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Pedagogical Management in Support of a Generalized Framework for Intelligent Tutoring

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11 May 2017 – GIFT User Symposium

AGENDA

- Introduction
- Guiding Requirements
  - Dimensions of Instructional Management Research (ARL-SR-0345)
- Current Practice in GIFT
  - Instructional Management at the:
    - Lesson Level
    - Interaction Level
    - After-Action Review Level
- Future Directions

INTRODUCTION

- Goal: provide a set of tools for training practitioners to rapidly build adaptive instructional materials based on an interplay of
  - Knowledge acquisition and
  - Skill development
- Challenge:
  - Expected users are SMEs, not ITS developers
  - Authoring workflows and ITS methods must be developed to compensate for the skills a GIFT user lacks…instructional design, cognitive psychology, computer programming, etc.

INTRODUCTION

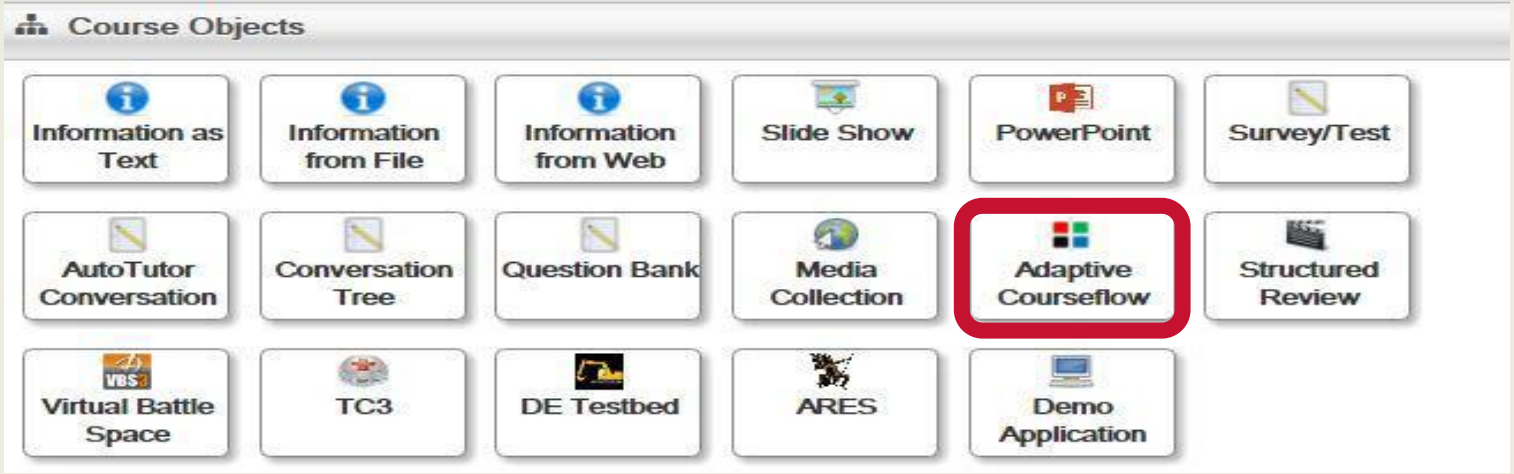
- Instructional Management Research Vector:
  - Develop enabling technologies that allow SMEs to author GIFT-based lesson materials that are
    - Empirically informed
    - Grounded in instructional design theory
  - Develop AI technologies that optimize pedagogical approaches over time
    - Data-driven
    - Evidence-based

GUIDING REQUIREMENTS

- Research outline published November 2015 (ARL-SR-0345)
- Defined desired end-state capabilities across the following dimensions
  - Guidance and Scaffolding
  - Social Dynamics and Virtual Humans
  - Metacognition and SRL
  - Personalization
- Provides a means for organizing and prioritizing efforts to enhance GIFT's current pedagogical function

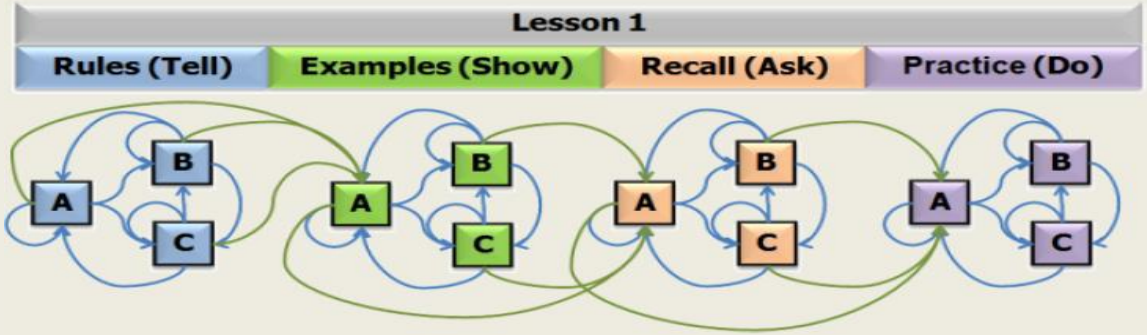
Current Development:
Lesson Level

LESSON LEVEL

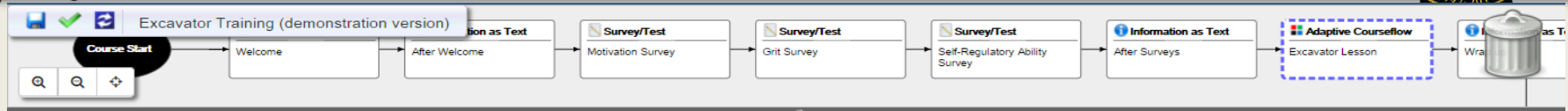


- Personalization based on learner attributes and metadata
- Lesson level pedagogy captured in GIFT's Engine for Management of Adaptive Pedagogy (EMAP)

- EMAP (Represented in the Adaptive Courseflow object)



  - Based on Merrill's Component Display Theory
  - Provides framework for adaptive content selection and remediation
    - Based on literature review and empirically informed
  - Shortfalls: Deterministic in nature and uncertainty in generalizable use of strategy implementations



Excavator Lesson

Concepts to cover:

☑	Boom
☑	Bucket
☑	Arm
☑	Swing

Rule Phase

Add Content | Show Content Files

☐ Show message on completion

Example Phase

Add Content | Show Content Files

☐ Show message on completion

Check on Learning Phase (Recall)

Course Question Bank:

Edit | Remove

Knowledge Assessment Question Bank

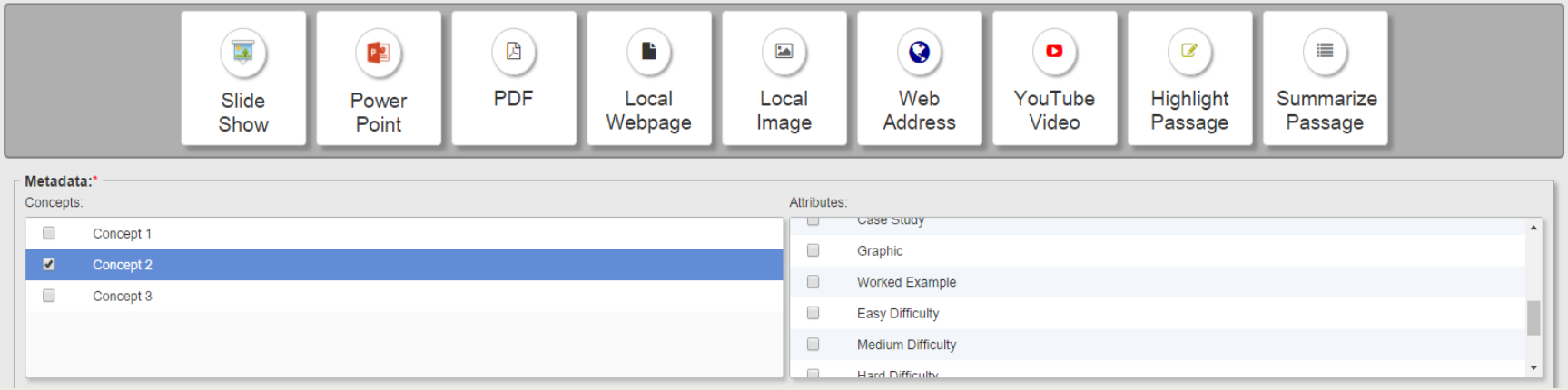
Number of questions to show per concept:

Concept	Easy	Medium	Hard
Boom	1	1	0
Bucket	2	0	0
Arm	1	1	0
Swing	2	0	0

- EMAP Enhancements (NCSU/IAI):
  - Re-factoring the Adaptive Courseflow Object to incorporate Chi's (2009) CAP Learning Activity Framework
  - Enhances tutorial planning logic
    - Incorporates MDP policies for selection of remediation materials following assessment practices in GIFT
    - Will incorporate a reinforcement learning component for policy optimization as data is made available

LESSON LEVEL

Add Remediation Content



- GIFT and MOOCs (CMU/UPENN)
  - Investigating application of GIFT in a MOOC environment
  - Through LTI compliance and EdX integration, GIFT can now serve as a lesson delivery platform within a larger learning ecosystem
    - Enables personalization and remediation through GIFT EMAP logic

LESSON LEVEL

- Structural Equation Modeling to validate course structure and object sequencing (eduworks)
  - Develop tool to automate process as data is made available
  - Intended to optimize course concept scheduling within a GIFT lesson to promote better learning outcomes (performance, retention, transfer)

Current Development:
Interaction Level

INTERACTION LEVEL

Execute Strategies When...

- **16 - bad move**'s performance changes from **Anything** to **AboveExpectation**

<< Add Variable

Remove Variable >>

Authored Tasks/Concepts:

- 22 - move boom task
- 23 - move boom objective timer
- 24 - boom
- 25 - moved non-boom component
- 34 - intermission 3
- 35 - intermission timer 3

Possible Learner States:

- Engagement
- Understanding
- Arousal
- Long Term Excitement
- Short Term Excitement
- Meditation

Drag variables to and from the appropriate lists to decide which variables will be evaluated.

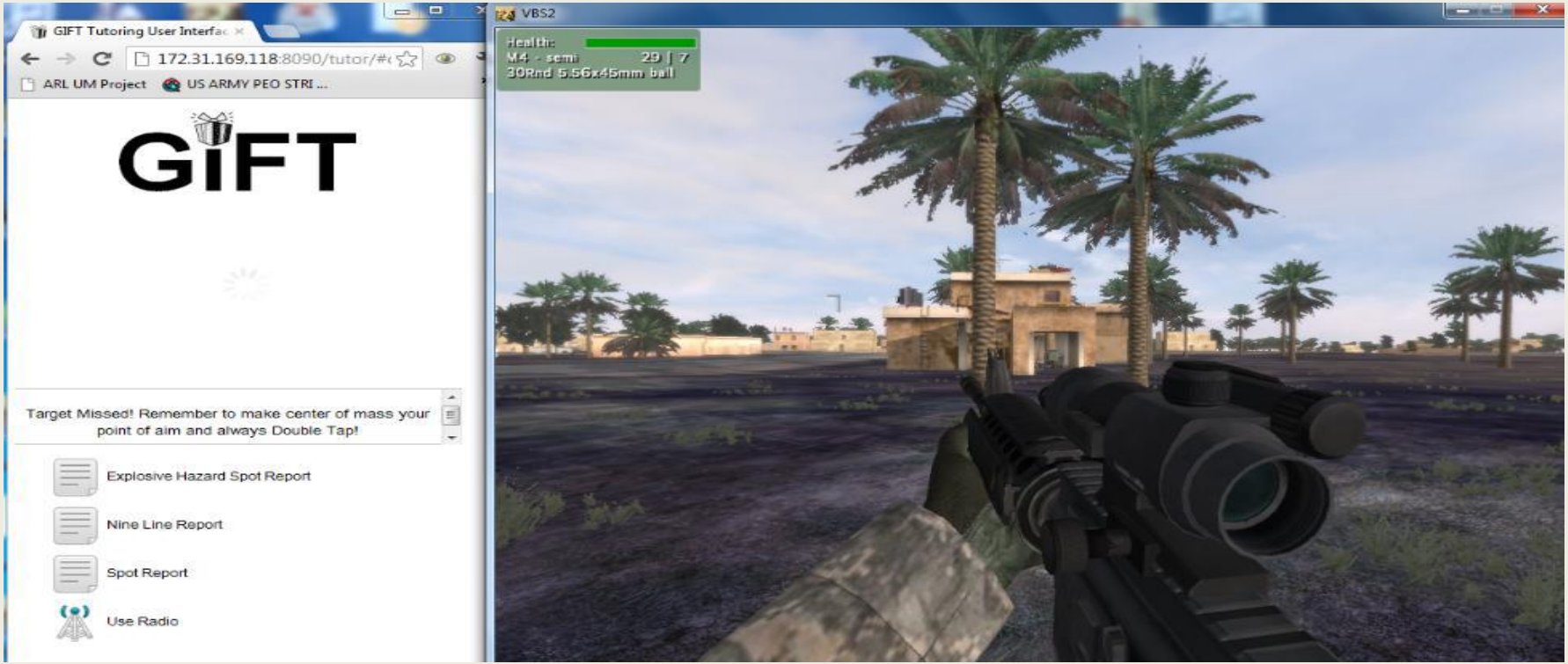
Strategies to Execute:

- incorrect move (bucket)

Authored Strategies:

- decrease weather difficulty
- increase weather difficulty
- completed task message
- Positive bucket movement feedback

INTERACTION LEVEL



INTERACTION LEVEL

- DKF Enhancements in Support of Instructional Management
  - Extend CAP Remediation MDP logic into practice/interactive environments (NCSU/IAI)
  - Extend schemas to support metacognitive modeling to guide pedagogy at multiple levels of abstraction (Vandy)
    - Metacognitive, Cognitive Strategy, and Cognitive Skill
  - Extend DKF to enable pattern recognition for more contextual performance assessment (SoarTech)

INTERACTION LEVEL

- Extend assessment logic to support psychomotor skill assessment
  - Model behavioral representations to guide specific coaching practices

Current Development:
After-Action Review Level

- Current effort aims at development of tools and methods to support personalized AARs
  - Grounded in Ericson's Theory of Deliberate Practice
  - Goals
    - Reinforce Learning Objectives
    - Address Impasses
    - Contextualize training event with real-world application
  - Approach
    - Use adaptive MDP policies for content selection based on learner performance history and policy component assessments

FUTURE DIRECTIONS

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- Instructional management at the team-level
  - Support team development and cohesion
- Instructional management in a mobile world
  - Investigate pedagogical functions for mobile applications
  - Investigate adaptive training in live environments using cellular data for assessment (e.g., land navigation)

THANK YOU FOR YOUR ATTENTION