Objective:

Describe Cognitive Flexibility Theory and consider its application to Instructional Design.

We will also examine the Flexibly Adaptive Instruction model, and the adaptable instructional design software program STAR.

Cognitive Flexibility Theory

Theory developed by Dr. Rand J. Spiro
University of Illinois at Urbana-Champaign

An explanation of some of the underlying mechanisms of how people learn.

Addresses the realities of advanced learning for problems with complex solutions

“Cognitive Flexibility Theory: Advanced Knowledge Acquisition in Ill-Structured Domains”

Rand J. Spiro
University of Illinois at Urbana-Champaign
Richard R. Coulson
Paul J. Feltovich
Daniel K. Anderson
Southern Illinois University School of Medicine

from Theoretical Models and Processes of Reading 1994

Differences in Knowledge Acquisition

Introductory Knowledge:

Expose learner to content and give them a general orientation to the field.

Advanced Knowledge:

Learner should be able to reason with knowledge and apply it flexibly to different contexts

Problem: Structured methods used to teach introductory knowledge may actually conflict with advanced knowledge acquisition because of the way they compartmentalize knowledge

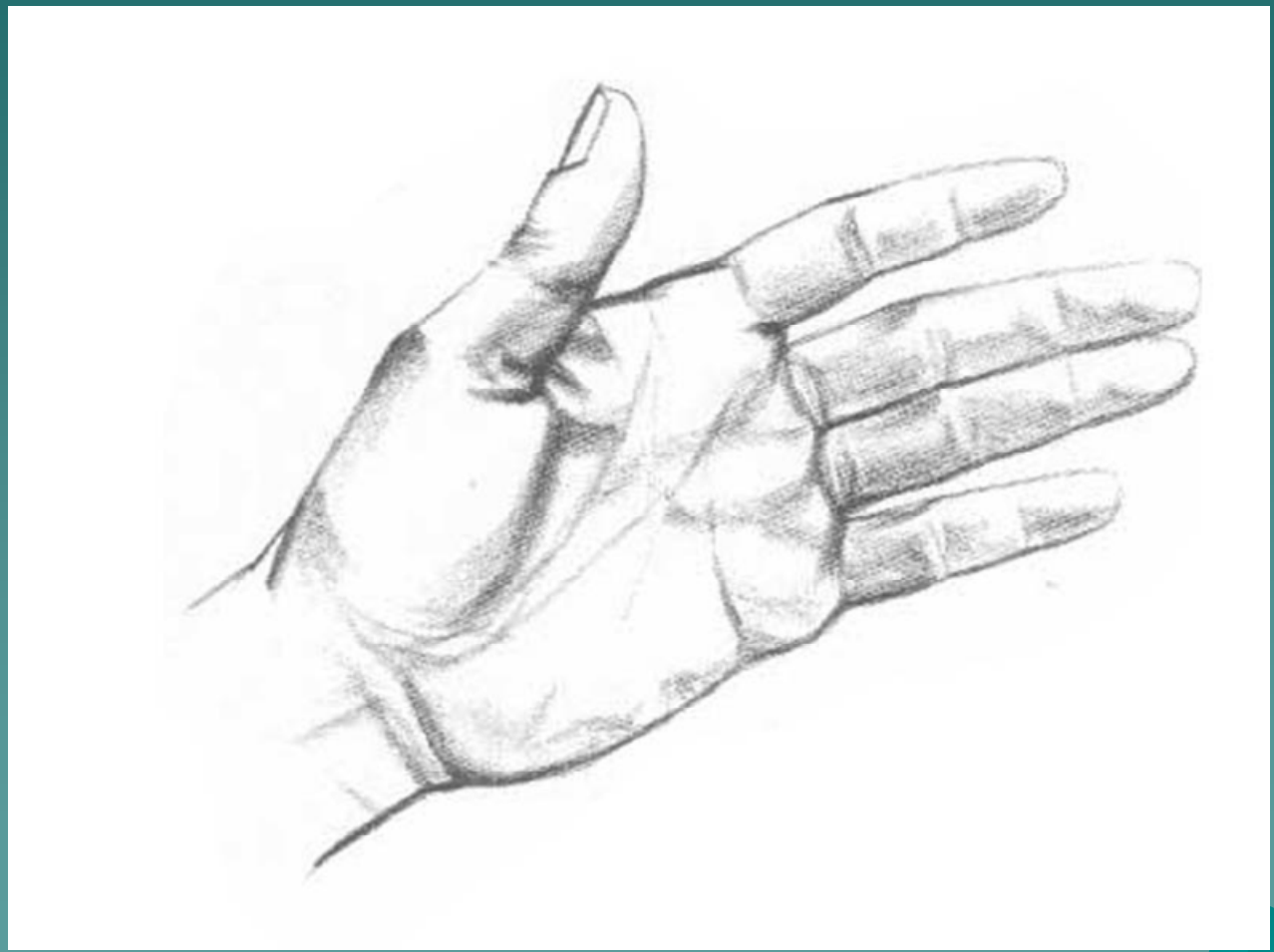
Demonstration

Compartmentalized Knowledge – Well Structured Hand

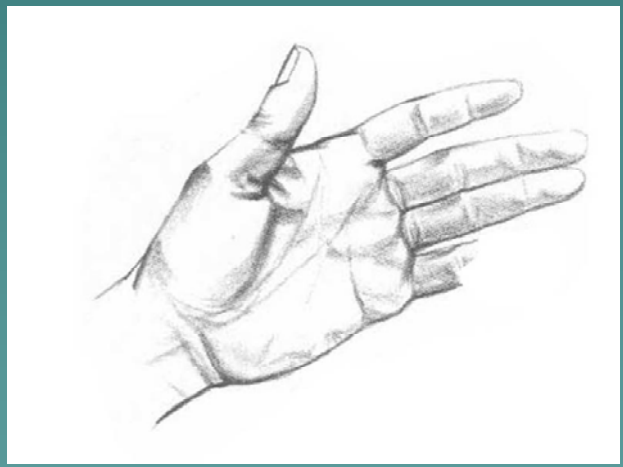
- Real World

Ill-Structured

Real World
Ill-Structured



Real World
Ill structured
Problem



Compartmentalized Knowledge – Well Structured Hand

What interferes with advanced knowledge acquisition? “Reductive Bias”!

- 1. Oversimplification of complex structures- routines, methods, irregularity is made regular, chaos is made orderly
- 2. Over reliance on a single mental representation.
- 3. Over reliance on top-down processing, generic abstractions- knowing “how cases go”.
- 4.Context independent conceptual representation- contexts are represented as being overly uniform.

What interferes with advanced knowledge acquisition?

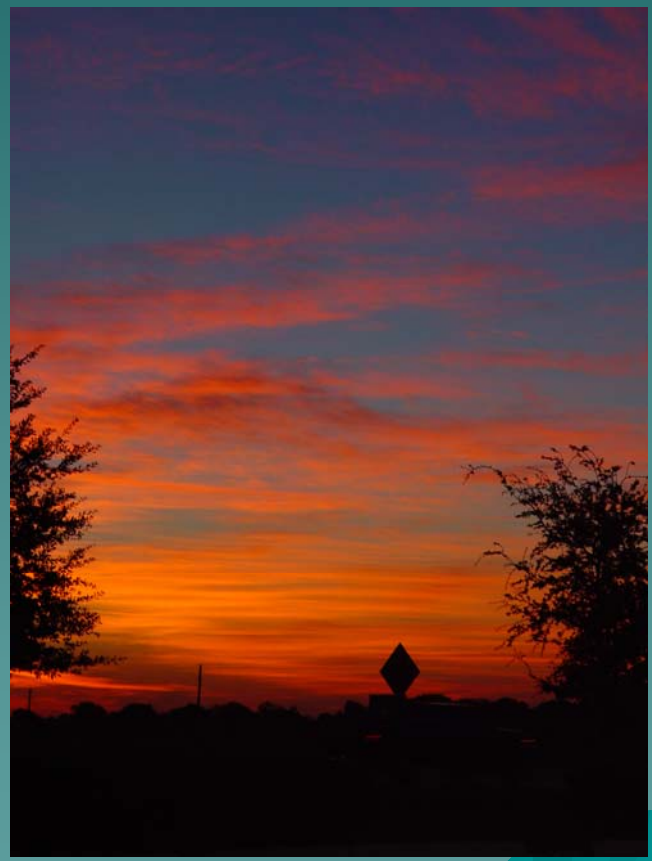
- 5.Over-reliance on fixed protocols and structures prepackaged schemata presented as recipes
- 6. Rigid compartmentalization of knowledge components. Components of knowledge are interdependent and should be taught as being linked- instead of separate.

What interferes with advanced knowledge acquisition?

- 7. Passive transmission of knowledge- knowledge is handed to the learner who receives it passively- cannot integrate with personal experience, active exploration, etc

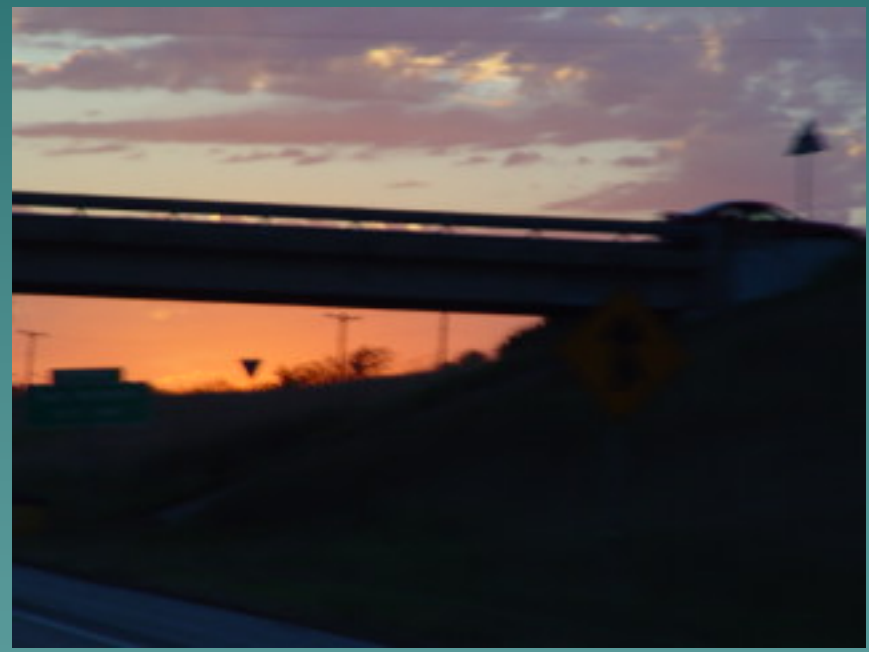
Cognitive Flexibility Theory Landscape Analogy

Advanced knowledge is a “criss-crossed landscape” Spiro et al., 1987, & Wittengenstein, 1953, (as cited in Spiro et al.1995) a nonlinear exploration of complex subject matter, on different occassions from different directions.



Spiro et al.'s Themes of advanced knowledge acquisition:

- Avoidance of over simplification
- Multiple representations at different levels of instruction- revisiting and rearranging them present the same concept in different contexts.



Themes of advanced knowledge acquisition

- Problems will vary greatly from case to case, with different variables.
- The ability to respond to the great diversity of cases comes from reasoning, using knowledge gained in previous cases

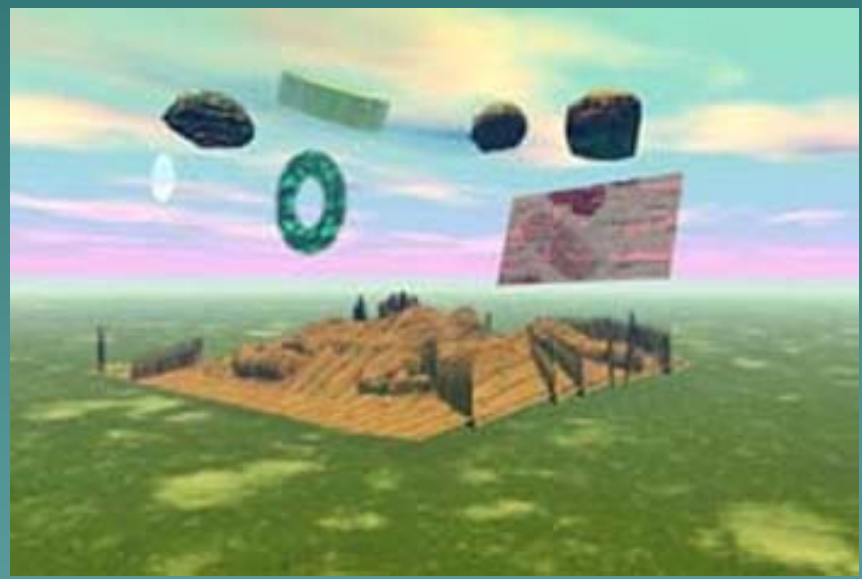
Themes of advanced knowledge acquisition:

- Concepts and principles will be applied differently in different contexts

- Instead of retrieving intact pre-existing knowledge, flexible re-assembly of knowledge – erector set metaphor (Spiro et al. 1995)

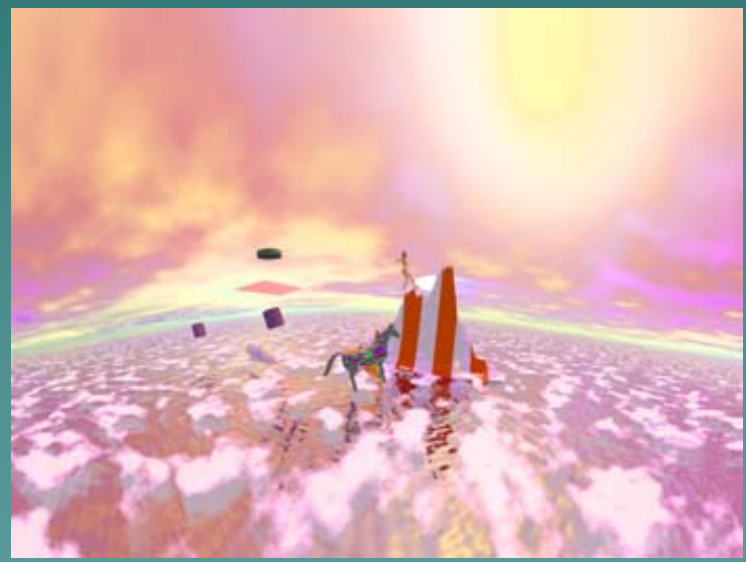
Themes of advanced knowledge acquisition

- Knowledge must be assembled from different sources.
- Concepts cannot be thought of as separate “chapters”, but rather intertwined and interconnected

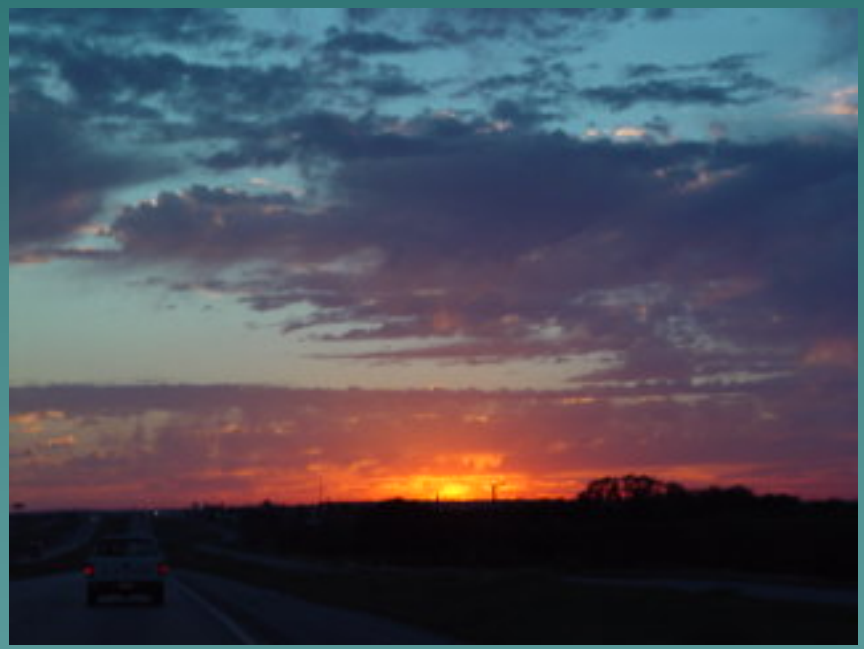


Themes of advanced knowledge acquisition

- Learners must be able to explore complex knowledge in many directions, with expert guidance.
- Hypertext programs are ideally suited for this.

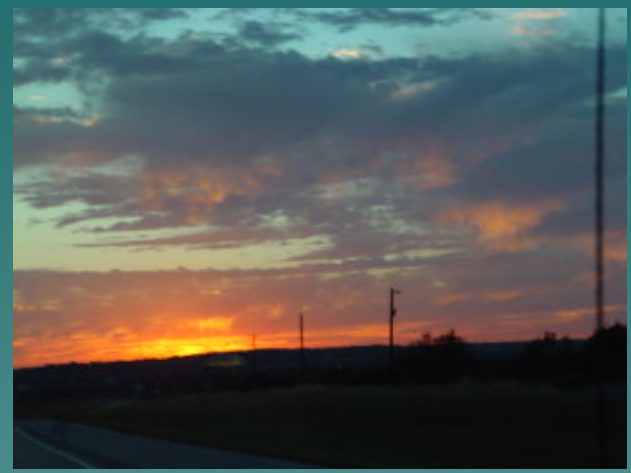


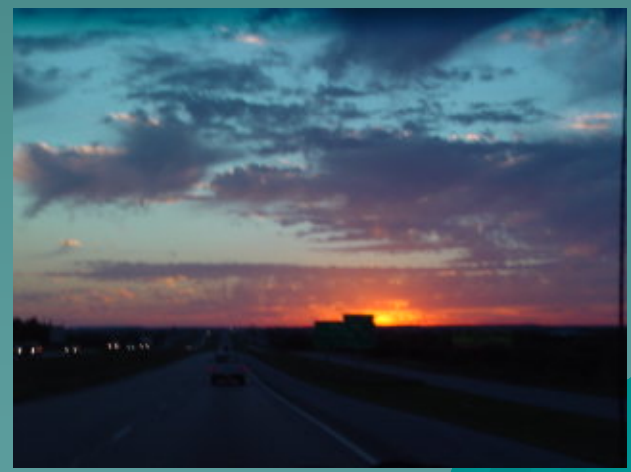
Advanced knowledge domains



Rand's Random Access Instruction

- A type of Constructivist theory-
- Instead of retrieving intact pre-existing knowledge, CFT assembles the existing knowledge flexibly to fit the needs of a new situation.





Rand's Random Access Instruction

- Ill structured knowledge involves multiple schemas, perspectives, organizational principles; the pattern varies greatly across cases.

Learning- mental representations and instructional approaches should all be flexible. Citizen Kane example

Rand's Random Access Instruction

- Knowledge has to be used in many ways that can't be anticipated in advance.

  Construction of new understandings in the novel and situation specific.

- Multiple juxtapositions of content

Rand's Random Access Instruction

- Criss cross the landscape for new insights and understandings. Return to the same situation from different directions
- Mastery of complexity is now transferable to other situations.
- Hypertext – explore many aspects of the subject matter

Is it ill structured?

- Spiro says that any problem that involves cases is ill- structured (Spiro et al. 1996)- medicine, literary review, history

- They may contain structured principles.

Is it ill structured?

Examples:

- CSI
- Amazing Race
- Jeopardy

- **CSI Forensics professor**

- With the popularity of recent TV series, more learners are enrolling in college forensics courses.
- You will develop an instructional design to train learners how to use evidence to investigate crime scenes.

- Is this an ill-structured problem?
- Does it contain structured principles?
- How will you teach learners to be able to solve this problem?

The Amazing Race Coach

- You've been hired by Colin and Christie to coach them to win the Amazing Race. They will pay you 10% of their winnings- $100,000.

- Is this an ill-structured problem?
- Does it contain structured principles?
- How will you coach them?

- Jeopardy Coach

- An A & M student has landed a spot on Jeopardy's College Game show. She asks you to coach her so that she can win the game. You do quantitative research on past shows, and discover that 60 per cent of the game questions have to do with either history or geography.
- Is this an ill-structured problem?
- Does it have well structured principles?
- How will you coach this student?

Flexibly Adaptive Learning

Daniel L. Schwartz, Sean Brophy, Xiaodong Lin, & John Bransford
Learning Technology Center
Vanderbilt University

Concerns about teaching methods

- Reaction to “inert knowledge”: students fail to apply their relevant knowledge in novel settings
- Concerns about problem based learning, case based learning: student engagement may be mistaken for learning. Rocket example.
- Constructivist activities: may eliminate traditional activities- such as fact based readings or lectures

S T A R Legacy
Software Technology for Action and Reflection

- An adaptable instructional design software based on CFT. Uses Problem Based Learning, Collaborative Learning, Project Based Learning, Case Based Learning. Results can be archived for future reference.

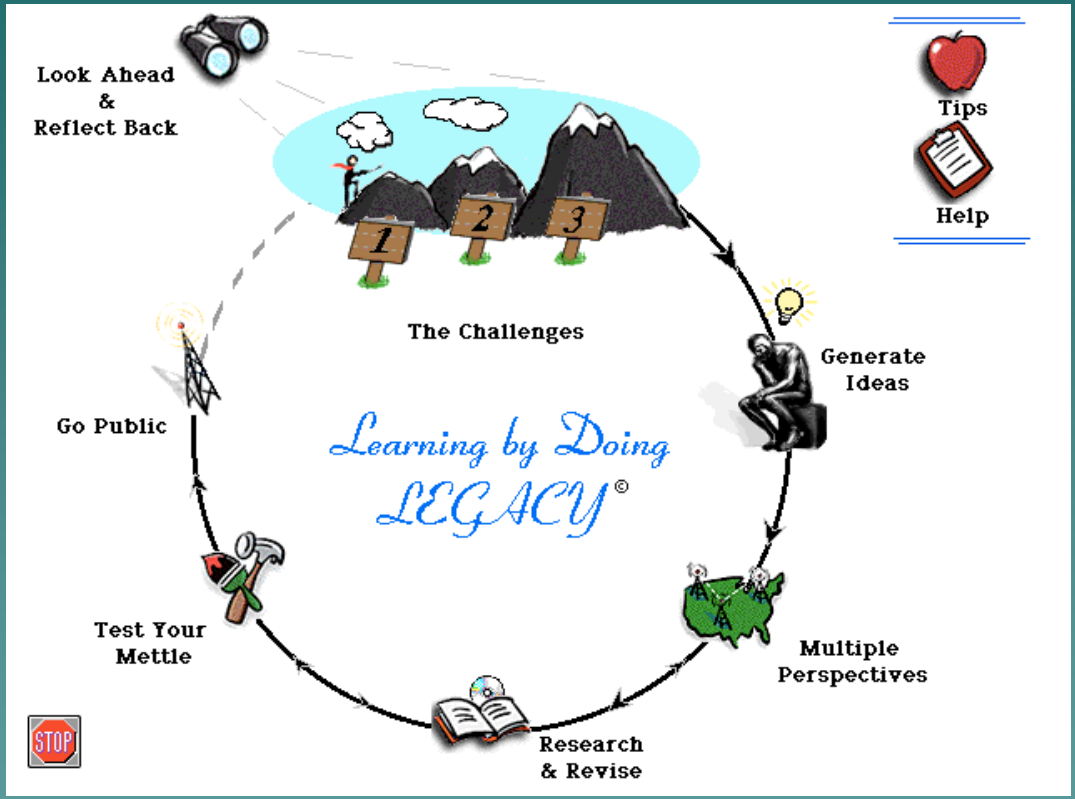
S T A R- uses problem based, case based and project based learning

- Learner centered
- Knowledge centered
- Assessed by both learners & teachers
- Includes community environments & collaboration

S T A R
features

- Explicit inquiry model
- Components arranged in a single learning cycle
- Multiple learning cycles so learners can progressively deepen their understanding
- Reflection on the overall learning process, includes creating legacies for other people to use.

S T A R


Look Ahead
&
Reflect Back
Tips
Help
1
2
3
The Challenges
Generate
Ideas
Learning by Doing
LEGACY©
Go Public
Test Your
Mettle
Multiple
Perspectives
Research
& Revise
STOP

S T A R

- 1. Challenge - gives students progressively complex problems
- 2. Generate ideas
- 3.Multiple perspectives- share ideas
- 4.Research and revise- develop their solutions

S T A R

- 5. Test Your Mettle- formative evaluations, quizzes, hands on projects,
- 6.Go public- present final solution
- 7. Look ahead and Reflect back- Preview the knowledge domain, set goals, compare new responses to original ones

Homework

- Using the STAR model, write a brief description of a flexibly adaptive instructional design for an ill structured problem in your area of interest.
- Give at least one example of the activities that learners will find on each point of the star.
- We will refer to these next week in our discussion of Merrill's Instructional Transaction Theory.

CFT Research Question

What role does visualization play in solving ill-structured problems?

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Thank You !

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