Leveraging xAPI for AI-Based Performance Measurement and Adaptive Learning

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Center for Surface Combat Systems Course Challenges

- Lack of lab practice time due to schedule and physical constraints
- Students enter course with varying levels of skill proficiency and experience
- Formal knowledge and skill assessments are summative in nature
- Lack of objective measurement of student performance
- Numerous equipment baselines must be tracked across training courses

Aegis Computer Network Technician (ACNT)

Mission Critical Enclosure (MCE) Block
• Asynchronous virtual lab that gives students *reps and sets* practice and provides a **clear and self-evident view** of their knowledge and skill progression.

• The system interoperates (i.e., “wraps around”) with **existing simulation-based environments** to extend xAPI statements into more granular measures of performance.

• **Continually assesses** each student’s strengths and weaknesses, and selects fault scenarios that will best improve skill level and proficiency.

• The skill progression graph shows the **student’s current progress toward proficiency** using the six-step troubleshooting process mental model.

• Maintains scenario difficulty with **basic, intermediate, and advanced** faults within the student’s Zone of Proximal Development (Vygotsky 1978).

• The Artificial Intelligence (AI) recommendation engine **optimizes a learner's path** using “middle-loop adaptation,” helping to accelerate time to proficiency.
My activity

- **23 APR**
  - Completed
  - View Results
  - Scenario 004: Basic Firmware
- Completed
  - View Results
  - Scenario 003: Basic Hardware
- Completed
  - View Results
  - Scenario 002: Basic Hardware

- **21 APR**
  - Milestone
  - 3 scenarios completed!
- Completed
  - View Results
  - Scenario 001: Basic Hardware

- **20 APR**
  - Attained Basic Level — Fault Analysis

My Skill Progression

**Equipment Initialization / Operational Verification**
- Basic
- Intermediate
- Advanced

**Fault Isolation**
- Basic
- Intermediate
- Advanced

**Fault Analysis**
- Basic
- Intermediate
- Advanced

**Symptom Recognition**
- Basic
- Intermediate
- Advanced

**Fault Localization**
- Basic
- Intermediate
- Advanced

**Repair Procedures**
- Basic
- Intermediate
- Advanced

Recommended Scenario

Continue My Recommended Learning Path
Based on your continually assessed skill level.

Scenarios Completed: 22  Attempted: 6
SHIPMATE Concept of Operations

**Sim Environment**
- Generates Data (xAPI/HLA/DIS)

**Messy Data**

**Measurement Engine**
- Parses data
- Matches to measures
- Assesses against metrics

**ALMP / POMDP**
- Informs
- Stores in

**LRS/Data Store**
- Stored Measures
- Belief States
- Recommendations

**Scenario Orchestrator**
- Launches Scenario Selection in

**Student UI**
- Tailors UX
- Student Choice
- Interpreted by

**Access Control**
- Authorizes access

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Immersive Training Environment
- Tracks user interactions
- Generates xAPI statements (actor, verb, object)
- Sends xAPI statements

SHIPMATE
- Parses xAPI statements according to actor, verb, object
- Matches xAPI statements to performance measure(s)
- Extends xAPI statements as needed with additional data (HPML)
- Assesses xAPI statements against metrics
  - Binary scale
  - Tertiary scale
- Assigns full, partial, or zero credit
- Stores results in an LRS
- AI Algorithms run on the results in the data store to generate recommendations
- Landing page retrieves results, aggregates, and visualizes the proficiency data in the user interface
Adaptive Training Methodologies

- **Theoretical:**
  - Zone of Proximal Development (Vygotsky, 1979)
    - Training should be not too easy, not too hard

- **Modeling:**
  - Item Response Theory (IRT)
    - Relate measures and item difficulty to assessments
    - Used for SAT and other standardized testing
  - Bayesian Knowledge Tracing (BKT)
    - Predict training progression
Adaptive Training Learning Curve

- Precision training that targets skill/knowledge a student is ready to master
  - Achieve mission-ready proficiency faster, or
  - Increase learning capability given a fixed training time
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