-2). (G. Jefferson, Ed.). Oxford: Blackwell.

Salas, E., Burke, C. S., Bowers, C. A., & Wilson, K. A. (2001). Team training in the skies: Does crew resource management (CRM) training work? *Human Factors, 43*(4), 641-674.

Salas, E., Wilson, K. A., Priest, H. A., & Guthrie, J. W. (2006). Design, delivery, and evaluation of training systems. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics* (pp. 472-512). (3rd ed.). New York: John Wiley & Sons.

Sarason, S. B. (1999). *Teaching as a performing art.* New York: Teachers College Press.

Savery, J. R. (in press). Problem-based learning and story telling: Finding common ground as instructional strategies. In D. H. Andrews & T. D. Hull (Eds.), *Storytelling as an instructional method: Research perspectives*. Netherlands: Sense Publishers.

Savery, J. R. (2006). Overview of problem-based learning: Definitions and distinctions. *The Interdisciplinary Journal of Problem-based Learning, 1*(1), 9-20.

Savery, J. R. (1998). Fostering ownership with computer supported collaborative writing in higher education. In C. J. Bonk & K. S. King (Eds.), *Electronic collaborators: Learner-centered technologies for literacy, apprenticeship, and discourse* (pp. 103-127). Mahwah, NJ: Lawrence Erlbaum Associates.

Savery, J. R., & Duffy, T. M. (1995). Problem-based learning: An instructional model and its constructivist framework. In B. Wilson (Ed.), *Constructivist learning environments: Case studies in instructional design* (pp. 135-148). Englewood Cliffs, NJ: Educational Technology Publications.

Schank, R. C. (1988). Dynamic memory: A theory of reminding and learning in computers and people. *Proceedings from CBRW '88: The Case-Based Reasoning Workshop* (pp. 1-20). Clearwater Beach, FL: Defense Advanced Research Projects Agency.

Schank. R. C. (1999). *Dynamic memory revisited.* New York: Cambridge University Press.

Schank, R. C., Fano, A., Bell, B., & Jona, M. (1994). The design of goal-based scenarios. *The Journal of the Learning Sciences, 3*(4), 305-345.

Shinn, H. S. (1988). Abstractional analogy: A model of analogical reasoning. *Proceedings from CBRW '88: The Case-Based Reasoning Workshop* (pp. 370-387). Clearwater Beach, FL: Defense Advanced Research Projects Agency.

Spiker, V. A., Walls, W. F., & Karp, M. R. (2006). Simulator design and assessment tool for training (SimDATT). *Phase II final report.* (Volume II). *A commercial aircrew version and a training effectiveness evaluation*. Orlando, FL: Naval Air Warfare Center.

Sternberg, R. J. et al. (2000). *Practical intelligence in everyday life*. New York: Cambridge University Press.

Trabasso, T., van den Broek, P., & Suh, S. Y. (1989). Logical necessity and transitivity of causal relations in stories. *Discourse Processes, 12,* 1-25.

Van Berlo, M. P. W. (2005). Towards improving the instructional design process for team training. *Proceedings from I/ITSEC 2005: The 26th Interservice/Industry Training Simulation and Education Conference*, Paper No. 2027. Arlington, VA: National Training Systems Association.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds. and Trans.). Cambridge, MA: Harvard University Press.

Whipp, J. L., Ferguson, D. J., Wells, L. M., & Iacopino, A. M. (2000). Rethinking knowledge and pedagogy in dental education. *Journal of Dental Education, 64* (12), 860-866.

Wieviorka, M. (1992) Case studies: History or sociology? In C. C. Ragin, & H. S. Becker (Eds.), *What is a case? Exploring the foundations of social inquiry.* Cambridge, UK: Cambridge University Press.

Wood, D. F. (2003). ABC of learning and teaching in medicine: Problem based learning. *British Medical Journal, 326,* 328-330.

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