Instructional Management in the Generalized Intelligent Framework for Tutoring: 2018 Update

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Agenda

- Introduction
- Guiding Requirements
- Instructional Management in GIFT
  - Functions Now Available in Public-Facing Baseline
  - Functions Under Development
  - New Efforts
- Future Directions
  - U.S. Army Synthetic Training Environment

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**
- **Variants in Learning and Decay Rates**

Introduction

Challenges:

- **Expected users are Subject Matter Experts (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.**
- **Authoring workflows must be generalizable and apply across Live, Virtual and Constructive (LVC) training environments**

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**

Introduction

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**

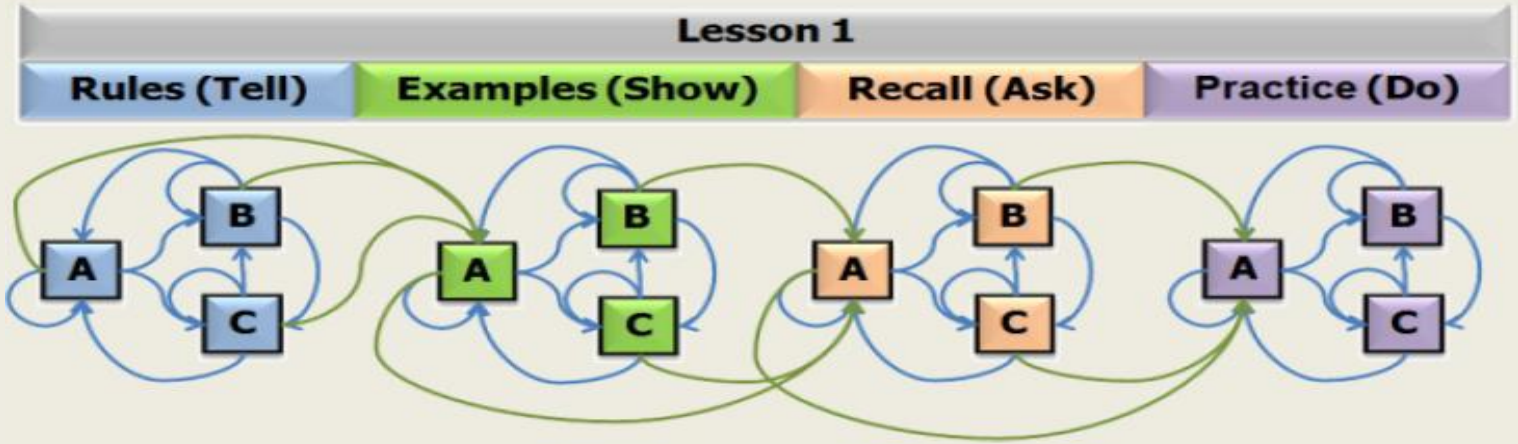
- **Provides a means for organizing and prioritizing efforts to enhance GIFT's current pedagogical function**

Instructional Management in GIFT

Functions Now Available:
Public-facing Baseline

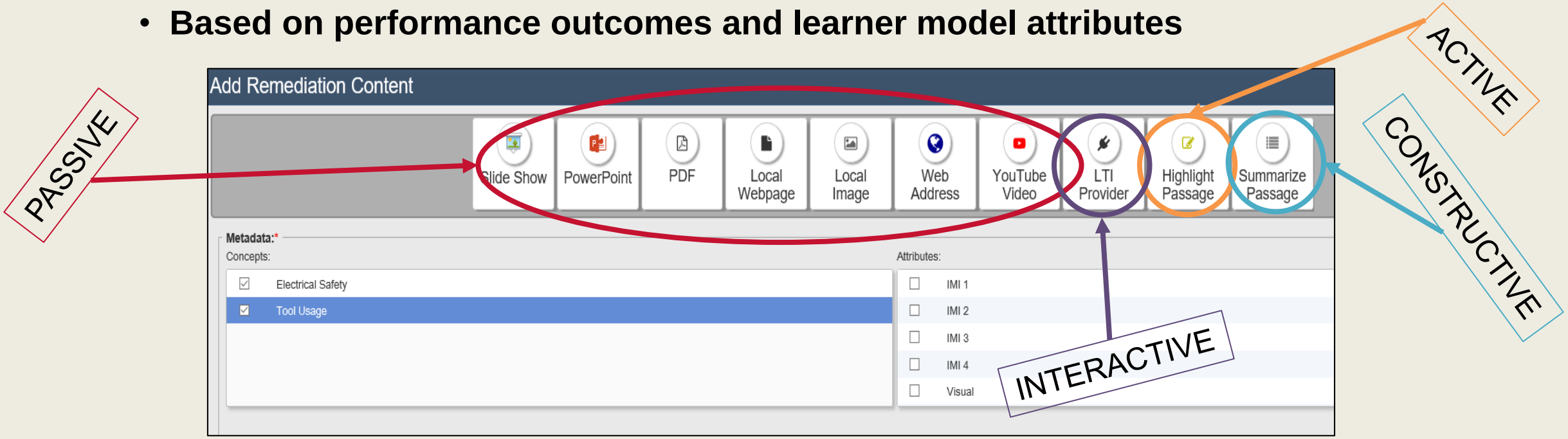
ICAP-Inspired EMAP: Drop 1

- New re-factoring of the Engine for Management of Adaptive Pedagogy (EMAP)



ICAP-Inspired EMAP: Drop 1

- New re-factoring of the Engine for Management of Adaptive Pedagogy (EMAP)
  - Incorporates ICAP-Inspired (Interactive-Constructive-Active-Passive; Chi, 2009) remediation levels
  - Extends current remediation functions to facilitate variants beyond content delivery
    - Based on performance outcomes and learner model attributes



ICAP-Inspired EMAP: Drop 1

- **Drop 1 Limitations:**
  - **Randomization-policy in place to support ICAP-Remediation type**
  - **Requires library of “Active” and “Constructive” activity types to take full advantage of new EMAP instantiation**

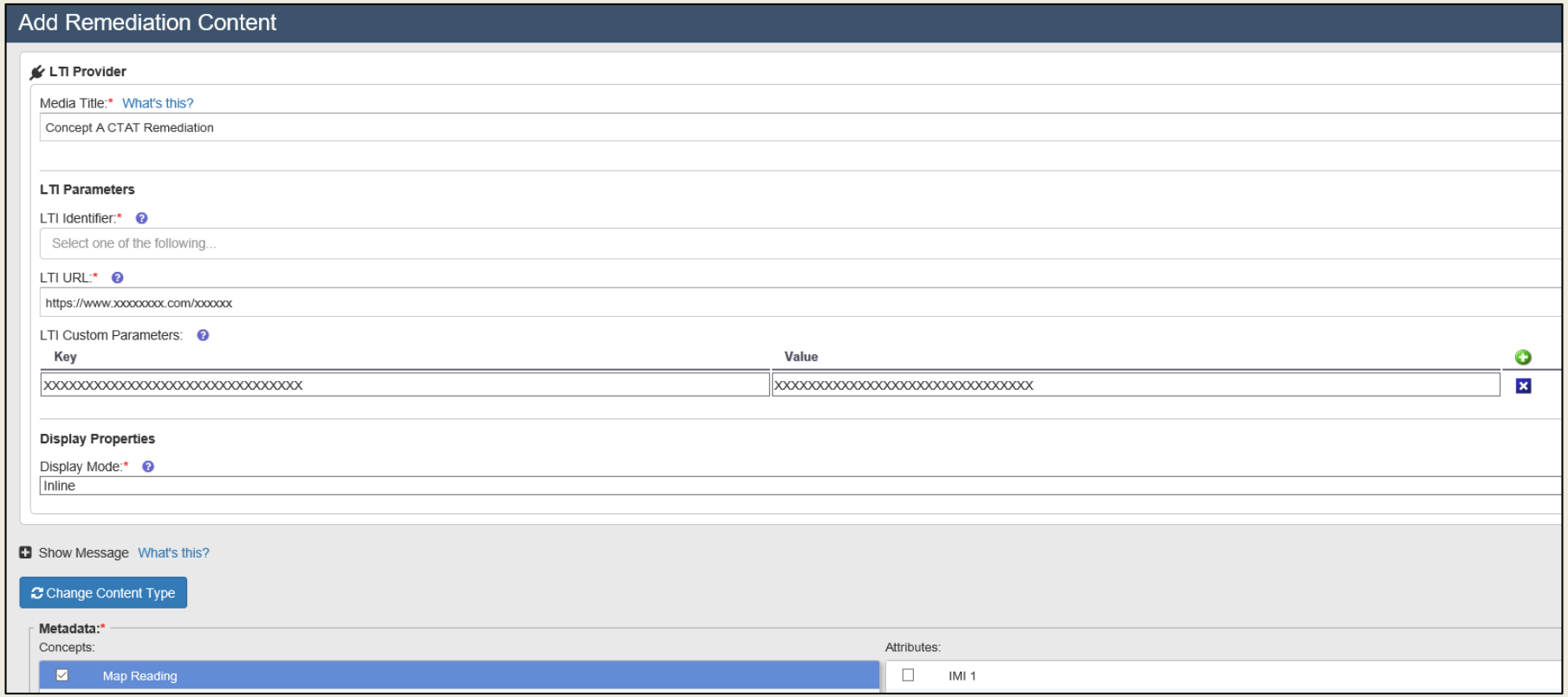
GIFT Interoperability and Personalization through LTI Standards

- **Support Instructional Management across disparate applications through Learning Tools Interoperability (LTI) standards**

- **Two Instances of LTI Integration:**
  - **LTI Provider**
    - **GIFT Interoperability w/ Learning Management Systems**
      - **Use GIFT lessons to provide personalization in MOOC configured courses**
        - **» edX Example**
  - **LTI Consumer**
    - **GIFT Interoperability w/ LTI Providers**
      - **Use other ITS and adaptive learning solutions within GIFT lesson to extend pedagogical functioning**
        - **» CTAT Example**

GIFT Interoperability and Personalization through LTI Standards

- LTI Consumer
  - Stand-alone interaction
  - EMAP Practice Quadrant
  - ICAP-Inspired Remediation in EMAP



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Instructional Management in GIFT

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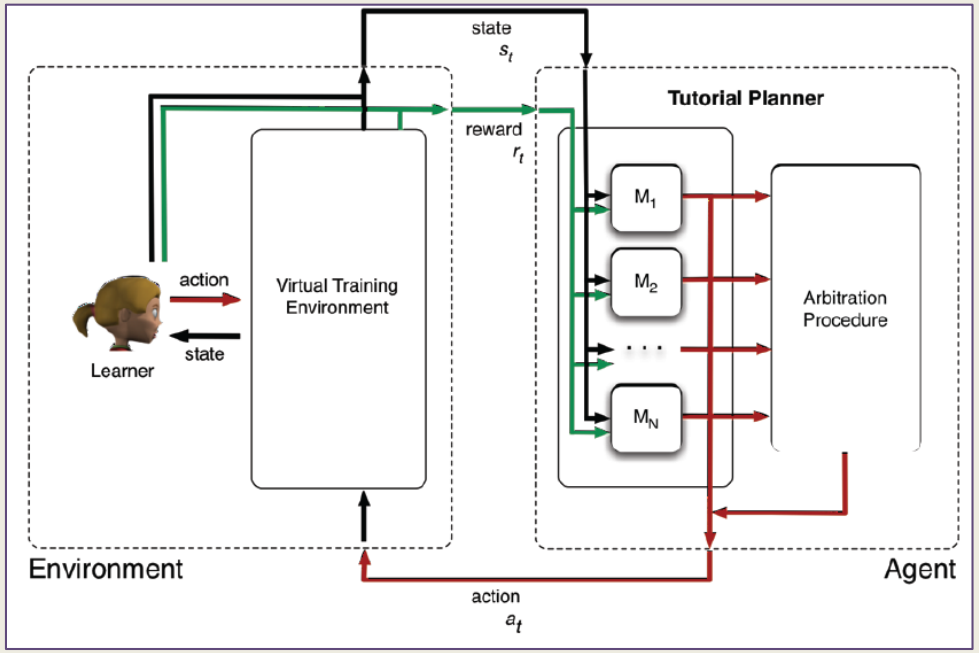
Functions Under Development

Establishing Policies in the ICAP-Inspired EMAP

- **Objective: Data-driven policies implemented as Markov Decision Processes to manage ICAP remediation**
- **First Domain: Counterinsurgency**
- **Method:**
  - **Use Amazon Mechanical Turk to gather data for building simulated students**
  - **Establish initial policy weights based on maximum reward functions**
  - **Institute reinforcement learning back-end to support policy optimization over time**
- **Will be reported in further detail in Rowe et al. presentation**



(Rowe et al., 2016)

New Efforts

Game-Based Worked Examples

- Use structured interview approach to add pedagogical wrapper to the free-play game-based environments
  - Leverages GIFT's Survey Authoring System to structure procedure oriented prompts
  - Feedback and remediation materials can be configured at a step-by-step level

- EXAMPLE: Land Navigation in Virtual Battle Space (VBS) 3 for Dead-Reckoning procedures
  - Plan is to apply scaffolding approach
    - Remove interview component when trainee shows competence (e.g., correctly answers all interview assessments for two assigned points)
    - Switch from question-by-question directed scenario to task/condition/standard directed scenario
      - » Task: Navigate to the following Waypoint
      - » Condition: Avoid the following areas at all costs
      - » Standard: Reach destination in under 20 minutes

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Key: SP – Starting Point GP – Given Point AP – Assigned Point

What is the best Given Point (GP) for you to begin at in order to reach your Assigned Point (AP) most efficiently?

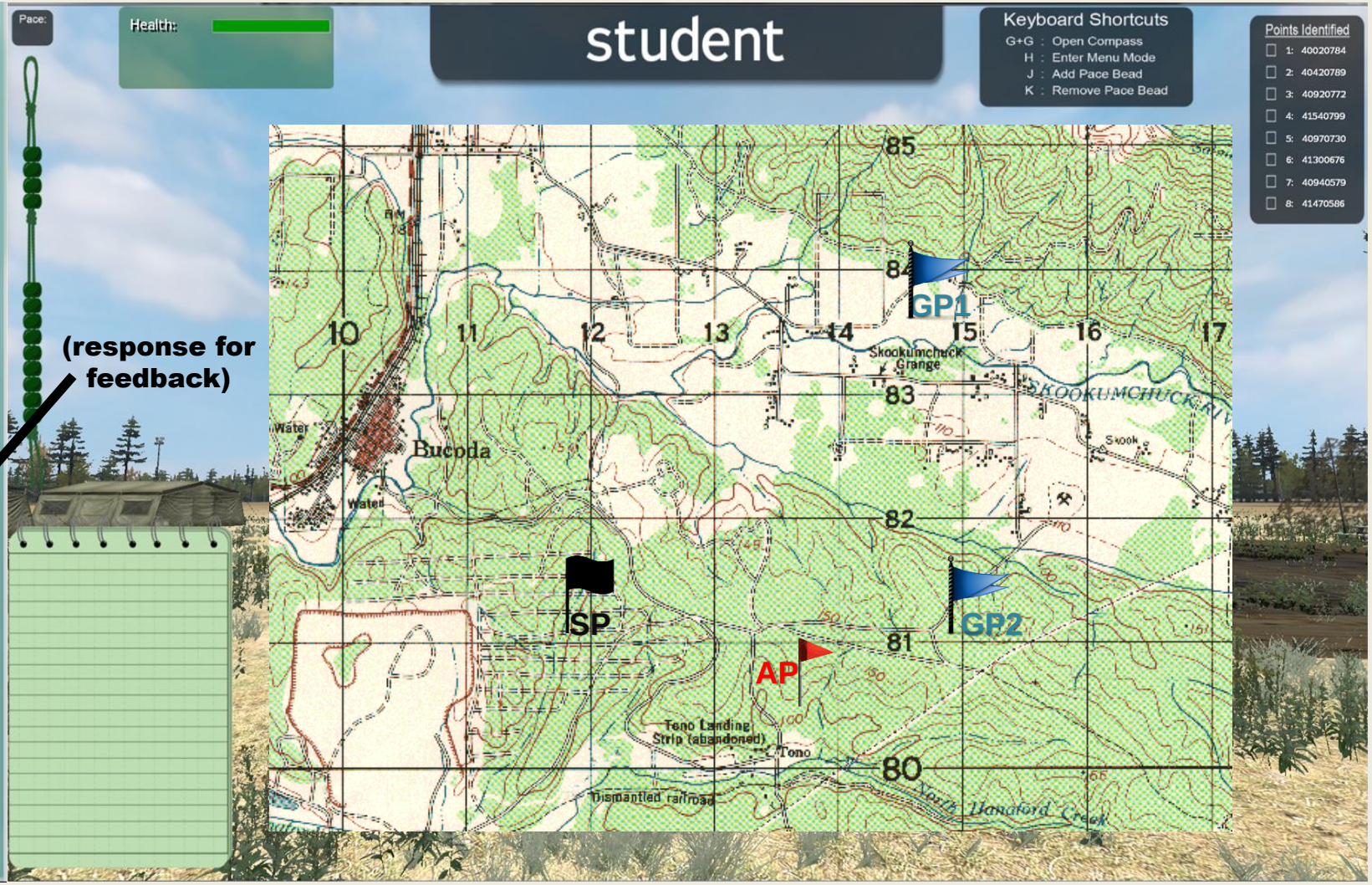
GP2

Why?

Because it provides the quickest and most efficient route to the AP.

(response for feedback)

(response for data collection)



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ARL

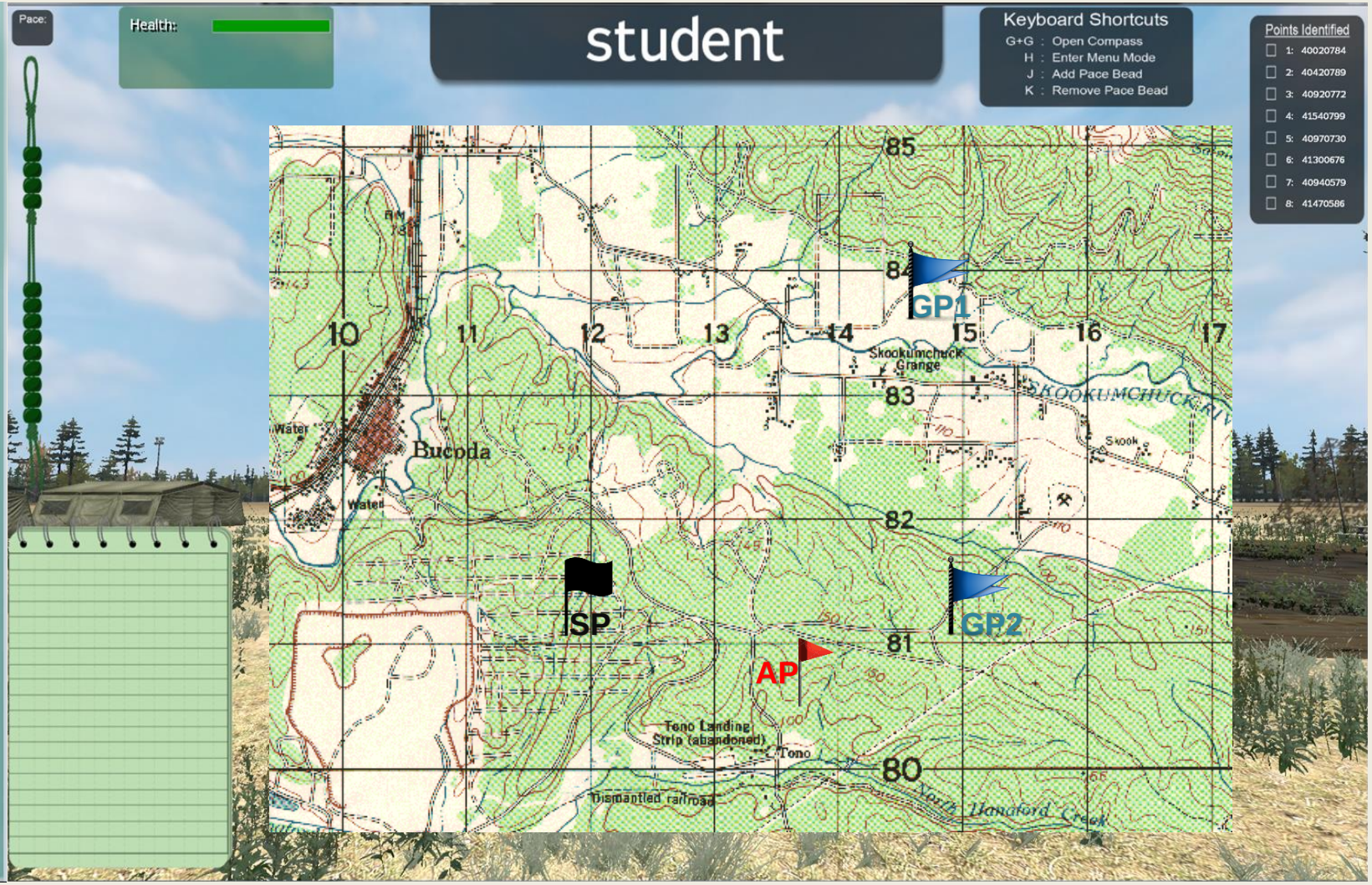
Key: SP – Starting Point GP – Given Point AP – Assigned Point

Which azimuth direction is the AP from GP2?

223 degrees Southwest

How did you determine this?

I drew a line from GP2 through the AP and using the outside of my protractor I converted the degree measure to azimuth with the formula (azimuth=degree-13).

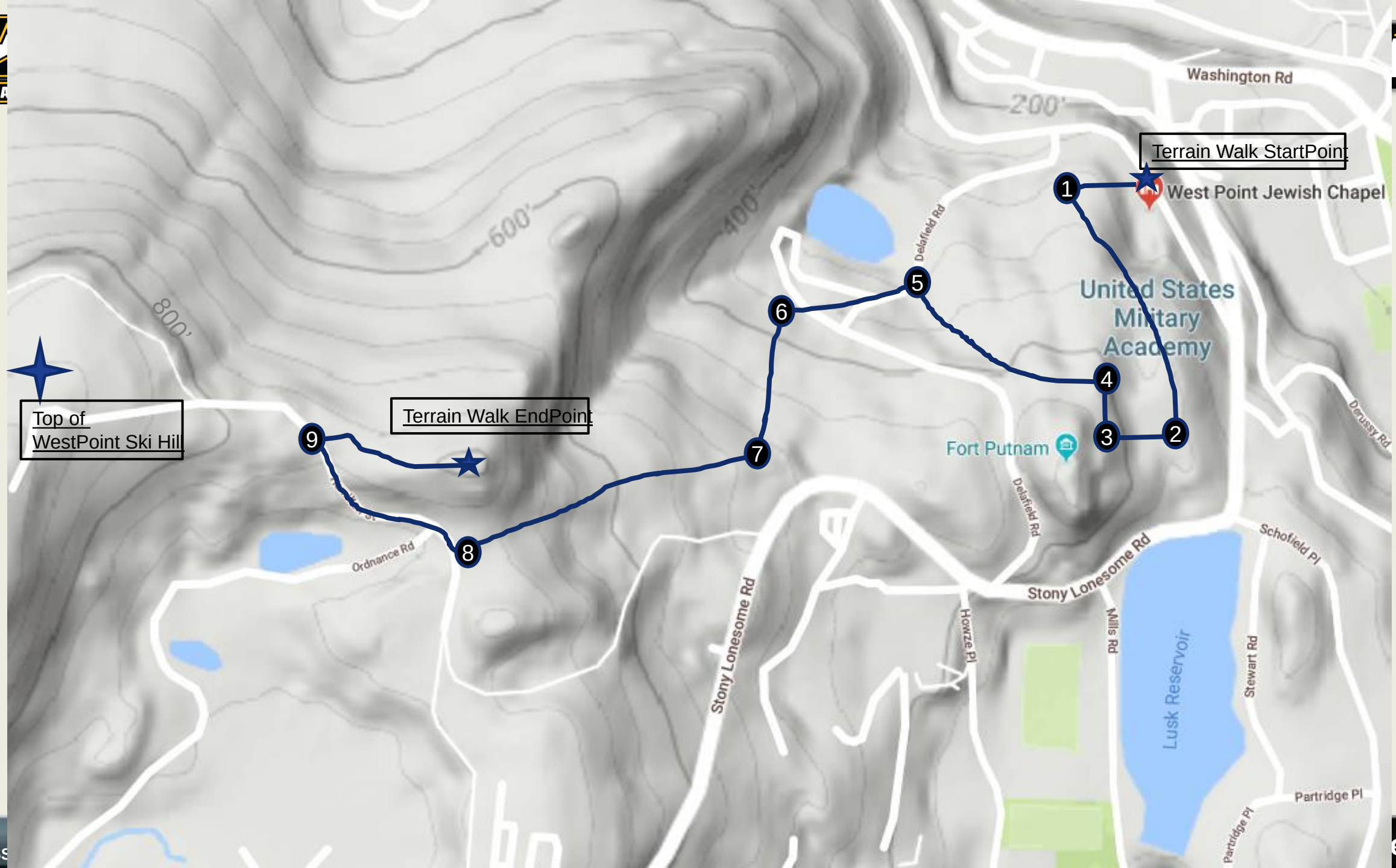


Mobile GIFT App

- Uses real-time positional data to track trainee location via cellular network

- Design instructional interventions based on trainee location
  - Designate specific GPS coordinates and threshold (e.g., come with 10m of Waypoint Alpha)

- EXAMPLE: Land Navigation 'Terrain Walk'
  - Instructional interventions are based on SME input and Tasks/Conditions/Standards for each "Stand"
    - Stand 1 Task: Orientate Map and plot location using visible terrain features
    - Stand 2 Task: Confirm pace count for 100m
    - Stand 3 Task: Plot route from SP to CP 1


Terrain Walk StartPoint
West Point Jewish Chapel
Washington Rd
200'
400'
600'
800'
Delafield Rd
United States Military Academy
Fort Putnam
Top of WestPoint Ski Hill
Terrain Walk EndPoint
Ordnance Rd
Stony Lonesome Rd
Howze Pl
Mills Rd
Lusk Reservoir
Stewart Rd
Schofield Pl
Partridge Pl
Partridge Pl
Debussy Rd
1
2
3
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8
9

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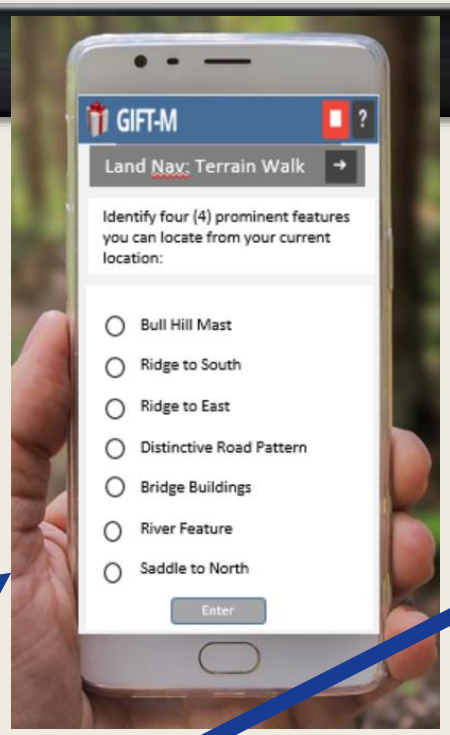
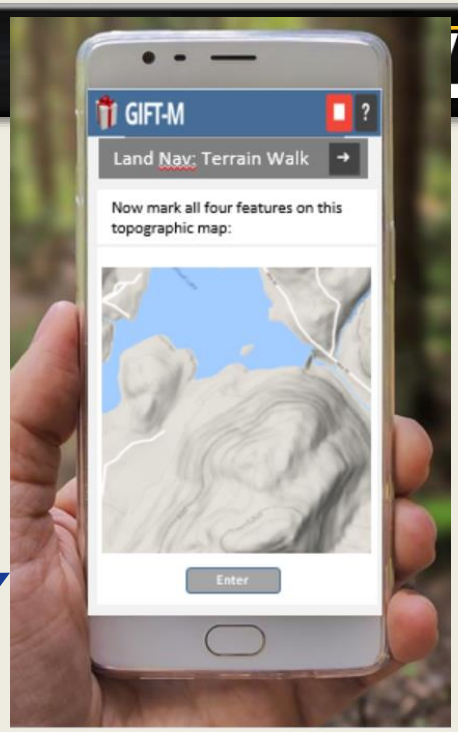
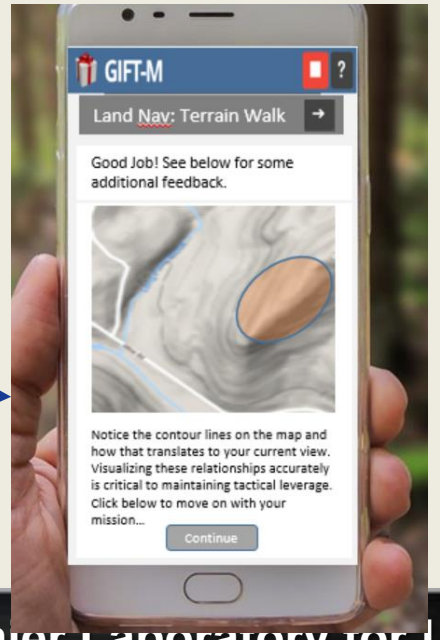
Stand 1: Orientate Map and plot location using visible terrain features

Upon trainee reaching designated way-point, Mobile App initiates interaction through notification sound and vibration

- Uses GIFT's survey features to assess ability to identify features
  - Multiple-choice question with specified correct/incorrect inputs (Currently Available)
  - Interactive Map function to mark a topographic map with specified features (Needs Development)
- Incorrect responses get corrective feedback
- Correct responses get feedback to reinforce objectives
  - All feedback is easily configurable and can be directly defined by instructors and SMEs

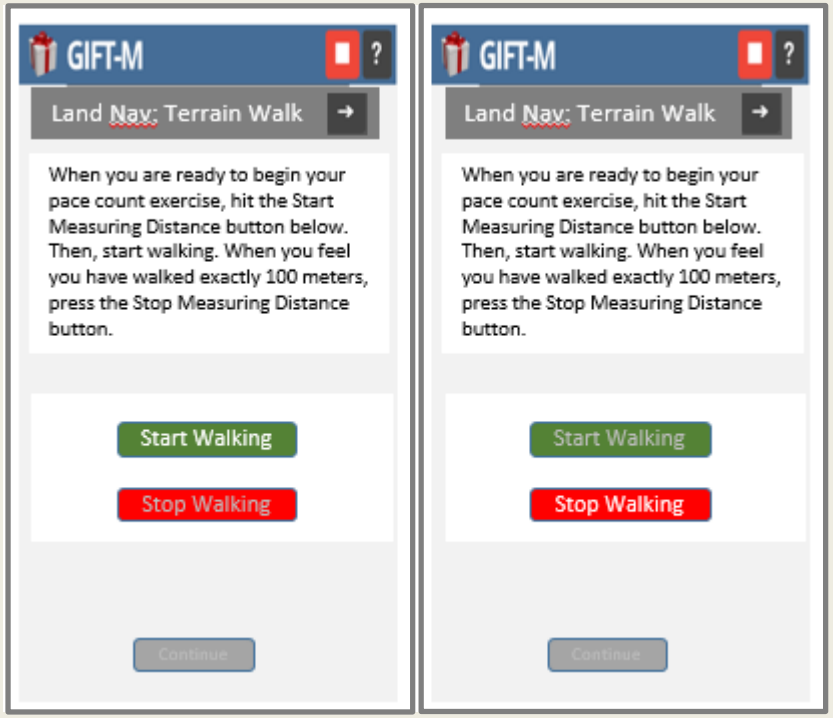






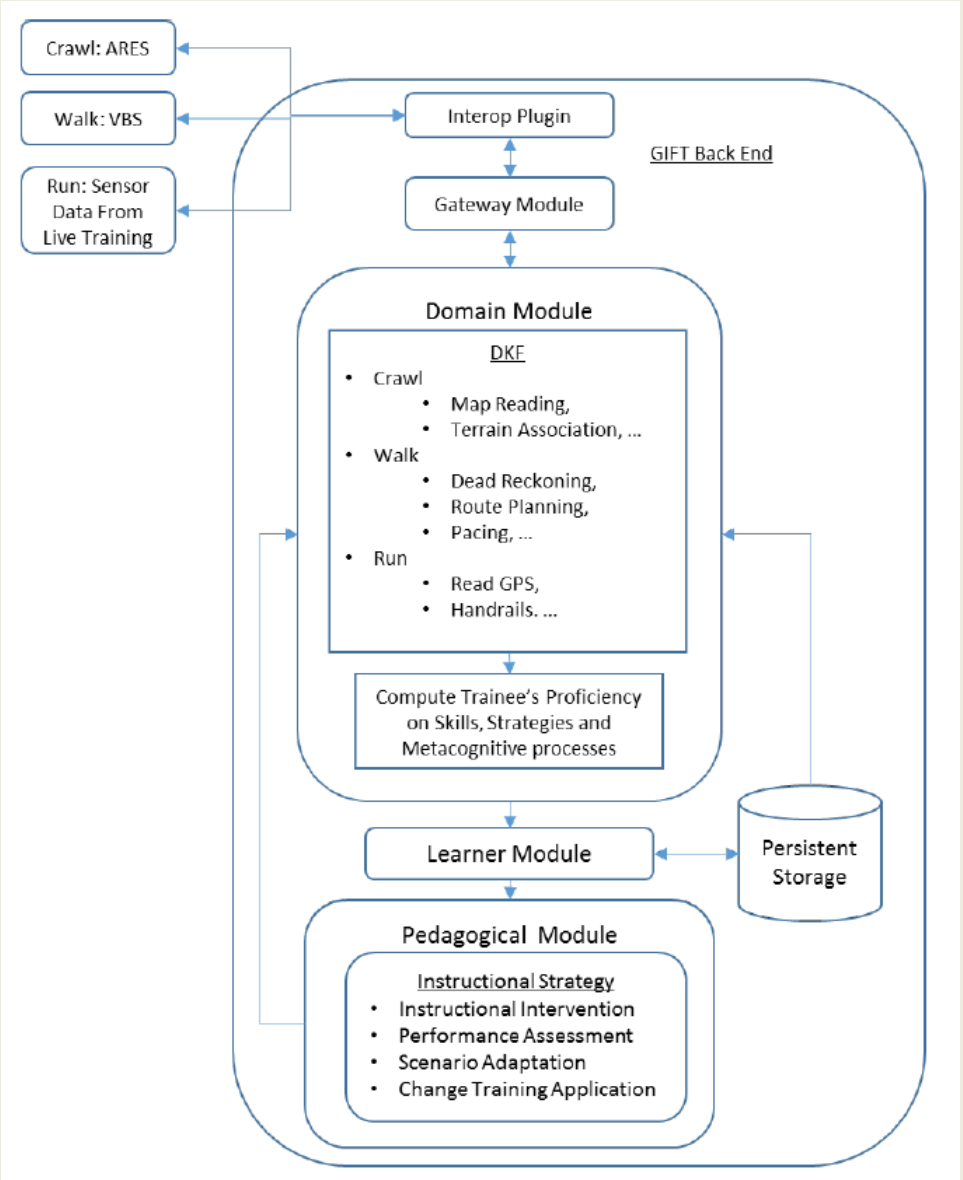
Stand 2: Confirm 100m Pace Count

- **Assessment uses real-time distance calculations based on registered points**
  - **Trainee will start and stop the pace count measurement based on interface inputs**
  - **Potential to track exact pace count using smarthealth app technology**



Multi-level Learner Modeling across Simulations

- **Hierarchical learner model that tracks and differentiates interaction data to infer:**
  - **Cognitive Skills**
  - **Cognitive Strategies**
  - **Metacognitive Processes**
- **Approach applied in Land Navigation across a network of simulations**
  - **ARES, VBS3, and Mobile App**
- **Requires persistent learner model and learner record store to track experiences across disparate systems**
  - **Uses experience data to personalize subsequent interactions**
- **Uses competency trend metrics to determine the hierarchy level to guide pedagogical decisions**



Future Directions

Synthetic Training Environment

- **Formalize method and framework for Intelligent Tutoring on Collective Team-based Tasks**

- **Instructional Management Challenges**
  - **Team and Task Structures**
  - **Coaching and Feedback Philosophies**
  - **Communication and NLP Dependencies**
  - **Role Switching and Evolving Contexts**
  - **Granular Assessments to Infer Team Cohesion**
  - **Data-driven After-Action Reviews**

- **Instructional Management Goal**
  - **Establish framework informed by IO and Sports Psychology to determine strategy types**
  - **Research application of Agents to manage feedback and adaptation decisions**


I'M OUTTA BULLET POINTS...
ANY QUESTIONS?
TROLL ME