All Workshop Notes Grouped by Themes the Breakout Groups were asked to Address

This document presents the unedited notes that were taken during each breakout session. It is organized around the four main themes that breakout groups were asked to address. The four main themes are; definition/theory, research issues, research approach, and real world applications of storytelling method research. The four breakout groups were; case-based method of instruction, narrative-based, problem-based, and scenario-based.

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Definition/Theory

Groups were asked to address the following questions:

1) Define the instructional method (i.e., case, scenario, narrative, or problem). Try to find consensus among group members regarding the definition.
2) Discuss various theories that support the instructional method.
3) Address any theory gaps. If there are any theory gaps, what needs further development?

Case-based Method

- Stories are success oriented events.
- A story is at the heart of most computer/video games. A story in the gaming world is definitely defined.
- However, in the military, people in lower ranks often participate in training exercises without knowing the point of them. It is a serious issue. And at times, those who create the training are unaware of the point as well.
- In order to define a "case," we must compare it in respect to the other story types: problem, narrative, and scenario. A matrix shown below, notes the groups' definition of case, relatively to the other types of stories.

	Case	Problem	Narrative	Scenario
MUST be Real Experience	Yes	No	No	No
Known Outcome	Yes	No	Yes	No
MUST be Factual (History)	Yes	No	No	No
Story Line (Beg, Mid, End)	Yes	No	Yes	No
Selective Focus	?	Yes	Yes	Yes
Must be Entertaining	(No)	No	Yes	(No)
Interactive	No	Yes	(No)	Yes
Authority				
Assessment	No	Yes	No	Yes

*Note: Items placed within parenthesis are negotiable

- A "narrative" allows for embellishments. But, there are also embellishments in "cases".

- What is the difference between a "case" and a story? What is special about "cases?"
    1. Cases are a constrained way of showing something complex.
- There is a story behind all four types of instructional methods (case, narrative, problem, and scenario). Is there so much overlap that they should not be divided up? From a pedagogical perspective, all four are different.
- In the legal sector, a "problem" is a derivative of a "case."
- In a "problem" the answer has not yet been determined. A "case" is more of a historical fact.
- A "narrative" is closest to a "pure" story.
- A "scenario" is more structured than a "narrative."
- Perhaps the difference between "case" and "narrative" is descriptive versus entertainment.
- A "narrative" is more multifunctional.
- By using humor in stories it helps to make it "stick." By firing emotions, people better recall the story or learning experience.
- In MBA programs, "case-based" instructional methods are prevalent.
- It seems as though we start with "cases" and then evolve to "problem."
- "Scenarios" are contrived or very structured. There is an authority that is not in the "narrative". However, "cases" have an authority behind them as well.
- In "scenario-based" training the story is told for some truth. In "scenarios" individuals are interacting in real time with elements of the scenario. Performance and feedback are elicited. Scenarios are simplified in order to explain an issue. A scenario is something that has no history. But it is as real as you can get it to approach an issue.
- "Scenarios" reason from experience, "cases" reason more from history. Therefore, "cases" are the only story that *must be* a real experience.
- In regards to knowledge outcomes: in "problem" the instructor may know the outcome. In "narrative" the storyteller knows the outcome, but listener/learner does not necessarily know the outcome.
- "Cases" are *factual.*
- A "case" can have a story line and there can be heroes and villains. You can present a "case" as a story. "Cases" try for an outcome, not really a *story* but a *situation.*
- A story keys in on characters interacting.
- In regards to selecting focus: When selecting a focus, do you embellish at all? Some "narratives" are not selective. "Scenarios" are set up to try for a selected focus with key decision points.
- In regards to entertainment: making it entertaining gains attention and is more inherently interesting. It is hard to discriminate between games and situations. If the disclaimer *must be* entertaining is added, then "narrative" is the only story that must be entertaining.
- The group defined interactive as, "Something that can affect the outcome of your decisions." A "case" cannot affect the outcome.

Narrative-based Method

> **Narrative for Instruction** has a temporal nature to it, a defined structure that is recognizable, flexible and malleable (primarily by narrator), and engagement must be included as a component of the narrative. Key components: narrator, audience, temporal, structure, flexibility, conclusion, context

- Dictionary definition of narrative: representation in art of an event or story. Narratologists can not agree on one definition for narrative. A simplistic look at narrative is a recounting of a sequence of events.

- A narrative contains a continuance subject with relationship to events. Causality or goal is an integral part of a narrative, it helps us process things, gives access to more things. Within the narrative, one thing has to lead to another thing. Narration would be the basis for establishing some type of causality, but causality terminology is not necessary to use within story.

- Narrative leads to the person telling the story; two people could have different views of the story and either tell it in different ways or interpret the narrative in different ways. Differentiation of narrative from story is how it is told, how it is represented as an artful way or pertains to how the narrator is interacting with the audience. Narrative is more than just a sequencing of events.

- Is narrative all in past tense, does it all come from past or can it be projected into future?

- There is a specific perspective narrator brings to the story. A narrator actually experienced the event, or is sharing events that occurred first hand, or is the messenger telling this is what happened.

- The goal of the narrative in the story might be – teach a lesson, learn a story, provide facts, or maybe there is nothing to learn. Using narrative to communicate the culture of an area may require a multitude of narratives to show big picture, bring in perspectives from people like villager to politician. Leads to bringing in influencing factors, social influence.

- Stories are sometimes suitable for transmitting information and sometimes not, they lend ability to define difficult concepts of why something is why it is – example - why is a commander in the field a good commander?

- Perspective of narrative source (how it is told), and perspective of recipient of story –all adds up to muddle the definition. People draw visual picture through gestures. Words that are between the lines, what is not said is almost as important as what is said. Leave things open to manipulation. Facts in reverse order can influence character perception or belief.

- Narratives can be used for transmitting information or generating interest, information can be secondary. They are representation of some kind of a sequence of events, in a form either written or verbal. Transmission of a representation, knowledge, and interest.

- Necessary components that define narrative: teller, sequence, context, audience, maybe desired outcome in mind, storyteller's intent.

- Teller/instructor must understand audience before choosing story to share. Intent versus actual result, interpretation forced upon recipient – it is up to you to pull it out. Stories for instruction – intent comes from instructional goals, and still need to worry about interpretation on other end. Every person has a specific experience – emergent story, becomes narrative once story is shared.

- Do stories teach or are they just tools in an instructor's toolbox?

- Scaffolding the story induces a perspective, existential influence.

- Instructional narratives – components – must have structure, time based, sequence, past tense, visit various time periods within narrative, first event – fourth event – second event must lead to understanding of where you are at, unfolds linearly – but recounting doesn't have to be linear.

- Linearity may be the POWER of the method, may impact learner more. Storyteller can tell what they were thinking at a particular time in the event. Backing up within story is okay – hindsight is 20/20. Time can be used to emphasize various affects, used as justification for action or rationalization. Time forces processing of information when it is not linear. Time is very critical in several storylines to hold audience interest. In the book, *Johnny Got His Gun*, time is critical. Future or past – narrative must include timeline of some kind.

- Does flexibility in story lead to engagement?

- Maybe narrative needs to be boring, too interesting may disallow learner from remembering all points. Story needs to be relevant or surprising, or conflicting to allow learner to remember story. Must be engaging – group consensus. Good narratives for instruction have different characteristics than just narrative. Outcome is dependent on quality of teller, and other characteristics.

- Environmental déjà vu (frame people or prepare them for what might present to them) versus environmental hypotheses. Representation of what did happen or what could happen. Hypothetical narratives. Time based recounting. Credibility of the outcome.

- What is the purpose of the narrator? Credibility, a story is all that could happen versus a narrative is something that did happen. The point may be to be incredible versus credible.

- Does it need to be believable – story and narrator?

Audience needs to be able to apply it for use; therefore the narrative must have a purpose, moral, entertainment, point, or instructional goal. Needs debrief, maybe need brief and debrief and conclusion.

Supporting Theories
- Structure of memory, episodic memory, how we organize, heuristics
- Motivational theories
- Emotional engagement and encoding
- Emotional affect on memory and retrieval
- Levels of processing
- Association or empathy
- Does the degree audience empathizes with story affect memory of story?

Problem-based Method

What is PBL?
- Problem Based Learning (PBL) began with Howard Barrow's medical education. Asked the question - What is it that Dr.'s do? They learn anatomy first then encounter the body. Physician encounters a patient with symptoms. Then work way to cause.
- Same approach in a lot of disciplines: Cog scientists – learning is knowledge based.
- PBL approach – first year students in team of 4 (no lectures, etc) give them a problem to solve as a TEAM they are immediately motivated and engaged.
- CASES AND PROBLEMS ARE INTERCHANGEABLE! Cases are a precursor to doing problems. Cases can be ill-structured. Cases have a known outcome, so using a case you are helping students a long a path. Cases have a known outcome, problems do not. But we can use cases in PBL. Cases provide everything you need to solve it. (Cases are single solution)
- Students are given cases and must decide what to do to solve them. Then asked what else do I need to know? What didn't I know in that last case? How can I confirm my hypothesis?
- When it becomes a group process, you take the collective ideas of the group. Individuals must ARTICULATE their understanding.
- What are defining characteristics of PBL?
  - Has to have ILL STRUCTURED problem at the core. What is the definition of ill structured? Not a single solution or single path. FUSSY.
  - Usually collaboration among students, small group or team approach

- o Students come to the problem not knowing all information needed to solve problem (need to use external resources – people, books, etc.)
  - o It seems as if all different categories are efforts to address situated cognition.
  - o PBL becomes a cognitive apprenticeship as the tutor and student work together.
  - o It's not an instructional strategy without the group aspect.
- Students work alone with intelligent tutoring systems (ITS), but now they are working in groups. When they first started working in groups it washed out the effect of the ITS.
- In PBL if the problem is 'how to improve water quality' the solution would be some kind of improvement but people can focus on ALL kinds of solutions (lead in water, run off, etc) so people come to all kinds of different solutions – BROADER, not ONE RIGHT ANSWER.
- Can always ask for help in the problem solving process. (Even in intelligent tutoring systems based on PBL).
- Is tactics part of the definition?
  - o Tutor asks questions of individuals specifically to make sure every single person is involved in the process, make sure not one person can be invisible.
  - o Independent learning occurs after and is brought back to the group.
- Reciprocal teaching is similar to PBL. It is used in reading comprehension, like a reading circle, the teacher does not ask questions the children do. Children rotate through positions so that children are able to experience all parts of a model of reasoning so that children can experience all parts of a model reader.
- Is it a key feature of PBL that people have a visual representation of the problem solving process? (i.e. posters and white boards of group process?)
  - o It is a technique of the PBL process.
- During a PBL session members of the PBL team are creating their very own stories. They add facts and eliminate things, it is a living document.
- Does it HAVE to be a group? Can it be 1-on-1?
  - o one on one is TUTORING! It is problem solving, not PBL.
- Are kids (people) in a group without a tutor engaging in PBL???
  - o Someone is expected to take over the role of leader
- PBL as a curriculum design tool. Using a series of problems that are interrelated. University of Newcastle Architecture has PBL learning program. The expert decides score.
  - o Is it required that they do it collaboratively? (Don't know)
  - o They are sequential tasks – desk- office – office floor- high rise. Increasing complexity.
- Herb Simon – Book on Human Problem Solving. There is a difference between problem solving and problem based learning.
- The problem being that you are not at the goal state, which is the critical point to the instructional method.
- PBL is a design task
- GOALS for PBL
  - o Learn content
  - o Learn Problem solving skills and higher order thinking skills

Scenario-based Method

- Old technique of checklist observations is nearly impossible in current settings.
- What distinguishes scenarios from cases? Scenarios are authored while cases are selected. This is an advantage because scenarios can be built to achieve goals and to measure specific things. Cases are used when you have identified training goal and you find one case that fits it.
- What is a scenario? Is it what you program and present or does it also include the things that occur in response to scenario? If the scenario includes the responses that observers have, those responses must be anticipated when the scenario is developed. A problem is that individuals always do something that you do not anticipate.
- Could a problem be resulting from taking a bottom up approach? Cases are used to build scenarios. In case based, the diagnosis is in the management, not the case. You cannot be adaptive in a case (only externally).
- One of things that makes scenarios different is that things are happening over time. Most case based systems give you the information but there are not unknowns nor are there timelines. In medical cases, there is a history. Cases can incorporate time issues, but dealing with the case does not include a real time process. Sequence is maintained in scenarios but you can accelerate the time.
- Narratives could be authored. Does the story change as the story acts?
- Scenarios are different because you can be adaptive. Measurement issues are tricky between individuals all the way up to the team.
- Performance measurement and management in scenarios is different from the other types of storytelling instruction. It must be adaptive. There is not one way to do the task. The after action review of the scenario can become a case study.
- Another thing that distinguishes scenarios is that scenarios are much more engaging than narratives and problems.
- Difficulty index – for the most difficult scenarios novices underestimate the number of things that the scenario depends on.
- If you are trying to teach something by stair stepping the skills/knowledge, in the end it is likely that they are ready for difficult scenarios. The multi-echelon team work scenarios are difficult.
- If observers don't have enough time in the simulators, the scenarios cannot be successful. Scenarios involve context. They are dynamic.
- Scenarios are not used to teach declarative knowledge.
- We need a taxonomy to describe what situations each type of storytelling can be used for training/education. Where in the scenario is the storytelling? What role, how much of a role does storytelling play? It is easy to see the use of storytelling to motivate. It is harder to see storytelling in the selection of appropriate actions.
- Debrief may be nothing more than a storytelling event, but the observers may use the debrief session differently. Debrief will be different for the same scenario

depending on the experiences of the observer and their perception of the performance.

- Problem: we need valid methods for something inside scenario that generates a meaningful outcome.
- It may be useful to look one unit up, looking at the team rather than the individual. It may also be useful to look at dynamical system to detect changes in variance. Ultimately, the hope is to label the communication (problems). One way to go about it might be to go about building up databases of patterns.
- Are there bandwidth problems? The problem is not only knowing who to talk to but also how to communicate in the wake of communication problems.
- Were you collectively effective at getting something done? How do you go from scenario to pull out diagnostics?
- The scenario heavily depends on the history of the system or event. Without the history, the scenario falls short (USS Vincennes). Experts can troubleshoot, while novices grab hold to the first thing they think of. How many things are going on that actually affect a multi-echelon outcome?
- History and content must be provided. Scenarios cannot just start at the current situation. The development of scenarios is often based on a certain story. Scenario must account for instances where you don't know what your trainee is doing, so that it is open enough to be open ended. For a scenario, you must have certain skills in mind (e.g., multi-tasking, shared understanding).
- The command and control systems are pushing people together faster than they know their own jobs. Part of the design of the systems allows for free ranging, but we have no ways to measure. Outcomes are one way to measure. Open ended solutions are another. Scenarios can also be used for exploration of alternatives (scenario development).
- Scenarios are authored
- Scenarios must be adaptive
- Scenarios are dynamic
- Scenarios must have corresponding performance assessment tools
- Scenarios must take trainee responses into consideration
- Scenarios typically involve multiple modalities (e.g., episodic memory, declarative knowledge).
- People are impressed by a bad outcome. Does the scenario affect the learner sufficiently? The important thing about errors is that without them observers may not feel that they need to change anything.
- We believe that certain types of tasks need to be taught in scenario settings. We don't have much theory that scales up to the collective performance of the team. Nobody is doing scenario-based training is doing it because of theory, but rather because they want to reach a certain outcome: the ability to measure the collective performance. The underlying premise of training is that it is measurable.

Research Issues

Groups were asked to address the following questions

1) What issues exist for the instructional method depending on if it is used in basic or applied research?
2) Create a list describing some examples of where/when/how the instructional method could be used in both basic and applied research.
3) Again, address any theories gaps that may exist. What needs to be done to fill such gaps?

Case-based Method

- One of the presentations during the previous session was entitled, "AXL.Net: Web-Enabled, Multimedia Case Method Instruction for Accelerating Tacit Knowledge Acquisition in Leaders." AXL.NET is a joint U.S. Army and Institute for Creative Technologies project. As part of the presentation a video was shown depicting a decision making exercise for Army officers. The case-based group deliberated as to whether they thought the enactment that was presented was a "case?" It seemed to be more "narrative" in nature. The case presented was very different from a legal case. The presentation probably fits under a "case." However, if it was called "narrative" the group's feeling was that the AXL.Net folks would not be upset. At first, it appeared to be "narrative-based," until she showed all of the tools used around it. We are not used to seeing "case" in such a manner as was presented.
- The reflection piece of the film is key. It gives everyone a chance to review what happened. This is an important part of Army culture.
- In regards to theory: people use stories as a way to share knowledge. In telling the story, people learn though the story.
- Research also shows that it may be possible to let people learn their lessons faster if shown with AXL. The films are crucial. It is not just about the movies, but it is about everything that goes around it.
- Then perhaps a "case" is a domain specific instruction tool.
- For the learner, it is a way of imparting the "system." In the legal sector, there is a "system." Learners are taught how to learn from the past and extract the information. There is a whole concept of tacit knowledge. Therefore, we could expect to see vastly different enactments of the case. The case process is the same process used to make a point.
- Almost all teaching is a process. In law, "cases" teach the process. But in learning about the process, you also do the work.
- Engineering is the same way. It is both teaching how to learn and how to apply knowledge.

- Specifically, what theory are we trying to support? Why does our framework/matrix (of defining "case" compared to the others) work?
- Would it be worthwhile to build a theory?
- From a university perspective, it leads everything we do.
- We develop theories from all of the practice that we have done.
- In respect to cases there are two issues: 1) what can be garnered from the case? and 2) what is the process learned from the case?. The theories underlying the two could be a little different.
- In Gary Klein's idea of prime: people make decisions on the basis of our past experiences that match our circumstance (within 2-3 +/-). But in order to do that, we must have a library of past experiences. However, with "cases," the experiences in the library do not have to be your own. By studying "cases," it allows you to have a library of experiences and apply it.
- Have library of cases→ pattern recognized→ recognition primed decision making
- This is different that a piles of facts, because the "cases" have context.
- We take the story and piece though it. So we look though the library and find the closest match.
- Gerrig and Green have a theory of "transportation." It is about how one "transports" into a story to connect with it and engage with it.
- Do cases have a "narrative" component? They can. The additional "narrative" portion can be crucial for setting the context.
- Johnson and Kolodner describe the process of a person solving a problem. Experts reason from past cases.
- The grand goal is to try and develop how a learner develops a sense of expertise (Brown and Duguid). So part of the question is how to novices become experts? Depending on where one falls on the novice/expert continuum, he/she may learn cases differently.
- Waisel tried to compare stories in a computer data-base. But then the issue becomes how to extract principles from a large amount of cases. How apply "a lot" of cases to specific instances? There is a theoretical gap about how people extract out the important "cases." As individuals, it is a little bit of trial and error. In doing "theme' explicit training, you can decide on a level of specificity. If too general or specific, is useless.
- What is it about the way we encode stories? What is more effective?
- Sternberg has a taxonomy about expert leaders. But there can be differential effects. There is little clarity about what it is to be a good or bad leader.
- The process of teasing out the important parts is both tactical and technical. In the Army Research Institute research "Think like a Commander", they can take a vignette and tease out the expert vs. novice level responses.
- Novices try to compare to "specifics" in their inventory. Experts have developed a "conceptual" view that allows them to better attack new situations.
- The question is how build expertise so the concept becomes engrained. So maybe there is a theoretical gap between expertise and leadership.
- There is a lot of discussion of intuition, but it may be pattern recognition and depths of processing (Craik and Lockhart). There are different kinds of

procedures. And some are declarative and are forgotten more easily. By drawing causal links, they can be remembered more easily.

- How do we pick the "right" thing that the story is trying to get across. Do cases teach an abstraction skill? And maybe in certain contexts (such as law), the "case-based" method is used because is has "always" been done that way (not necessarily because it is the best method).

- In law, there is a story model for jury decision making (collaboration). It is used to improve retention.

- Stories are used to develop shared mental models. Stories are used in "organizations." They are used to preserve or conserve culture. The stories provide something to hang the rest of information on, even if counterproductive.

- There is also the notion of completing a story. Can we provide the introduction of story and have others finish the story. However, will people be reluctant to change a case because it doesn't fit the model? There are examples of this: investigator "A" uses a typical model of deduction, and misses key information. But when investigator "B" looks at a case in a less textbook manner, he solves it.

- This also relates to theories in automaticity in judgment.

- Counterfactual thinking can be shown in cases. Can show what really happened and point out that if someone had made a different decision at point "X," then things may have turned out differently.

- Using cases can help you to learn and retain procedures. If the causal link is understood, then it gets retained.

- J.G. March. Stories protect the structure of organization and beliefs. It becomes a part of your culture.

- However, if we extract the wrong principles or parts of a case, it can be harmful and deleterious to learning.

- In the case method there are some coaching issues. In order to avoid extracting the wrong meaning from a case, you need an instructor to help guide.

- There are limits to persistence/perseverance of belief. In building mental models, we cut and paste experiences on it. However, if a "case" does not fit our model, it is not added. This can lead to resistance in changes (rather than modifications).

- It seems that much of what has been said applied to all four types of "stories." Is there anything that explains why "cases" work? Out of all four it seems that "narrative" is the most closely related to "cases."

- The authority of cases relates to: (1) abstraction, (2) pattern recognition, and (3) expertise development.

- What makes "cases" unique is that they have authority because they are real. Their strength is in the fact that they cannot be denied.

Narrative-based Method

- What issues are there in a college classroom regarding use of narrative? Diverse class presents cultural difference in interpretation of story. Diversity, gender, interest, prior knowledge, language comprehension, culture, motivation. There are

"nine phases" of interpreting own experience – choosing what stimuli to pay attention to is influenced by these nine factors. Continuum of factors – fit for student

- Instructor should help make it clear what the context is, focus attention on the right aspects of the story. What about implementation? Instructor should be reading clues from audience. There is much research in the Art of Teaching available. Narrative is not necessarily an interactive experience.

- How do different cultural backgrounds affect interpretation? Culture can be used as a tool during debrief, or as a point of discussion. What audience diversity factors can we put into post processing factor – debrief, and then use in an instructional intervention?

- Can we ever expect a narrative to stand alone as instruction?

- What are the best types of questions to ask after a narrative is presented? What kinds of things can you do to promote reflection (applied research)? Online narrative has posted questions guiding reflection process, it is not instructor led. Online lends itself to feedback resolving issues in a communal space. Is it unreasonable to test students right after presenting text?

- How do you explore alternatives after using narrative in movie form? Will role-playing work instead of movie?

- Is there an interaction between characteristics of narratives and memory processing? (basic research)

- Similarity between narrative and scenario – narrative sets up scenario, then student has to take person? Narrative part is why, when, and how you would want to do something. Interesting anecdotes make learning memorable. Is it important to look at engagement between the 1st person narrative and the observer of the narrative?

- Can we create a condition in which narrative has merit? Should we ever use a narrative to improve effect? Can participants listening to narratives extract X from a story, when X is what we want them to learn, or do they also extract Y, when Y is a distracter?

- There are hidden meanings that people get from narratives and misinterpretation. Do the benefits outweigh the challenge of using narrative as an instructional method?

- What are the things that you can teach? What domains are best suited for the use of narratives as instructional methods? Can we identify characteristics of narratives to guide instruction?

- Use a narrative that shows a positive effect, then comeback and keep removing items until narrative is no longer effective. Break it down to level of different narrative structures. What is the length of narrative that is effective – does learner begin attending to different things than the focus of designed instruction?

- Do we expect the sum of what has been discovered in basic research on constituent parts of narrative to guide future research? Is the whole worth more than the sum of its effects – it seems to be that the parts complement each other.

- Can what we have learned in basic text processing be used in a useful and fruitful way to look at narratives or do we start over? Can entire groups of sentences be memorized if presented in the context of a story? Delivery of narrative could be treated as a word processing and comprehension relation?

- Before student watches movie – tell them watch for times when such and such happens. Do you want to trust the learner? Is it more effective to give objectives upfront to the student, then present video? Every lesson should start with presentation of the objectives.

- Does amalgam of real stories produce narrative that is as effective as one real story?

- Is stopping the film after teachable moments more effective than playing the movie through? Sequence – when do you intersperse moments of reflections? If you interrupt story at wrong time do you lose some of the effects? Should sequence of the story match sequence of events versus non-linear presentation? How long do students have to be engaged to get long term retention?

- Terminology for research: at this workshop, different groups using different terms to identify the learner/actor/participant.

Problem-based Method

- Can Problem Based Learning (PBL) be represented in other media for Instructional Designers (ISD)? We need to think in terms of the designer
    - A design has many different levels, and dependant on the media used.
    - Addressing problem solving through individuals ideas of how they think it should be solved is NOT the way to design.
    - Nobody does strictly ISD, they put other things in there (personality and flair) it is not pure.
- So little discussion of figurative language or figurative thought.
- Culture problem. There is a shared knowledge base; intertextuality references shared across text allows for common experience that shapes comprehension.

- Campbell says that in myths there are common themes, hero/ villain. Uses of Enchantment book, fairytales. Themes that challenge for cognitive psychology underpinnings, you can script a story deliberately and benevolently/ maliciously stories are powerful enough.

Goal of PBL:
- One goal of problem solving is for students to determine declarative knowledge about the domain, and to get students to apply abstract knowledge of the domain (apply mathematical models, biology, etc) REAL GOAL to use problem to understand abstract knowledge
- Metacognitive control of the process. How do you improve this process?
- Ask about sub goals specifically? How do you do this? Get students engaged to get them interested in this aspect. Or do you remove the aspect of self monitoring?
- Is the best way to do it to just let it happen or do you STRUCTURE PBL?
- Do you need to know the basics before you start messing with metacognition?
- In MA there was an attempt to do authentic assessment of high school assessment. Give options ask approach and write up a story to tell how you did it. Able to demonstrate achievement of higher level cog skills. But did need to know some basic knowledge.
- 2 kinds of problems for ACT R – allow students to exercise using semantic units and to exercise using more rules.
- Constructivist view – the goal dictates the learning.
- When do you use cases? At any level despite missing foundational knowledge. It is not a wasted exercise for the novice learner.
- Would you call Problem Based Learning something else at that point (at a higher level)?

Research Questions
- Does PBL work for YOUNGER learners???
  - Modified PBL does work.
  - Lower case pBL can work.
- How do we most efficiently integrate learning to reason about the domain, and learning metacognitive skills?
- What role does the tutor play in PBL?
- How to pose the problems?
- How do you structure the problems to get the most EFFICIENT learning?
- Selection of appropriate problems
  - The words you choose will affect the problems and outcome
- How does one provide motivation?
- Curricular approach would have PBL as an instructional strategy.
  - In middle school, elementary you cannot make the problem as big as you could with college, etc. learners.
  - Scaffolding.
- What if we were to train students in problem solving (PBL) - is it more efficient or more desirable, and continue to be frustrated by teachers who do not meet that?
    - PROBLEM: Standardized tests.

- Training of students: Rules we are scaffolding, rules, cultural change, guidance for helping students become reflective practitioners of PBL, thinking in groups.
- How many teachers would actually WANT to teach this way?
  Lack of teacher prep that engages students. Lack of learner centered approaches.
- What makes PBL appropriate for learners?
- Who (what type of learner) does best in PBL environments?
- Training/ Competencies for PBL Instructors?
- What are the best PBL environments?
- What are the learning outcomes for PBL and how are they measured?
- How do you structure PBL (problems, sequences of problems)
- Relationship of knowledge structures to problems (domain knowledge, metacognitive, integration of domain and metacognitive)
- Rules for scaffolding, reflection, articulation and support.

Scenario-based Method

- Yesterday we had concluded that measures were a big deal, which indicates that we need more quantitative research. What are the dimensions of approach? Under measurement, what are some of the other alternatives?
  1. within scenario measurement
  2. after simulation evaluation (automated or human rated).
- The problem with the Command and Control environment is that many actions are not recorded easily. The hardest thing to figure out is the cause and effect for multi-echelon teams. How does a professional organization approach measurement? We have training but not measurement. If we have a measurement approach, then we must understand the tasks well enough.
- Measurement is both a qualitative and quantitative enterprise. Latency and flow are two things that you can look at. We have not done good enough analysis at the systems of systems level.
- The Cognitive Engineering Research Institute's Cognitive Engineering Research in Team Training lab tries to measure team Situational Awareness and coordination, but they cannot validate those assessment tools until performance measures exist (chicken vs. egg problem). Latency and other measures can be embedded, but we don't know what it means. Must the embedding be done first? Question: how well can the instructors observe exercises? You are beholden to the quality of the observer. Many of the things people may observer and attribute as a cause may not be accurate.
- Some of it may be an agonizing post event. Is it working in real-time? No. We don't build in the amount of time that it takes to train observers to do a good job. Teaching the observers to make qualitative distinctions is a great deal of work. Right now we have a lot of un-inspectable relationships. We are not used to all of our new technology.
- We have not seen literature in emergency response that indicates that humans can provide a valid observation. There is not a test of validity because there is not a

- defined outcome. Katrina may have presented a non-linear increase in complexity.
- Are we saying that to take scenarios into training, is measurement the number one problem? Yes (for team training). Measurement feeds the front and backend. What we need are new tools and ways to think about teams of teams. Team performance is not the sum of the parts. The interdependencies are what complicate matters.
- Look at the difficulty at doing critical event analysis or fault event trees. They explode. It may be that all there is content specificity, and that there are not generalizable rules.
- We need tools. We need a birds eye view. We need to visualize a system of systems, and to do embedded automation. Can we take data and converge it with what people are seeing?
- Are we changing the way we train so that when we do a large score exercise, we know that we will receive a 10% gain?
- Many problems can be traced to the individual level. Many of the data at the individual level was lacking context. The people doing the design have a problem at the front end because they have to anticipate many of the interactions. The observers may want to look at the macro level while the participants are performing for the micro level. The question: is there a generalizeable theory for this?
- The distinction between individual and collective tasks is troubling. Train so that the system can meet the criterion goal rather than for the individual to do their task. The system development people and training people would need to work together. Sometimes the engineering of the system can be adjusted before adjustments have to be made to trainees. The user and the trainers must be involved early in the design. Break down the barriers between development and training.
- Back to storytelling.... Do events like hurricane Katrina now become scenarios? What are the design principles of good scenarios? Analyze the task, identify critical events...scenarios should be used to train observers. Often good SMEs are not available to do observations.
- It would be useful to have a checklist for what a scenario should be. The data types that you want recorded must be included in the checklist. If we can't measure everything, what can we live with? How do you know if there is any training value?
- Can we measure the training value of the scenario before it is delivered? Once you have defined the training objectives, they you can specify information about the scenario design? Critical events must be included so that the event will (hopefully) trigger the behavior that you are trying to train or practice.
- Are pretests needed? Our end goal: competent performance. If we are getting feedback indicating that there are problems with lower level skills, diagnostics must assess those problems. One way to assess that problem is also to let higher-level individuals know that their assumptions about competencies may be incorrect. That is remediation and instruction. If we look at it as a conventional training problem and you detect a problem with performance, you remediate it

and then move on. We need methods and tools to be able to assess the various levels.

- What do we need to build into scenarios? Are there unique requirements to command and control scenarios? There are C2 problems that often appear (e.g., dispute over resources and confusion over Commander's Intent).

- We are trying to make learning engaging, but it is not supposed to be easy (entertaining), is it? There is something about whatever task we are talking about that maintains people's attention. It is fair to say that scenarios should be rewarding, but not necessarily engaging. The user must feel that they gained something. How much time does an individual trainee have to be engaged? How much of that time can they tolerate? It would be nice in scenario design to have some measure of dead time.

Research Approach

Groups were asked to address the following questions:

1) How should we go about addressing the research questions?
2) Which may work better: qualitative or quantitative approaches? Or both?
3) Come up with some general research designs for the instructional method.

Case-based Method

- What research studies could be used to study stories or cases?
- It would be interesting to study the neural coding of our brain as we process stories (Rick Grainger). Our brains process information recursively. Because stories are associations, they have certain ways of firing brain circuits. Perhaps some stories are better at firing than others? Maybe it is elaboration (Reigeluth)?
- When an emotion is connected with a memory it aids in retention. Stories do this. But is it really emotion or arousal? There is the notion that there is a linear time-line, plot related encoding.
- Research has shown in gaming and training, that there is better retention after an "event" where characters were shot at.
- When an emotional association→ other parts of the brain become part of the encoding process. So short term then become long term. This is a good technique for "one-trial" learning.
- Perhaps if someone had Post Traumatic Stress Disorder, could use can use gaming/training to re-circuit some of the embedded memory.
- Perhaps understanding stories is all about understanding "brain reconsolidated memory." And if can interfere with it, then we can bust it.
- "Case-based" is also authentic because it is based on real-life. With other stories, you are often not sure if it is real or not.
- There is also the question of how people write cases. Why do people choose to gloss over/summarize some things and not others? It becomes a balance between clarity and complexity. It is a signal to noise issue: want enough noise (so not bored), but not too much (so confused).
- A study could embed multimedia stories with useless information. This could be used to tease out how students deal with relevance issues.
- Chatham's 3 MIRACLES:
  (1) Recording miracle. When record, must record those things that are relevant to instructional objectives (adduction).
  (2) Abstraction miracle (clarity and complexity). How do we abstract principles/encourage when there are so many cases? How do we know what to abstract? Can a machine do it? And if so, how would we implement it?
  (3) Application miracle (signal to noise). What principles apply?

- Perhaps it is a depth of processing issue (Craik and Lockhart). But is the depth of processing issue, the same as the abstraction issue? For depth of processing: if you really want it to stick, need them to think deep thoughts. If really want to apply, make it meaningful. Maybe depth of processing is an encoding issue? Maybe it is an elaboration issue? Maybe it is an abstraction? Jacobsen and Sparrow discuss the notion of cognitive flexibility. Do we agree that depth of processing is not well tapped? Is it related to case based? If so, how do we promote depth of processing? Perhaps metacognitive skills need to be developed.
- It is about doing it enough times until it becomes automatic. By moving from a novice to an expert, you free up cognitive resources. This frees up time to start looking for unique features and start looking for flexibilities. The key is to use your resources most efficiency, so that you have enough left over time to concentrate on other sorts of things. It is about freeing up cognitive resources so can do other things. So depth of processing may lead to automaticity? This is related to novice versus expert issues.
- Thinking pragmatically, if just thinking with case alone, what are realistic alternatives that the Air Force might fund?
- Perhaps could draw out Red Flags exercises by using the 66 Army cases. It would be great if all could hear 66 Army cases, but maybe it would be better to start a story-web instead. And it would be good if you could control and follow the paths that were interesting to you. It helps if have "self" involved in the choosing.
- Could work towards the development of Sternberg's practical intelligence from cases. What is it about a given story or case that is so valuable, that it can affect post-hoc behavior? Then it becomes a question of assessment. We must assess the 1) Lessons we take from story: How can we use cases to develop Sternberg's practical cases and 2) Make it generalizable (and if not, develop a taxonomy).
- Maybe you could have a virtual bar where you build cases? Creating the virtual bar has to do with the 1st miracle. How will the miracle be recorded? This leads to questions/issues of: engagement, misinforming, ensuring the "right" lesson is learned, and dealing with varying expertise levels.
- And is there also a "bad" learner? Most learners try and use the path that leads to fastest results. Novices will often have uses that bypass the easiest/quickest path. They do this either to increase efficiency or because they are lazy.
- Is it possible to create the "trainerless" trainer? Could there be tools? How do we build an intelligent tutor? What are the principals for deciding what levels of coaching to provide? And how do we assess levels of coaching? Perhaps by scaffolding.

Narrative-based Method

- How do we implement storytelling and interactivity in immersive environments? Audible, tactile, olfactory, visual – where does the storytelling come into this – how do we weave it all into it?

- Experience design relates to this conference – retail, what are components that make up experience – fair amount of work already conducted in this area. Sights, sounds, order of event make up experience. A wearable camera device with high capacity storage and lightweight is used to capture experiences of shoppers.

- Within gaming research there are methods to convey biometric data through variety of sensors to help define user experience. Games can be addictive, game play behavior can lead to physical trauma. No one ever talks about book-reading addictions.

- Yesterday the discussion included issues regarding engagement and raised questions on story interruptions – are these questions testable using instructional method testing.

- Are there benefits for story as game versus just story? Is it possible to film a movie or use a written story to test this? It makes more sense to start at lower fidelity, start with written story prototypes.

- Exploration of the engagement issue regarding length of story is basic research. It is not necessary to build a story. Start with an existing story and test components of it. Or start with small story and build on to it. What questions can be tested with using stories already available? A research study could compare movie version of narrative versus text based.

- What part of research would mandate we need to film different version of a story? There is an inherent problem with movies – styles, age dating of component parts. Do you lose too much effectiveness by using paper-based, or in-person delivery versus video-based?

- Dialogue as a manipulation – length of dialogue and how it is laid out, find out if more or less dialogue works better. Storyboarding – focus on scientific question versus medium

- Research the narrative itself – by testing difference between participant reading the story or hearing the story? How do narratives engage people?

- Use top-down approach to see how things are occurring naturally or do we want to build it up from the bottom up. Top-down is suited for qualitative approach. What are the components that we want to manipulate in the future? Many people using top-down approach – is anybody doing bottom-up approach? Multiple methods might be useful – if we are looking at various versions of a narrative.

- Cognitive load assessments are quantifiable. What is measurement method for narratives?

- Avoid contextualized specific research it is cheaper looking at narrative that can be used in more than one area. It is not research unless you invite failure.

- Author/Director/Game Developer – do they bring identifiable style to the story, narrative, or game? Hero factor has a role in narrative. Stories are successful for their allegorical nature.

- Develop research agenda for narrative instruction – empirically established guidelines for integrating narrative into instructions, develop process of testing

- Define the role of trainer in debrief lesson from video. Set up context, front end work, before using narrative. Do you want to trust the learner to get what you want them to get out of it? Instructor needs to know the student. Content versus Context is an area to explore.

- Within instruction that is wrapped around the story, five different approaches will produce five different results. Can you build stories that by themselves are instructional systems, or do they always need a separate instructional system wrapped around them?

- Are there differences in using narrative for recreational learning versus life-saving skills, or inquiry based science learning? Cognitive Dissonance – stories can create tension

- The purpose of an instructional system is lost when instructors just pull out activity to use. If you make learning too much fun is it teaching the wrong concepts – should learning be fun always?

- Basic research builds from the bottom up. We need to look at how narrative is currently being used and what is effective, and then choose IVs to use. We do not have design theory but we do have robust analytic critic evaluation. Pick a hard problem that narrative has an ability to address. Build taxonomy in parallel with other approaches. Writers are not starting with a theory before they begin. Start qualitatively, zero in on things, then move to quantitative

- What would a story theory buy us? Framework for novices, experts don't need it, theories explain and predict, eliminate creativity. Story theory would be useful for people investing training dollars as a decision factor. Guidelines are different for beginners versus experts. Theory must pass some type of authenticity tests

- Dependent variables – performance, memory, attitude, engagement, willingness to continue, motivation, retention and transfer, appropriate generalization of transfer, identity, meta cognition, agency

- Independent variables – narrative versus non-narrative, type of narrative – person, sequence, medium, plot versus characterization, development of character or

development of events that occur, position of brief/debrief/reflections, scaffolding, role of the narrative, interposition of problems etc., domain type, fidelity – look feel act, author, writing style – general gross style, story type (factor analysis), support questions, instructional system, call-outs, quotes, tension

- Interaction of fidelity for expertise level. Well developed narrative can offset fidelity in games. Do experts need less fidelity than beginners?

- Acquisition of literacy – Head Start program, important piece of educational research.

- What is unique to narrative? Identity, the nature of story depends upon who tells it. Embodied cognition, no such thing as human thought without metaphoric thinking.

Problem-based Method

The structure of Problems:
- The selections of problems are by expert. Experts see KSA's that a successful graduate should have for learning outcomes. (See McDonald PBL curriculum in med schools)
- Focus on things that have the greatest payback.
- PBL is more of an art that is a science.

Approach
- How should problems be chosen? By experts?
- What do we know in terms of research? Not much.
- Folk wisdom suggests that different people are ready for different steps (Vygotskys zone of proximal development) inside this zone problems are too easy, outside they are too hard, within the zone they are just right but people's zones are all different. How do you design to fit these zones?
- How often should we expose people to things outside of their zone of proximal development? Things beyond their ability to stretch their imagination?
- A lot of this research would lead to guidelines, training tutors, assessment, structuring problems, etc.
- The group is only as good as its weakest member.
- Entry requirements into a program will help determine capabilities (KSA's) for certain problem structuring.
- Should PBL groups be reshuffled? Does the structure of the group matter?
- How do we track individual differences in learning?
- Instruction and assessment are two different activities, bring the two together and design things so that assessment is embedded in instruction.

- Form, norm, storm, perform model is what is current practice in PBL assessment. Where do best these practices come from? They come from the Elizabeth Cole literature of working in groups.
- Can the problems be structured/ posed on the fly? A good tutor could possibly do that. Ex: Law professor bringing in headline news from CNN.
- Transferability of PBL to different domains (PBL has been used in medical, law, etc) does it translate to military context? Decision making, informed decisions, could be a very useful instructional strategy in that environment.
- Any kind of existing standards of existing practice for PBL to measure improvement in the kinds of processes that are a part of the instructional goal in PBL (emphasis on collaborative work, investigation, etc) Makes sense to measure acquisition of domain knowledge are there methods for measurements?
- You can measure affective change (how students are making decisions about choices).
- Hardest piece – How to measure PBL, the development of critical thinking and problem solving skills.
  o And the other attitudes? What you are actually teaching in this instructional method.
  o There are NO STANDARD practices for measuring the effects of PBL
  o Some people have tried to take on small pieces of it.
  o The DoD would be very interested in PROOF that it is enhancing training
  o Transformative Learning experiences by Jack Mirasoff & Kevin Pugh.
    ▪ Value shifts and competencies in becoming a leader.
  o The competencies that the student is trying to learn in PBL are hard to define to begin with (Leadership, motivation)
- To have a pretest you would have to have a theory to begin with re: metacognition (self directed learning theory, self regulation theory)
- Levels of abstraction in the way we solve problems – (Case based reasoning posits this)
- In ITS can you measure metacognition?
  o Can measure meta related to one related to using the tutor. Students either do not ask for help.
  o "Help Abuse" Use help too much. Some kids know skill and still use it or those who don't know skill. (Corbett)
- ITS & PBL are related because they both model metacognition when they are asking questions to the tutor and responding.

Culture -
- In the military you already have content experts so should they be content experts? Or will they be apt to just give the answers?
- It disempowers the learners if they can just get the answer from the tutor.
- Demonstrated proof that a technology works (saves money time, lives etc) military will go for it. (Air Force Research Laboratory's Distributed Mission Operations program as an example) Cost/efficiency savings. If you can do that then people go for it. The proof and the data must be there, and there must be a measurement.
- Medical school PBL curriculum evidence is there that is works! (reference Savery presentation).

- (Law and business evidence, maybe?)
- Dr's are problem solvers, ISD and designers – its what they do.
- "Problem centered" engage in discussion etc, small off-shoot of PBL.
- Studies are done in Air Force and Medicine because the consequences of failure are HIGH!
- Who would benefit the most in the military from being competent problem solvers?

Training –
- Research may lead to say that tutors are better if they are not overly expert.

One would assume the tutor is a master of metacognitive processing, a tutor must be aware of group processes (good manager of the problem solving process).
- Tutor critiquing, training CD at University of Delaware.

Do this, just do it, do it the way I show you then you will figure it out.

Scenario-based Method

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Real World Applications of Storytelling Method Research

Groups were asked to address the following questions:

1) If we can do the research that we have outlined in the first three sessions, what are the overall applications?
2) What are the different applications that could exist in different contexts (e.g., business, law, military, medical, etc.)?
3) How do we foresee these applications being generated?
4) If we do such research, what difference does it really make?
5) Are there possible metrics for determining the "real world" impact? How can we measure if it really makes a difference?

Case-based Method

- In looking at real world applications, maybe it is important to apply Scandura's principles of cost and effectiveness. Scandura posits that if we know what we are trying to teach, we ought to try it directly, not indirectly. This creates cost-effectiveness.
- We can teach principles and still not be able to apply them in an effective manner.
- Declarative knowledge is without context (and a story provides context).
- But there are many occasions when we don't have time to do full-fledged research and must act. Suppose we want to test the 3 miracles. How would we do so?
- What if had case studies that were meta-cases. This is happening with military blogs. Perhaps you could search a whole body of interviews and do a story web. It would be nice to automate or semi-automate a whole package of interviews.
- Not a google search, but a "knowledge" search. It is webbed.
- There could be audio-case studies. Can pull out pieces out of many and automatically or semi sort certain meaningful and related clusters. And can go back and play back to guy who needs to know information (like the virtual bar concept).
- Would need to follow Grammar of discourse. Need the context to understand.
- This leads to communities of practice that could be used for vetting and collection.
- Is community of practice a learning environment or information exchange? Maybe there is another layer, maybe it is a recommendation engine? We want to assist in the formation self-forming human network.
- All stories traditionally only allow 3 miracles. The third miracle applies to knowing when to have "old crusty" show up at correct time. Perhaps "old crusty" could be a mini camera, etc. Then this creates situational awareness.
- Maybe move to the collaborative creation of persistent world and consequences. Perhaps could have: hand-held authoring, podcasts, videos, IED alley.

- Part of mobile technology. What can we give soldiers to take with them? Give the tools to the soldiers so they can make their own. Don't hire another company to make them for you. Have the soldier do it.
- What if had a huge collection of videos? Is there any way to cut them down and organize them into manageable cases? Google is building algorithms to search video. Everyone will be out in the field with capacity to store individual stories on handheld devices.
- We can take collectively what soldiers and tourist, etc. seeing then develop a sort of video intelligence (Microsoft labs working on). It would be an on-ground video intelligence made of up all the individual video clips.
- But there are also good stories versus bad stories. How define and make sure good rise to the top? Perhaps we could have soldiers give "amazon reviews." There would be a need to also timestamp the review because over time things may change.

Narrative-based Method

- Do results from testing one story apply to other stories? Can we develop characteristics of story? How does contextualization fit in? Are we looking for simple effects?
- Overall applications – what genres and what domains do narrative as instruction fit with? It is most suited for military operations and cultures that the operators are not normally involved in, novel, or low knowledge.

- It is more suitable for situations that are more gist understanding, or tacit understanding. Narrative creates a better understanding on gist level understanding versus details. It is not for detail oriented learning, tacit understanding is subtle. Narrative is better for gist, rather than tacit knowledge.

- Stories add fluff, which is like life, how do you get facts out of fluff. Aristotle argued that plays don't mimic life, but they share an exaggeration of attributes. It is difficult to pin down amorphous bad guy/enemy/situation/culture that is embedded in real life that is difficult to convey in cold hard facts.

- Simulations in AF do a good job in air to air combat, but it is more likely in life to encounter air to ground conflict.

- Signal detection tasks may be embedded within story. Form exaggerates function, making cues salient, highlighting gist, broad understanding, fuzzy, different cultures meet, diplomatic soldiers, modeling behaviors, interest and motivation, highlight examples, illustrate consequences.

- Complex problem solving tasks – stories are useful in illustrating salient cues prior to encountering stimuli. Mystery stories – all cues are presented within story – can the reader recognize the cues. Can everything be described as a mystery

story – engagement in constructive inquiry? Related to mystery story – subtle clues can be missed – author sets up red herrings.

- Every word in a narrative carries so many associations that make them particularly tied to tacit knowledge. Relational processing – can be problematic if associations are false. Activation of nodes – how to move past highly active node to reach message in less active node. Wittgenstein – family resemblance. Fictional truth relies on intertextuality. Prototype theory – definition of a chair – indefinable activity.

- Narratives may lend themselves to situations that are very ill-defined or that require general broad understanding, situations where there are great differences in culture and they are meeting each other. Example: current issue of soldiers getting tasked to fill diplomatic roles after a quick briefing. What if a variety of different stories were presented to the soldier would this help them improve diplomatic skills by giving them cultural knowledge?

- Can narrative be used to generate learning in hard sciences? Analogy in science is experience and phenomenal, give students a chance to develop an experience, helps to construct the knowledge.

- Narratives can be used to teach lessons learned, they give understanding of why we do the things we do. Stories are effective regarding ethical dilemmas, complex dilemmas.

- Is the point of a story teaching consequences or teaching cues? One method of teaching cues is to debrief with sharing the encoding of the cues. Sometimes stories illustrate conflicting consequences.

- Will the research make a difference – we will be forced to develop measurement tools for ill-defined issues? As long as you are moving in research, whether forward or backward, at least you are moving.

Problem-based Method

- PBL seems to be the most "packaged" compared to case-based, scenario-based and narrative-based methods. There is not a technology or philosophy to PBL.
- PBL is a design philosophy.
- pBL is dependant on the role of the tutor. Capital "p" PBL is more organized and the tutor has a more defined role.
- Homegrown lowercase "p" pBL is more fun for the learners since it is more engaging. It tends to be more problem centered.

- PBL is iterative, and increasingly efficient, the more you do the more comfortable you are with the methodology. So it can come in a whole bunch of different flavors.
- Must maintain the quality of the tutor since Barrows discussed PBL being used wrong so he came up with a new term that he has possibly copyrighted. ISD – PBL was only developed for enlisted technical people but then it started to be used for all kinds of people.
- Grad student did case study on programmed instruction and they felt it could be used by the Army.
- PBL is already heavily used in the medical world.
- Ought to be some study on the essential factors on the tutor role since the tutor needs to know when to be quiet and when to speak up.
- What are the roles of the people who are getting PBL? Are they the leaders or the subordinates? Only leaders should engage in PBL not lower ranking military personnel due to the nature of the learning environment.
- APPLICATION – (Gluck) you would look for domains within the Air Force (AF) that meet the description of PBL. For example, AF personnel that need to resolve an ill-defined problem in a group collaboration type of way. Not necessarily useful in AF for tactical problems. But may work in information analysis and operations.
  - Troubleshooting and maintenance applications.
    - Any type of problem that requires possible multiple solutions.
    - Predator UAS troubleshooting, diagnostics and ground crews coming into station as a group and putting their heads together to solve the issue while Predator is in air.
- Common characteristics – must have to build a vocabulary about the 4 to determine the differences among PBL, case-based, narrative-based and scenario-based. Need to find commonality in language since so much time is spent in coming to agreement with design team and client on what the terms mean.
- What are the intended learning outcomes? How will the learner be different after the intervention? What they do in practice is what they should be training to do. User centered instruction.
- It's equally important to teach metacognitive skills as regular skills.
- ACT-R = Theory of cognitive architecture but may one day be able to pull instructional guidance out of it. Can say why you may not get desirable effects out of instruction, Ex: Do PBL and another type of instruction model the thinking that goes into the computational process models? Depends on the two approaches to see if there are enough obvious differences in the output. Hesitant to develop a research approach since ACT-R is so detailed, it would just be undesirable to operate under that architecture.
- Tutoring technology of Cognitive tutors are based on early ACT-R versions
- ACT-R mission is different; at one point (maybe) they could converge. PBL is not of the same type of foundation that Andersons ACT-R is based on.
- PBL people use abductive learning, like an expert would, makes big leaps not small steps.
- The question was asked - what counts as a problem? Is flying a plane a problem?
- Who engages in PBL? NTSB and accident investigators engage in PBL.

- It is important to arrive at a common language as part of the PBL experience.
- Heuristics, what if the solution is algorithm based it is not PBL? But if it is rules of thumb (heuristics) is it then PBL? (Yes, you lack the specifics).

What is a problem?
- MAJOR ISSUE – Need to define problems.
- Newell and Simon – problem is any situation in which you are not at goal state
- Some problems are unsolvable, some are ill-defined, there are all kinds of problems.
- Gibbons – Anything there is not an algorithm for.
- Newell and Simon - An "impasse" in problem solving is very similar to what Gibbons is discussing, you do not have an operator there is no where to go. You are stuck.
- People are better problem solvers because we are able to sub goal. And we can work together to find the goal for everyone to work together to find the goal.

Scenario-based Method

- Real world applications – which ones aren't applicable to scenario based training? All of our discussion has revolved around real-world applications.
- Is a lot of our work ungodly hard because (turnover, incomplete knowledge) what we really need to do is have flyaway teams for the key parts?
- Now we are worried about the external validity. How do you quantify Return on Investment (e.g., reducing the number of nonproductive sorties). Your hope is that your real world ROIs are something you will never have to deal with. Real world ROI may be impossible to calculate for areas like emergency response because of loss of life.
- What would quicker response result in? If we were using the Katrina model, we would have been better off had we been able to get the people out in a timely fashion? We might look at human loss. The execution of Katrina was poor although it was planned and warned. Maybe we need more what ifs in our scenarios. What it demonstrates is that when you are trying to do something that big, you must be aware of nonlinear increases in complexity.
- There is no way to have a base log for loss of life or property damage. Massive assumptions would need to be made. Regular people can tell a well-managed event. ROI is face validity. Based on our observations, there are not enough what ifs in current emergency management scenarios. Why do we always assume that we will still have cell phone contact? If there is a sliding scale of ROI (levels) that we can possibly quantify. What we have to do is look at the pieces or parts. You drill down to the smallest unit but then you scale back up.
- There are indices of mission success. There are other things related to efficiency or resource. Another cluster might infer value by looking at post incident reports. One size will not fit all based on the complexity of the problem. Another component is cost (of training).
- Mission readiness is almost as important as mission success. Inadequate training is expensive and dangerous. The return on training is a nonlinear, non monotonic function.

- Compared to DOD, emergency management is nowhere on the map when it comes to spending on training.
- Which contexts are not appropriate for scenario based training?
  - Motor skills (depending on how contextual) – would be applicable in terms of the plays but not in terms of catching a ball.

- In team training context, the scenario becomes the glue that incorporates all the pieces. How much can you back off from full fidelity while still getting value? Could you do it with less? Emergency management may be simulating the wrong things. They simulate victim injuries but then they do not simulate the things like communication glitches. Are there different kinds of fidelity? Can you simulate just the cognitive decisions and leave out the lower level details?
- Feedback is essential. Context for training can be important.
- Questions: can this system actually do the task (do these chains actually fit on the tires)?
- An advantage of using scenario-based training is finding weaknesses in the system that have nothing to do with training but is a result of doing the scenario.
- There is no context that could not benefit from scenario based training, but not all skills are best suited for this type of training (e.g., catching a football, tackling).
- ROI quantification is tricky but there are measures available.