



Critical Thinking in Challenging Times

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Workshop Agenda

The purpose of this workshop is to explore some ideas related to a project at UNT sponsored by the UNT NetDragon Digital Research Centre

The topic involves critical thinking ... what it is and how it can be developed ... and why it is relevant today in what can be called challenging times

It started one day during a fire drill at Discovery Park at UNT



Suddenly there were thousands of butterflies swarming around outside ...

Where did they come from I asked a colleague ...

Canada, she replied ...

She lies, I thought to myself ... no butterfly can fly from Canada to Texas ...

I was wrong, I discovered after the fire drill ended ... I got online and checked ...

- So how far can a butterfly in a day, I wondered ...
- How fast do butterflies fly, anyway ...
- What kinds of butterflies are they ...
- Where are they going ...
- What will they do when they get there ...

Asking questions – the Internet answered what I was asking

Learner: “Okay, so they came from Canada and are bound for Mexico ... about how far is it from Canada to Mexico?”

System: “More than 3,000 kilometers”

Learner: “Hmm ... about how far can a butterfly fly in one day?”

System: “Good question – maybe 50 kilometers or a little more in a day. Varies with the wind and weather and other things.”

Learner: “That means it would take a Monarch butterfly two months or more. Do they live that long.”

System: “No ... but they return to the same place in Canada.”



Monarch butterflies



System: “Monarch butterflies are amazing creatures. Did you know that monarch butterflies migrate from Canada to Mexico in North America every year.”

Learner: “Nope.”

System: “How do you suppose they can do that? What do we need to know about these butterflies to explain that ability?”



An explanation develops

After some time and with multiple rounds of questions and answers the learner might arrive at something like the following:

Monarch butterflies go through four stages of development. Adult butterflies typically live for only 2 to 6 weeks. Monarch butterflies migrate in North America from Canada to Mexico and back every year. It takes four generations of the butterflies to make the trip, and the fourth generation of the butterflies live longer than the previous three generations. They fly at about 9 kilometers an hour and can cover more than 50 kilometers in one day.

... there is much more that the learner may have extracted from the system ... for example, see <https://www.monarch-butterfly.com/index.html>

... The point is to help the learner develop the ability to explain something unusual or puzzling while shifting the questioning from the system to the learner



Another Early Example: Rocks and Fossils



<https://www.burgess-shale.bc.ca/the-cambrian-explosion-and-the-burgess-shale/>

Thinking about Critical Thinking

- Well, the truth is that thinking about critical thinking had other precursors ...
- There was that book by Stephen J. Gould: *Wonderful Life: The Burgess Shale and the Nature of History* ...
- And my experiments on my nephew when he was six years old
- And a failed proposal to Dejian Liu, CEO of NetDragon on one of many trips to the Smart Learning Institute at Beijing Normal University ...
- And my doctoral students who did not know how to think or write clearly ...

One precursor came from my experience teaching at the University of Bergen in Norway

- **Strategy** (see Milrad, M., Spector, J. M., & Davidsen, P.I. (2003). Model facilitated learning. In S. Naidu (Ed.), *Learning and teaching with technology: Principles and practices* (pp. 13-27). London: Kogan Page.)
 - **Start with observation and exploration**
 - **Find puzzling or novel or interesting phenomena**
 - **Support hypothesis formation**
 - **Support hypothesis testing and hypothesis refinement**
 - **Promote thinking about larger principles and policies to guide decision making**
- **Initial Principles**
 - **Learner Control** – support control over the what, when and why
 - **An Organic Approach** – promote individual growth over time
 - **Challenge Learners** – get the learner to have serious questions
 - **Provide Opportunities for Reflection** – help the learner develop a sense of growth

But the initial rejection by NetDragon led to a follow-up proposal – critical thinking game applications for kids ... after all, adults are just big kids with wrinkles ...



The Four Cs

- Communication
- Collaboration
- Creativity
- Critical Thinking

21st Century Skills -

<https://www.battelleforkids.org/networks/p21/frameworks-resources>

<http://sciencenetlinks.com/videos/are-crows-ultimate-problem-solvers/>

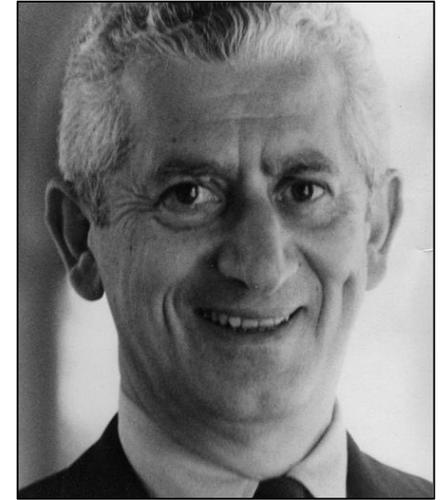
Critical Thinking definitions



Robert J. Sternberg
Psychology



Robert H. Ennis
Philosophy



Benjamin S. Bloom
Education

A reasonable reflective thinking that is focused on deciding what to believe or do (Ennis, 1993)

Bloom's Taxonomy (Bloom, 1958)

A set of cognitive skills and strategies that are purposeful and goal directed that enable someone to be likely to achieve problem solving (Sternberg, Roediger, & Halpern, 2007)



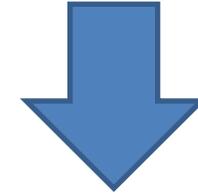
A multi-faceted and dimensional
concept.

The nature of critical thinking

The nature of critical thinking

“A developmental process that proceeds from experience (e.g., observation and interaction) to inquiry, investigation, examination of evidence, exploration of alternatives, argumentation, testing conclusions, rethinking assumptions, and reflecting on the entire process.
“ (Ma et al, 2020)

Literature review



Critical thinking elements:

Abilities, dispositions, level, time, context, knowledge, criteria, and other factors like emotion, motivation.

A series of games to develop inquiry and CT skills: phases and competencies

Development Phase	Example Competencies
Inquiry and puzzlement	Observing oddities; answering and asking questions
Exploration and hypothesis formation	Identifying factors; Creating an explanation
Evidence and hypothesis testing	Finding relevant facts; predicting an outcome
Influence and causality	Differentiating correlation and causality
Explanation and communication	Explaining reasons and causes to others
Coherence and consistency	Identifying inconsistencies and contradictions
Assumptions and biases	Recognizing unstated assumptions; identifying biases
Perspectives and alternatives	Considering multiple points of view
Reflection and refinement	Monitoring progress and adjusting to new evidence

A puzzle for the learner

Your friend Tikvah has challenged you with a puzzle to be answered correctly prior to your being allowed additional powers. Here is the puzzle:

In the year 1861, a person rode into Fort Sumter, South Carolina on Friday and stayed for three days and then left on Friday. How is that possible?

Example of Scenario - 2



- Monarch butterflies

It is known that monarch butterflies migrate almost 5,000 kilometers every year from Canada to Mexico and southern California and then back. An adult butterfly lives for only a couple of months and can only fly about 100 kilometers in a day.

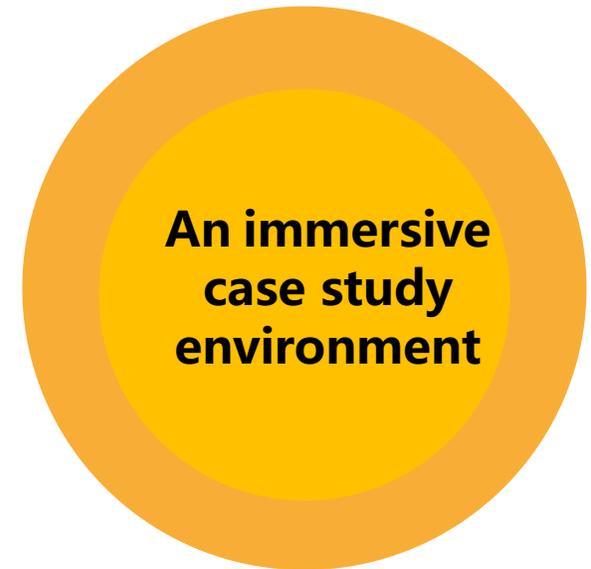
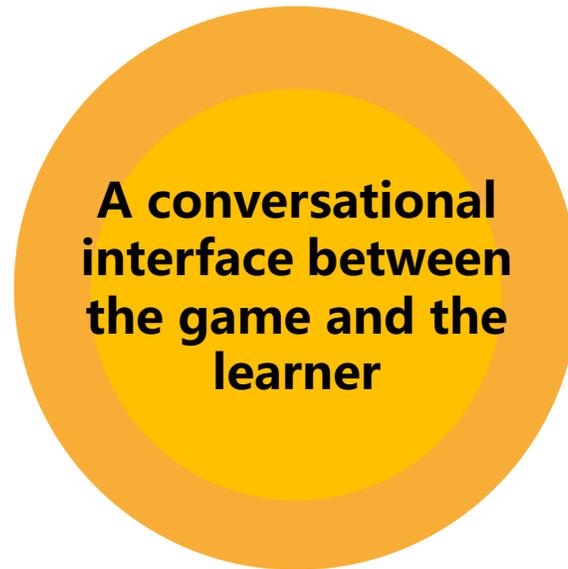
- What question would you like to ask first?

- a) How fast can a monarch butterfly fly?
- b) What do monarch butterflies eat during the migration?
- c) Is the butterfly that left Canada the same one that arrives in Mexico or California?
- d) Why do the butterflies migrate from Canada south to Mexico or California?
- e) Do the butterflies always migrate to the same place?
- f) Do the butterflies always return to the same place?
- g) How do the butterflies know where to migrate?
- h) How do the butterflies know where to return?



3D Learning Space For Critical Thinking

Strategy for Application development





3D Learning Space

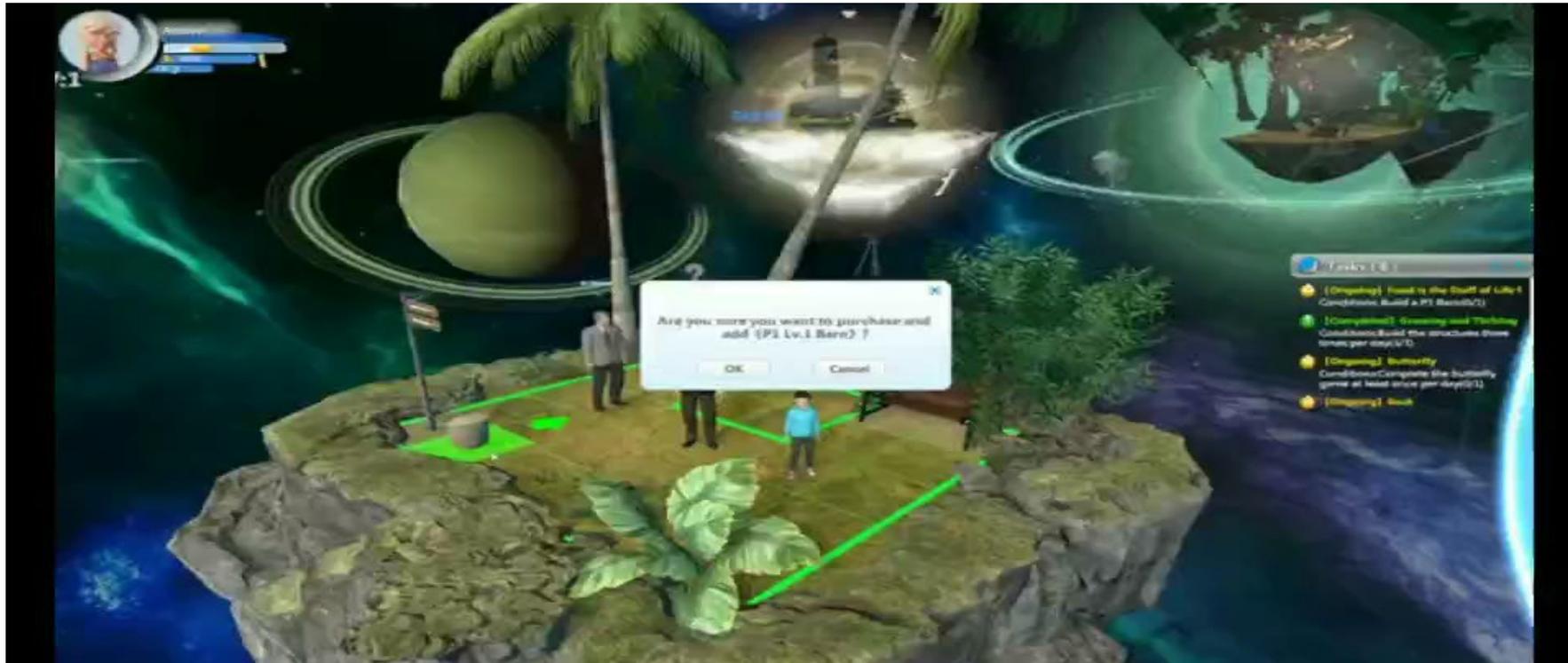
Enriched Learning Experience



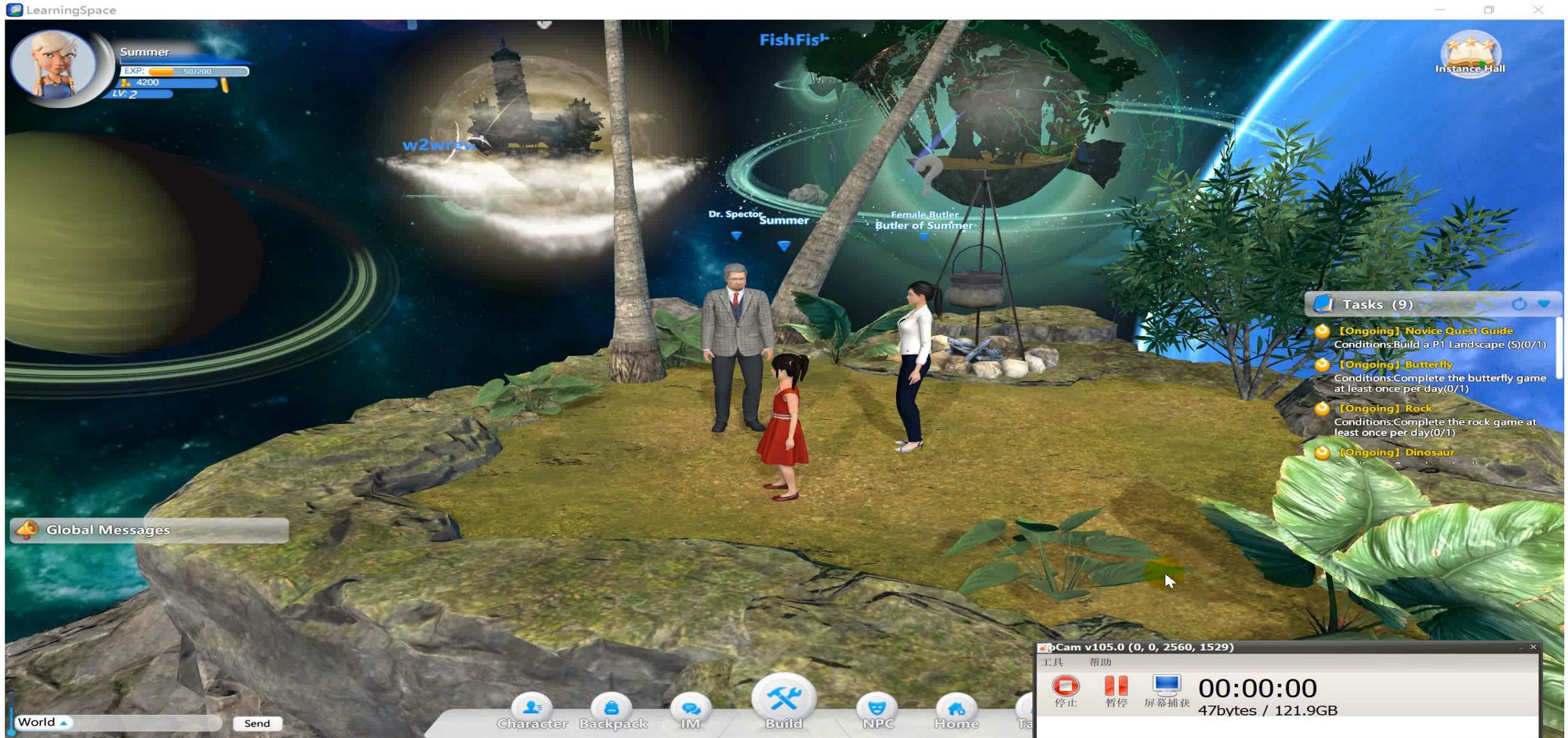
An educational software that stimulates students' learning interest and aims to guide learning in the form of 3D games.

Demo

Creative & Unique Home Construction



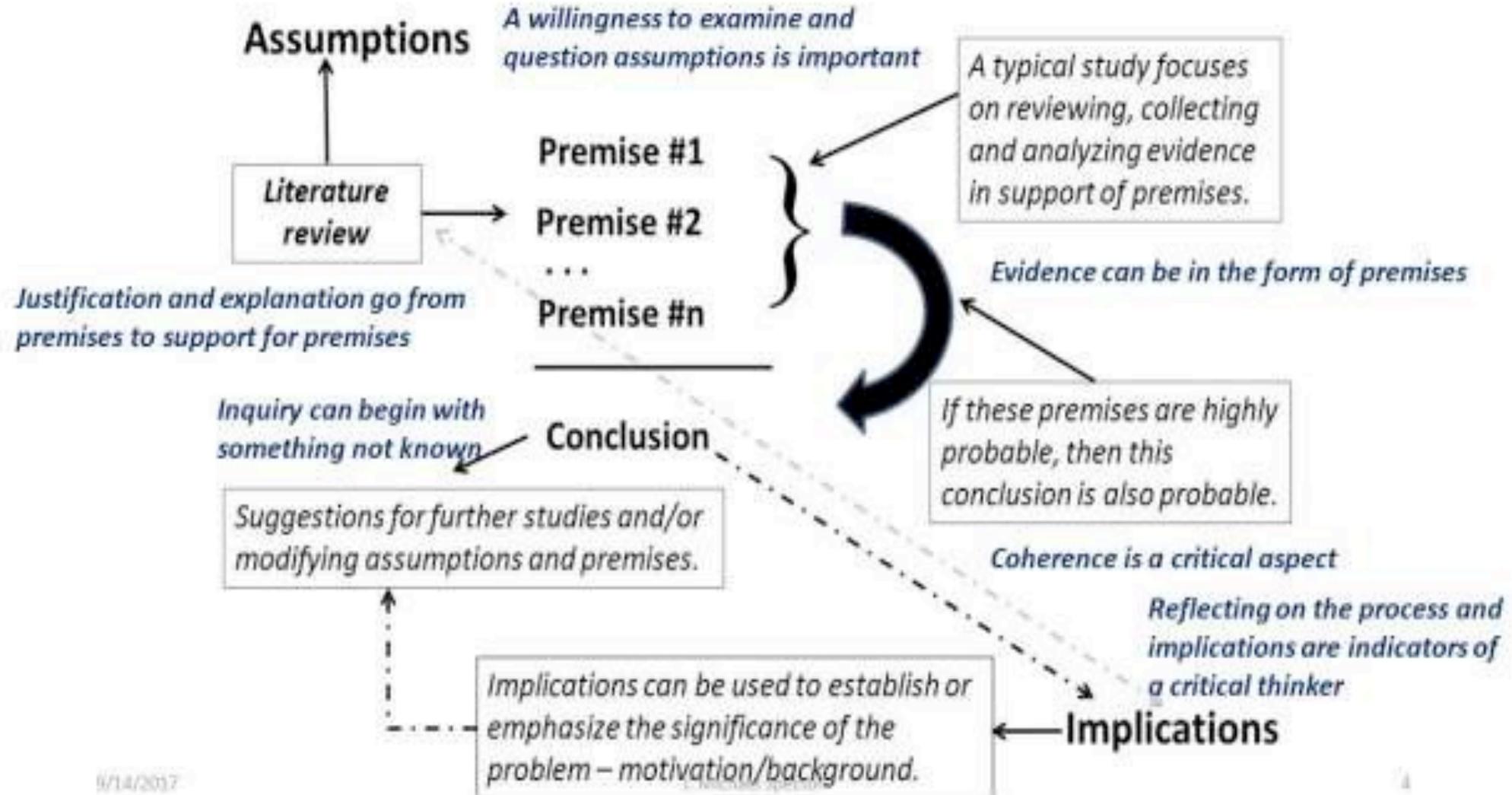
Level 1 Demo: Monarch butterflies



A Game of India



A General Framework for Research & Critical Reasoning



Thank You

O. K. Bouwsma: It is likely that a person knows less than that person is inclined to believe that he or she knows.

Rabbi Spector: A teacher is the voice that encourages, the ear that listens, the eye that reflects, the hand that guides, the face that does not turn away

The Team:

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