Pathway Active Learning Environment: Multimedia Instruction Design

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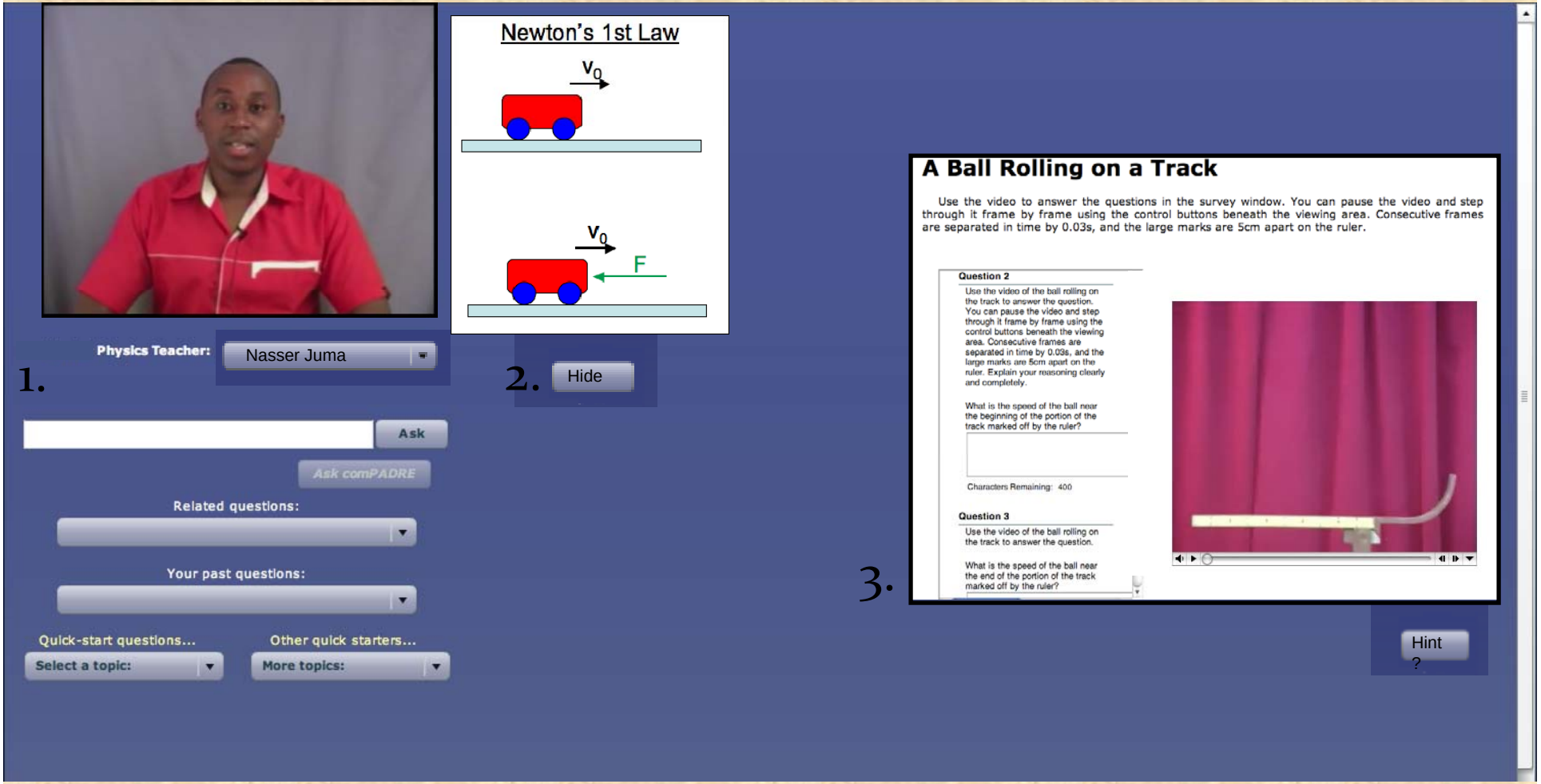
Project Goal (A Brief Reminder)



1. SI Persona answers students' Physics content questions.
2. Supporting multimedia is displayed along side SI persona.
3. Lesson materials are displayed on the right. Students can ask for Socratic hints.

Prologue: Things you already know

The Problem:

- Lecture is effective in restricted cases[1]
- Students often don't learn much[2]
- Interactive engagement helps[3]…
- …but is demanding in resources[4]
- Same thing with tutoring[5]

[1] Schwartz & Bransford (1998) [2] Halloun & Hestenes (1985), [3] Hake (1997), [4] You've seen it, you know, [5] Bloom (1984)

Prologue: Things you already know

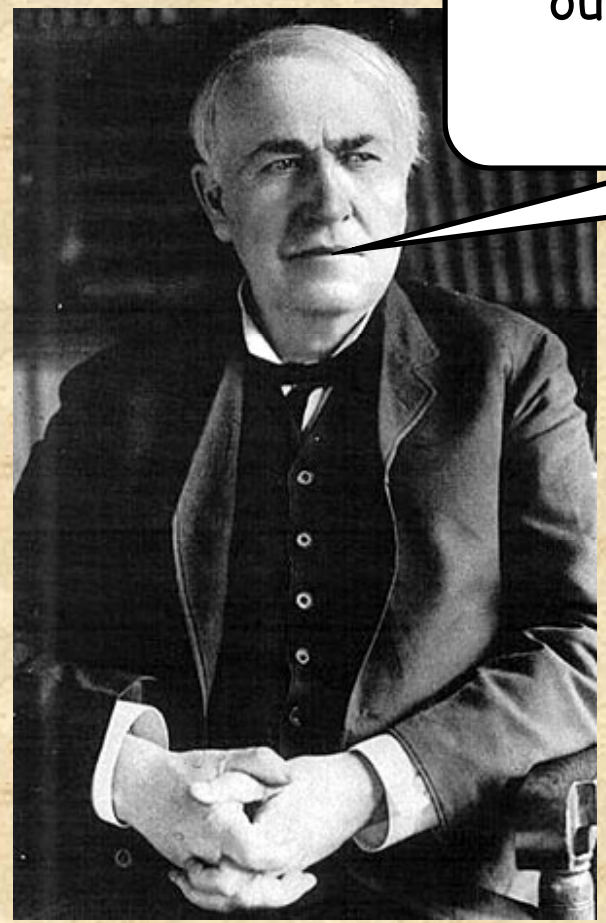
A Fortunate Solution:

We have available a technology which "…is destined to revolutionize our educational system and that in a few years…will supplant…the use of textbooks"

Prologue: Things you already know

Our Solution: Motion Pictures!

"the motion picture is destined to revolutionize our educational system…in a few years it will supplant…the use of textbooks!"
-Thomas Edison, 1922



Prologue: Things you already know

Well, that didn't happen…

Prologue: Things you already know

Well, that didn't happen...

...but this time will be different!

...won't it?

Prologue: Things you already know

Teaching with technology:
Big Promises & (Often) Disappointing Returns

- Radio
- Motion Pictures
- Television
- Video Games
- The Internet

Someone or other claimed each of these technologies would completely revolutionize education.

Prologue: Things you already know

So why should things be different now?

Motivation:Why its okay to do this

So why **could** things be different now?

- We know more about learning now.
- We can methodically study how to best use the technology.
- We can intelligently persist in using the technology.

Motivation:Why its okay to do this

Talk Goals

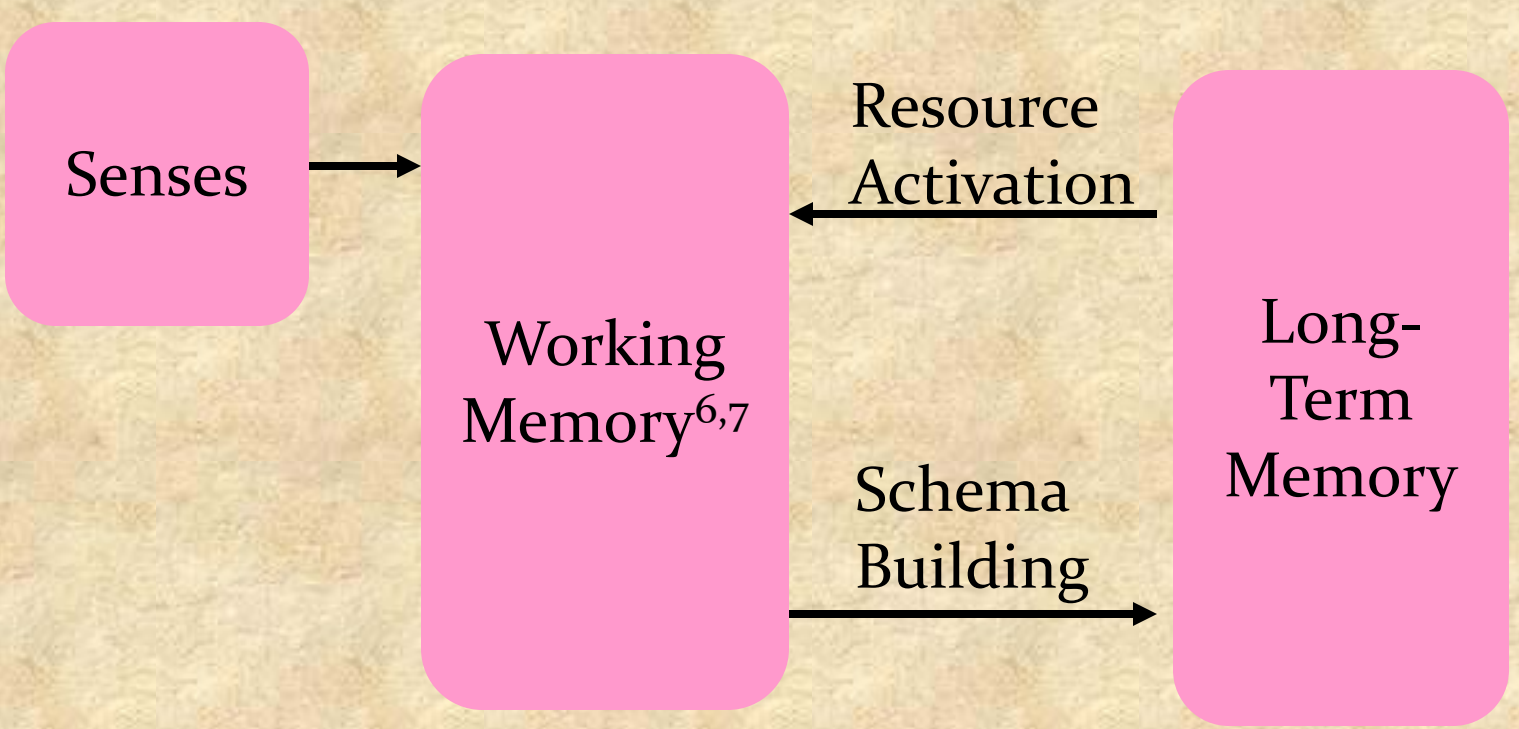
1. Explore a new (to me) facet of theoretical grounding in Cognitive Load theory.

2. Look at what others think works in multimedia design.

3. Establish questions/options to explore as we work towards building our system

A Simple Picture of Learning

We know more about learning now:



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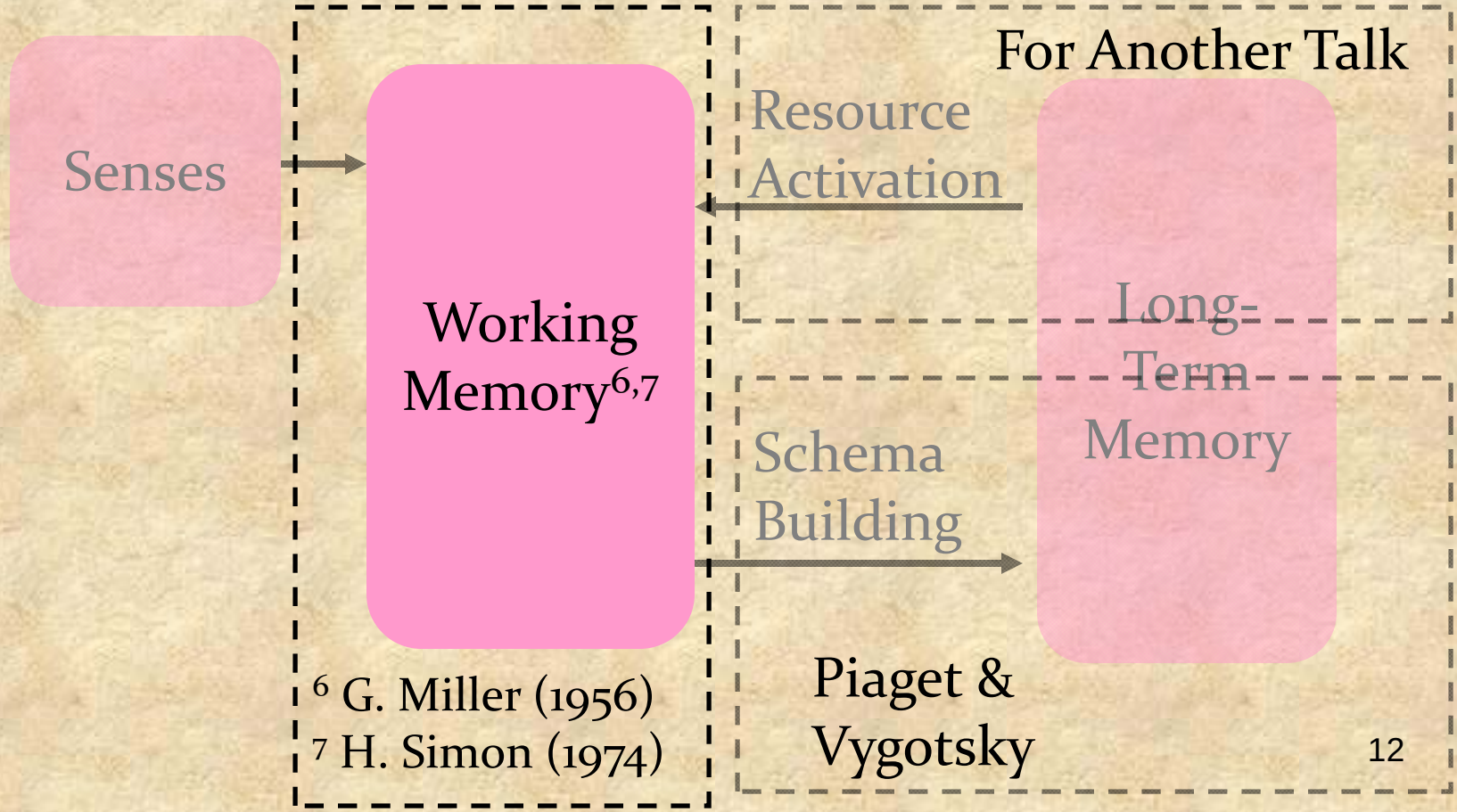


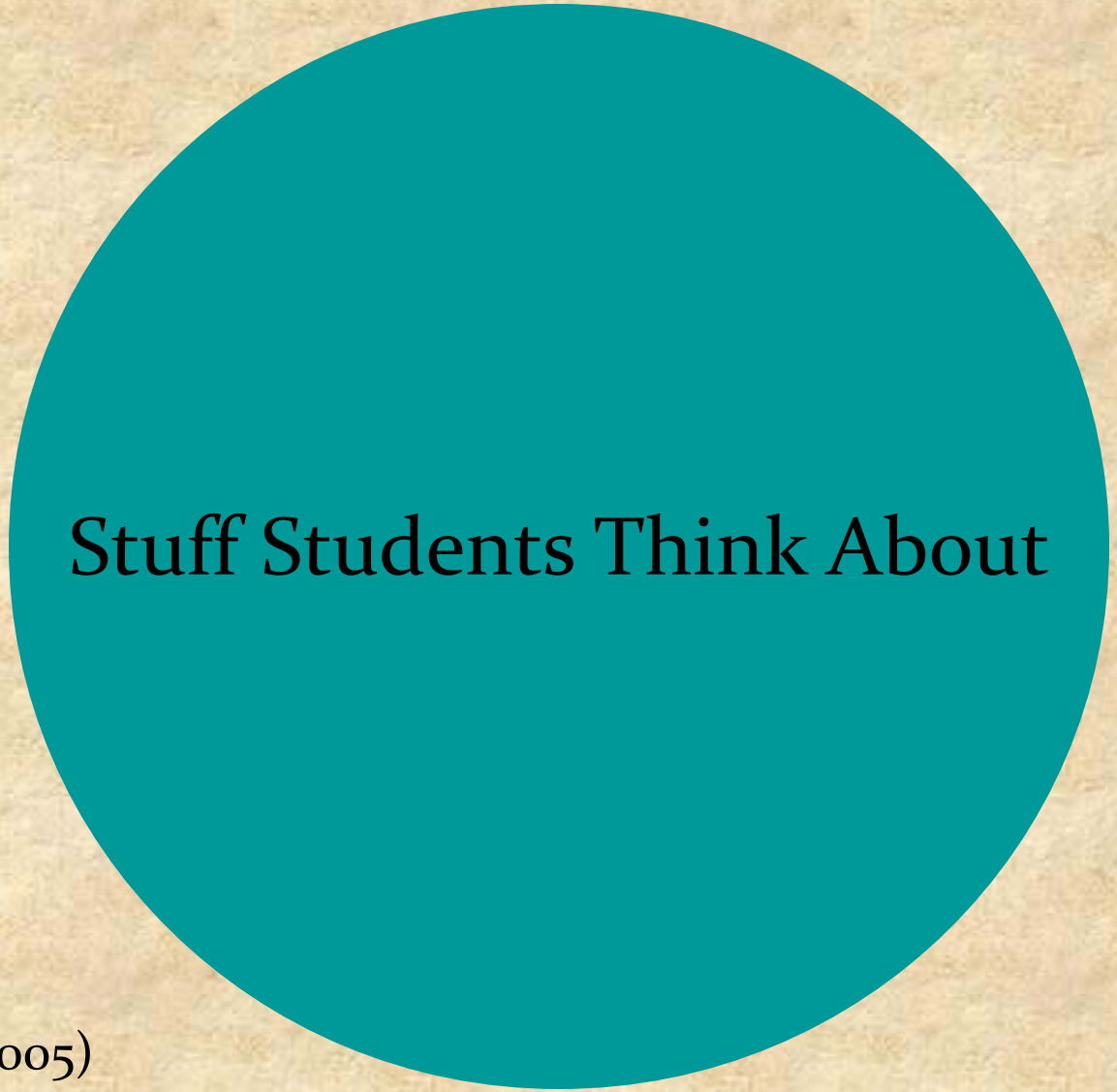
Cognitive Load Theory

Assumptions[8]:

- Finite working memory constrains learning
- Knowledge with high interactivity is more difficult to learn: high intrinsic cognitive load
- Extraneous cognitive load must be managed for such subjects

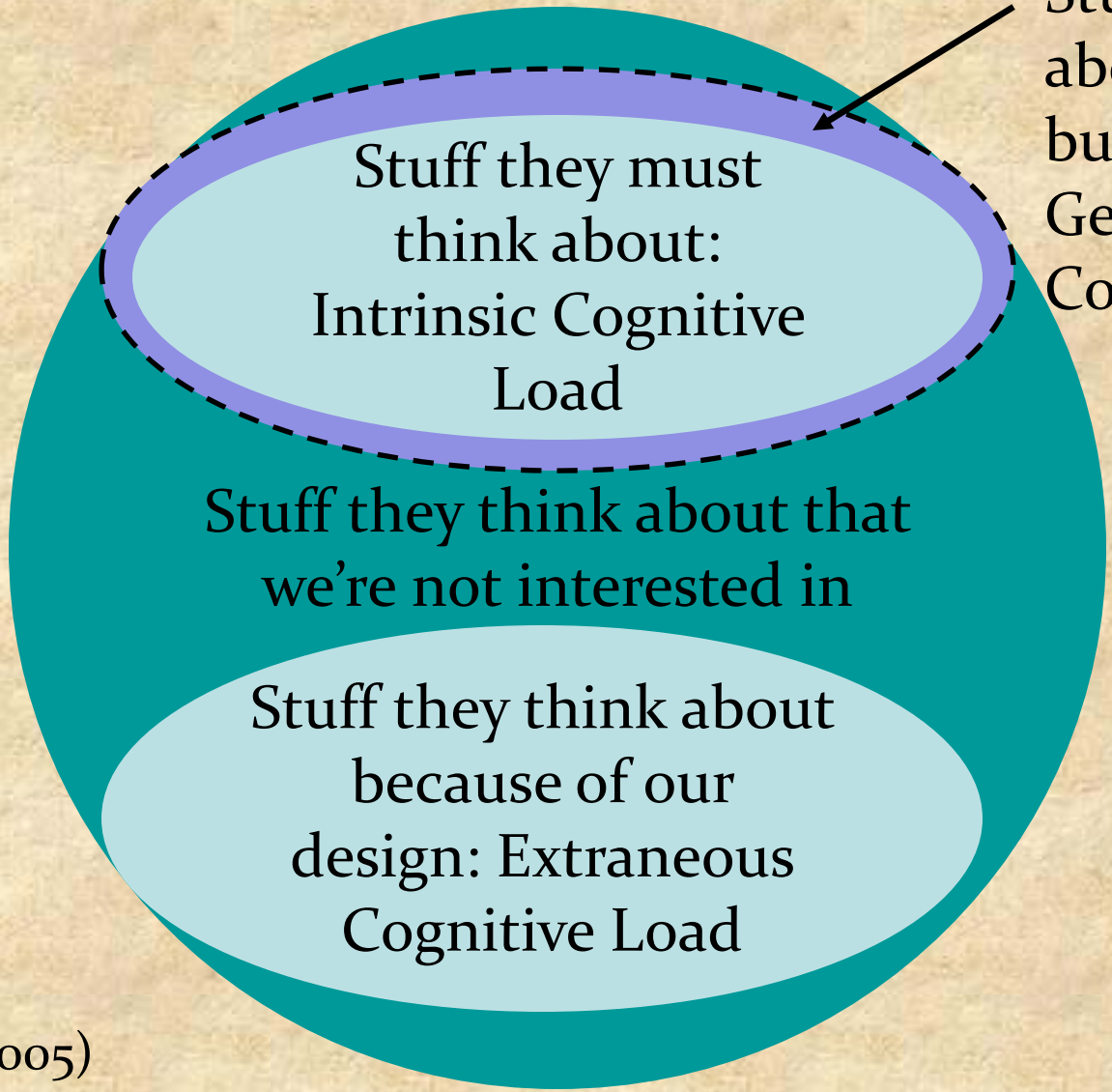
[8] Sweller & Chandler (1994)

Cognitive Load[9]



[9] Sweller (2005)

Cognitive Load[9]



Stuff they think about that helps build schema: Germane Cognitive Load

[9] Sweller (2005)

Cognitive Load Theory

CLT Sets as Design Goals:

1. Minimize extraneous cognitive load

2. Maximize germane cognitive load

3. Understand the Intrinsic cognitive load

Cognitive Load Theory

Questions to consider:

1. How does one measure cognitive loads objectively?

2. Are cognitive loads different for individuals?

3. Can one person's extraneous load be another's germane load?

Three-Step Model of Multi-Media Interaction

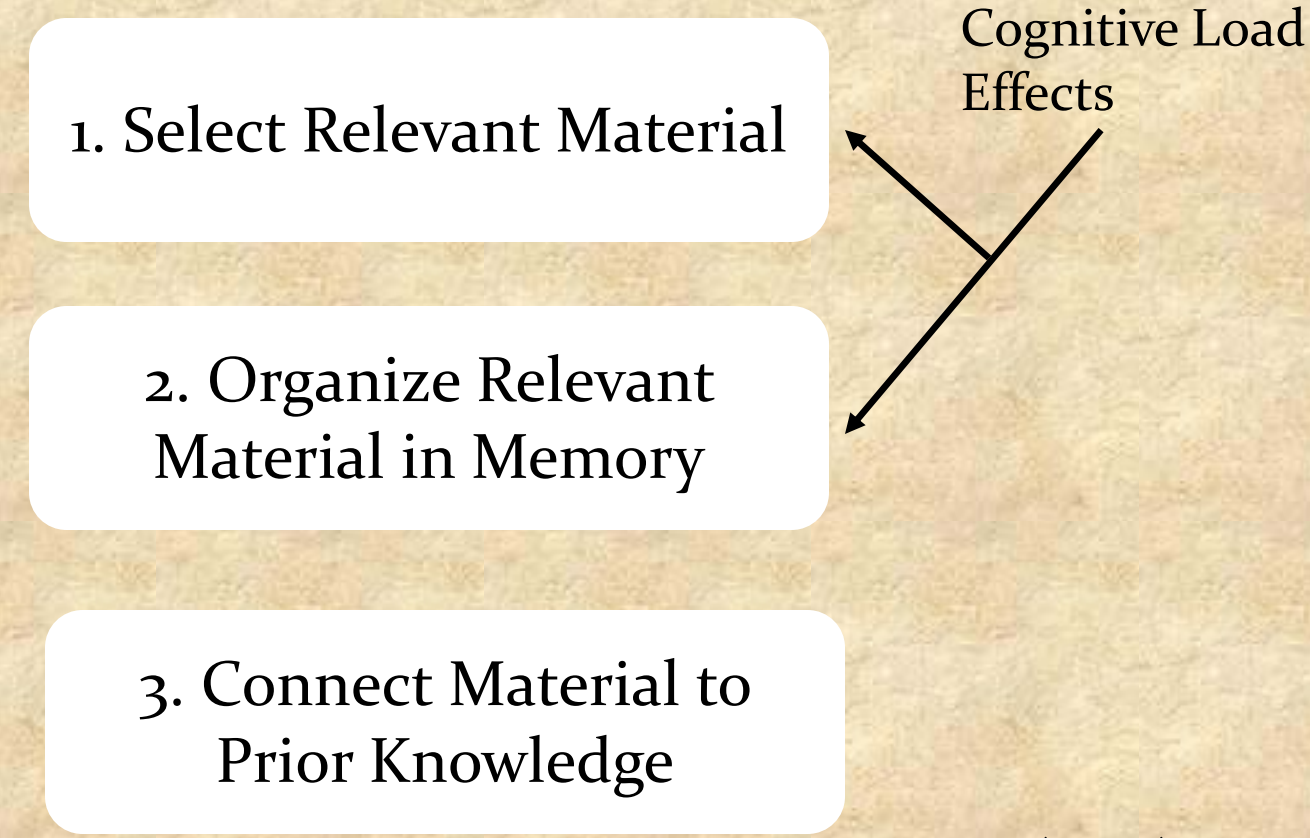
1. Select Relevant Material

2. Organize Relevant Material in Memory

3. Connect Material to Prior Knowledge

[10] Mayer (2005)

Three-Step Model of Multi-Media Interaction



[10] Mayer (2005)

Multimedia Design Principles

Since the early 1990's Mayer and others have compiled 16 principles of multimedia design[10].

[10] Mayer (2005)

Multimedia Design Principles

Since the early 1990's Mayer and others have compiled 16 principles of multimedia design[10].

Two Questions:

1. How true are they?
2. How useful are they?

[10] Mayer (2005)

Multimedia Design Principles

1.The multi-media principle:

People learn better from words and pictures together than words alone.

[10] Mayer (2005)

Multimedia Design Principles

1.The multi-media principle:

People learn better from words and pictures together than words alone.

What about Stelzer et. al[11]?

[10] Mayer (2005)

Multimedia Design Principles

2. The Split Attention Principle:

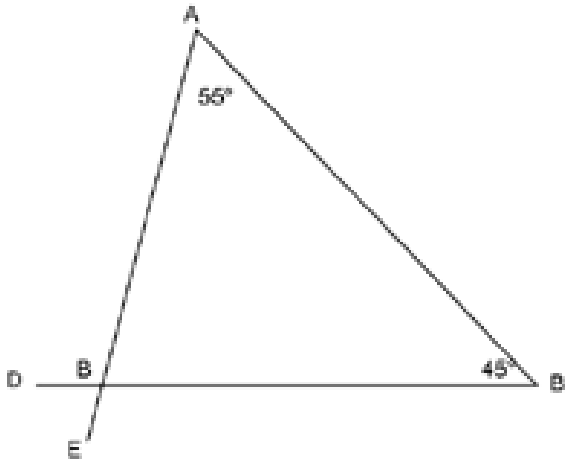
People learn better when information is spatially and temporally overlapped.

[10] Mayer (2005)

Multimedia Design Principles

2. The Split Attention Principle:

Example demonstrating split attention



In the above figure, find a value for Angle DBE

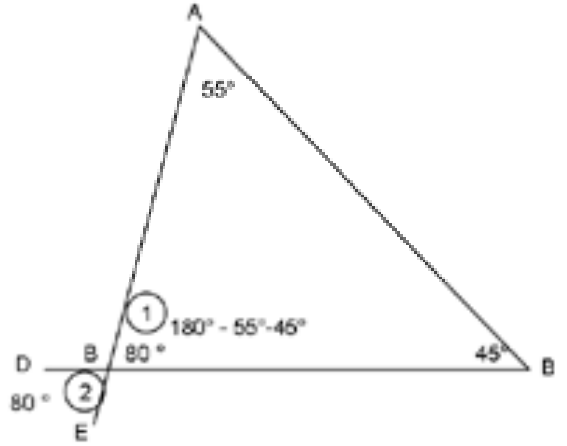
Solution:
Angle ABC =180° - Angle BAC-Angle BCA (internal angles of a triangle sum to 180°)

= 180° - 55°-45°

= 100°

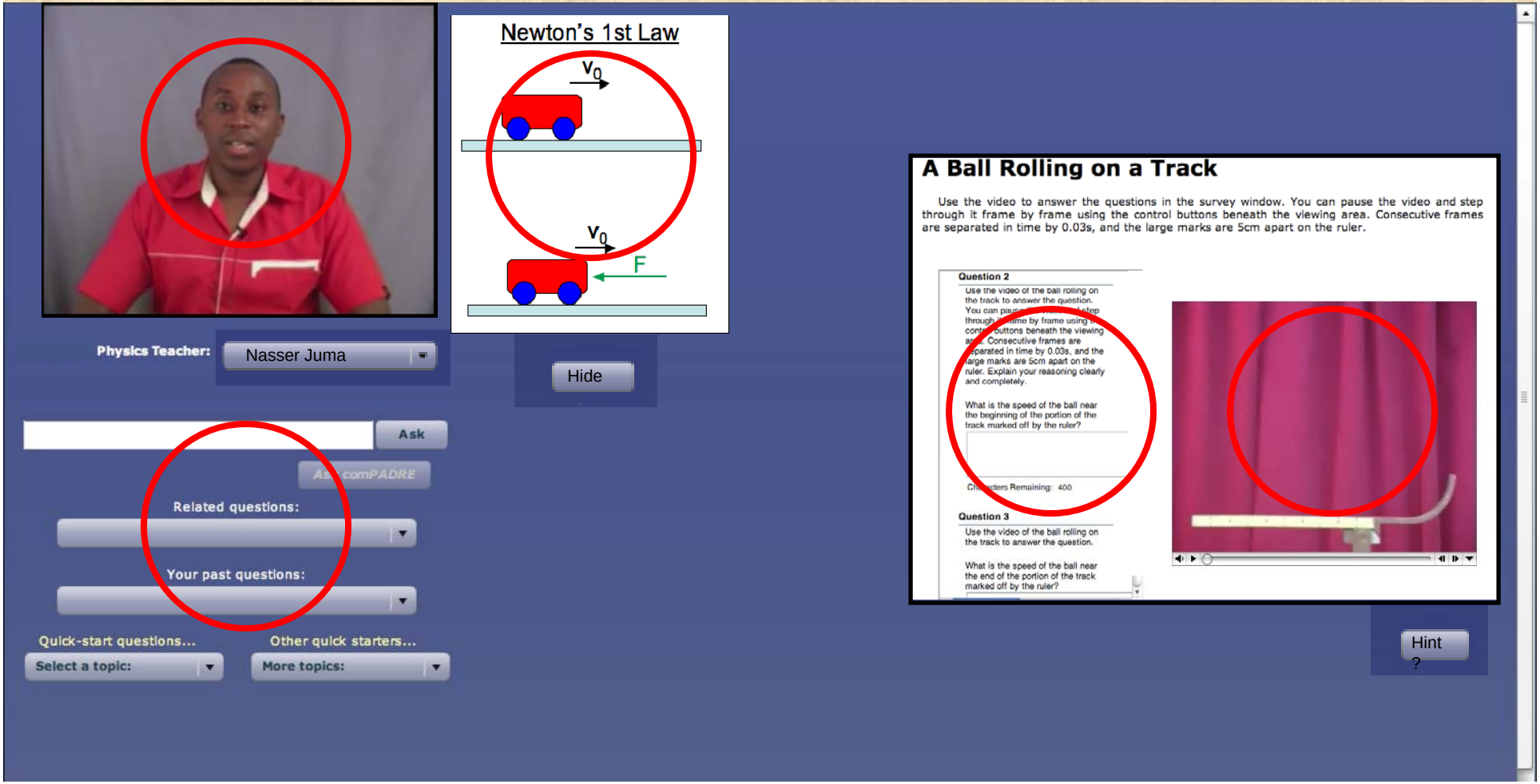
Angle DBE = Angle ABC (vertically opposite angels are equal)
= 80 °

Integrated example



Multimedia Design Principles

2. The Split Attention Principle:



Multimedia Design Principles

3. The Modality Principle:

People learn better from pictures/animations and narration than pictures/animation and text.

[10] Mayer (2005)

Multimedia Design Principles

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People learn better from pictures/animations and narration than pictures/animation and text.

Should our SI persona provide more narration to limit on-screen text?

[10] Mayer (2005)

Multimedia Design Principles

8. The Guided Discovery Principle:

People learn better when guidance is incorporated into discovery-based multi-media presentation.

[10] Mayer (2005)

Multimedia Design Principles

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People learn better when guidance is incorporated into discovery-based multi-media presentation.

What are the potential implications for our video measurement activities?

[10] Mayer (2005)

Multimedia Design Principles

Implications for video measurement activities

Students Get:

- Text Instructions
- Frame Rate
- A Ruler
- Radio Buttons

Multimedia Design Principles

10. The Collaboration Principle:

People can learn better by working collaboratively.

[10] Mayer (2005)

Multimedia Design Principles

Social Interaction?

10. The ~~Collaboration~~ Principle:

People can learn better by working collaboratively.

Can our Synthetic Interview play a role similar to collaborators?

[10] Mayer (2005)

Multimedia Design Principles

12. The Animation/Interaction principle:

People do not necessarily learn better from animations than from static diagrams.

[10] Mayer (2005)

Multimedia Design Principles

12. The Animation/Interaction principle:

People do not necessarily learn better from animations than from static diagrams.

What are the implications for our three level design?

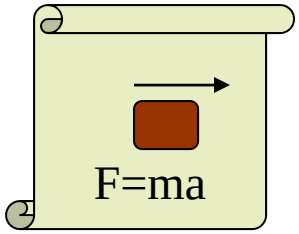
[10] Mayer (2005)

Multimedia Design Principles

Our three level design:

The SI Speaks alone

The SI & a static image



The SI & other video/applets

Multimedia Design Principles

15. The Prior Knowledge Principle:

Instructional designs that work well for novices may hinder those with more prior knowledge.

[10] Mayer (2005)

Multimedia Design Principles

15. The Prior Knowledge Principle:

Instructional designs that work well for novices may hinder those with more prior knowledge.

Should we look for suppressed learning post-instruction?

[10] Mayer (2005)

Conclusions

- Cognitive Load Theory may help provide perspectives for assessing effective design of Pathway-ALE
- Multimedia Learning (based on CLT) provides interesting principles, but must be looked at critically
- Both present resources, but also challenges (opportunities) for our design

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Thank You

Questions for Chris

1- What are the characteristics and conditions for the Modality principle to be true? (Visual memory, information processing and intrinsic overload is possible. How to compromise?

(Some studies shows negative impact)

2- Multiple modalities enhance recall, what evidence does exist for our learning goals?

3-How to elicit prior knowledge to minimize the extraneous load and maximize germane load?

4- How to incorporate learning theories (guided inquiry) to virtual tutoring?