The challenges of using SCORM compliant LCMS to implement an online training system for underground coal mine supervisors

Nada Dabbagh • Joe Breighner • Allison Czapracki • Tangie Gray • Rashmi Jain • Abi Jones
ID+SCORM Issues

- **Primary**
  - Efforts to implement SCORM: Successes and the *challenges* of change
  - Using SCORM to implement *well-designed* instruction into learning management systems
- **Secondary**
  - Potential for incompatibility between the principles of design and reusability for learning objects
  - Communication practices within and between instructional design and learning-tool development communities
Agenda

- GMU ID Immersion Program
- ID project description
- Theoretical framework
  - ILDF for online learning
  - Design approach
- Design to Development
  - LCMS challenges
  - SCORM challenges
  - Section 508 challenges
  - Instructional Design challenges
- Implications & Recommendations
GMU ID Immersion Program

- Masters in Instructional Design in 3 semesters of full-time student participation (summer, fall, spring)
- Participation in complex, real world design projects
- A design team of 5-7 students initially unfamiliar with the problem, the setting, and other team members
- The promotion of students’ positive interaction with a design team and support of their development as independent learners
- Students learn to manage and solve complex instructional issues related to effective instructional design much as they would in the real world
- Professors, instructors, and representatives from the sponsoring organization or client support students through the project experience
- Portfolio based assessment of student represents individual accomplishments and contributions to the design process
GMU ID Immersion Program

- Grounded in theories of action learning and situated cognition
- Learning Instructional Design by doing Instructional Design
- This instructional approach is supported by an electronic infrastructure that provides Web-based resources created by students as well as instructors in order to complement and reinforce teaching and learning as well as project management activities.
Team Members
- Joe Breighner
- Allison Czapracki
- LaTanger Gray
- Rashmi Jain
- Abi Jones

Spring Project Goals/Objectives
- Goal 1: Continue developing scenario content for training system in the following areas:
  1. On-shift Examination
  2. Pre-shift Examination
  3. Training Responsibilities
  4. Arrive on Section
  5. End-of-shift Examination
  6. Emergency and Unusual Situations

  - Obj. 1: Align remaining JTAs to the content areas and the 30 CFR
  - Obj. 2: Continue developing scenarios for the content areas
  - Obj. 3: Update and expand the training system's Resources page
  - Obj. 4: Validate new lesson content with SMEs

- Goal 2: Develop a design strategy for Duty 12, training responsibilities
- Goal 3: Develop an instructional strategy matrix for the entire training system that cross references all instructional strategies, learning objectives (terminal and enabling), assessment strategies and individual test items to validate our instructional approach
- Goal 4: Develop formative and summative evaluation plans
- Goal 5: Test and Validate modules, using a combination of tools (WAVE, Cynthia Says, W3C validators) Section 508 and SCORM Compliance
These links will take you to the specified month or week

March 2007
- Mar. 26 - Apr. 1
- Mar. 19 - Mar. 25
- Mar. 12 - Mar. 18
- Mar. 5 - Mar. 11

February 2007
- Feb. 26 - Mar. 4
- Feb. 19 - Feb. 25
- Feb. 12 - Feb. 18
- Feb. 5 - Feb. 11

January 2007
- Jan. 29 - Feb. 4
- Jan. 23 - 28

December 2006
- Dec. 4 - 15

November 2006
- Nov. 27 - Dec. 3
- Nov. 20 - 26
- Nov. 13 - 19
- Nov. 6 - 12

March

Week of March 26 - April 1
- Status Report
- Minutes: 03.28.2007
- Minutes: 03.27.2007

Week of March 19 - March 25
- Status Report
- Minutes: 03.22.2007
- Minutes: 03.21.2007
- Minutes: 03.20.2007

Week of March 5 - March 11
- Status Report
- Minutes: 03.06.2007

February

Week of February 26 - March 4
- Status Report
- Minutes: 03.01.2007
- Minutes: 02.27.2007

Week of February 19 - February 25
GMU ID Immersion Program

- Corporate & Government partnerships:
  - Mine Safety & Health Administration (MSHA)
  - Virginia Department of Education
  - Department of Defense
  - National Science Foundation
  - Defense Acquisition University
  - C2 Technologies, Inc.
  - Office of Special Education Programs
  - Parent Education Advocacy Training Center
  - US Forest Service, Bureau of Land Management
GMU ID Immersion Program

STUDENT RESOURCES

PROJECTS

- **Hoop Magic** (Fall 2006 - Present)
- **MSHA** (Fall 2005 - Present)
- **TTAC** (Fall 2000 - Present)
- **KIHD System** (Fall 2004 - Spring 2005)
- **TOA** (Fall 2003 - Spring 2004)
- **WWSF** (Fall 2003 - Spring 2004)
- **NSF** (Fall 2002 - Spring 2003)
- **LRM** (Fall 2001 - Summer 2002)
- **ZIOP** (Spring 2001)
- **LAO** (Fall 2000 - Spring 2003)
- **DEVISE** (Fall 2000 - Spring 2001)
A large percentage of the current supervisory workforce is nearing retirement, leaving the industry with a critical shortage of trained supervisors.

Mine supervisors are the key individuals in maintaining a mine’s safety and health programs.

Currently mine supervisory training lacks comprehensiveness and does not adequately address the complexity of supervisory tasks.

**Overall Goal**

Develop a systematic and effective training strategy for underground coal mine supervisors based on state-of-the-art instructional design principles, processes, and learning technologies.
Performance Challenge

State of the Coal Mining Industry


- 58.3% 25 or younger
- 38.3% 25 - 44
- 3.4% 45 or older

Source: Energy Information Administration
“[The mining industry] will need to replace a major portion, approximately 50% of the underground coal mining workforce in the next 5 to 7 years.”

- Bruce Watzman, V.P. of Safety, Health & Human Resources for the National Mining Association

- How can the mining industry, especially smaller mines, deliver supervisory training efficiently and effectively to its new workforce?
- How can the mining industry ensure that current supervisors are systematically updated on mine safety regulations?
Examine the extensive and validated mine supervisor Job Task Analysis (JTA) developed by MSHA in cooperation with the US Navy and transition these JTAs to an effective and efficient training strategy and instructional content for underground coal mine supervisors.
Pre-shift Examination

Conduct dust parameter examination
- Scrubber pressure readings
- See water pressure
- Check operating sprays
- Check roof bolter vacuum
- Record the exam
- Sign the dust parameter board

Check for proper venting to the return
- Take gas test
- Check for unusual odors
- Check fire protection
  - 5 bags for rock dust
  - 20 lb ABC fire extinguisher
- Check that ground clamp is properly attached

Examine faces and immediate returns

Check roof/ribs
- Check for adequate rock dust
- Check methane, oxygen deficiency (face and return)
- Check air readings in the last open line
- Check line curtains
- Check next to the last bolt reflective materials
- Check test holes at each intersection
- Enter date, time, initials
Conducted a comprehensive performance and needs analysis of the state of mine supervisor training

Conducted a learner analysis using usage centered design processes (user profiles and use cases)

Developed 12 generic JTAs aligning with 12 supervisory tasks

Conducted a task analysis of the JTAs to determine the cognitive domain type and level of the supervisory tasks

Developed an overall design and delivery approach for supervisory training

Developed a training prototype that modeled this approach for selected JTA tasks using Flash and Lectora
## Task Analysis

### Year 1 (2005-2006) First Phase

<table>
<thead>
<tr>
<th>Requires procedural rule-using skills</th>
<th>Duty 1: Self-Assessment and Personal Fitness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duty 2: Start-of-Shift Activities</td>
</tr>
<tr>
<td></td>
<td>Duty 3: Prior to Entering the Mine</td>
</tr>
<tr>
<td></td>
<td>Duty 4: Entering the Mine</td>
</tr>
<tr>
<td></td>
<td>Duty 5: Traveling to the Section</td>
</tr>
<tr>
<td></td>
<td>Duty 6: Arrive on the Section</td>
</tr>
<tr>
<td></td>
<td>Duty 7: Section Observation</td>
</tr>
<tr>
<td></td>
<td>Duty 8: Conduct On-Shift Examination</td>
</tr>
<tr>
<td></td>
<td>Duty 9: Conduct Pre-Shift Examination</td>
</tr>
<tr>
<td></td>
<td>Duty 10: End-of-Shift Examination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Requires problem-solving skills</th>
<th>Duty 11: Emergency or Unusual Situations</th>
</tr>
</thead>
</table>

| Requires principle rule-using skills| Duty 12: Training Responsibilities         |
Distributed Learning Support System

Overall Supervisor Training (Problem Solving)

Gagné's Events of Instruction
- Duties 1-10 (Procedure)
- Duty 12 (Principle)
- Duty 11 (Problem-Solving)

Scenario & Case-Based Learning

Macro level

Micro level
Statement of Work

Year 2 (2006-2007) Second Phase

Challenge

Develop underground coal mine supervisor training program

Six Duties (JTAs)

1. Arrive on Section
2. On-Shift Examination
3. Pre-Shift Examination
4. End-Shift Examination
5. Emergency & Unusual Situations
6. Training Responsibilities
GMU students will utilize a state-of-art Learning Content Management System (LCMS) known as “Workforce Connections” to create, manage, test, validate, and deliver the course lessons to the representative population (test class) of Mine Supervisor students.

A Workforce Connections instance will be provided for GMU student use by MSHA in support of the development of the curriculum objects representative of the Mine Supervisor course (6 lessons).

Workforce Connections training, initial and on an as needed basis will be available to support the GMU students.

The Mine Supervisor prototype presentation layer (look and feel) will comply 100% with all ADA, Section 508 conventions as required by OMB.

All curriculum objects developed representative of the Mine Supervisor training will include the required metadata tags to achieve SCORM 2004 compliance.

All instructional strategies, Terminal Learning Objectives (TLO) and the Enabling Learning Objectives (ELO) will be cross referenced in a separate matrix with the assessment strategies and individual test items to effectively validate proposed instructional strategies.
Instructional Design Process

Integrative Learning Design Framework
for Online Learning

(Dabbagh & Bannan-Ritland, 2005)
Design Approach

Research driven • Grounded in state-of-the-art ID • Multi-tiered

Macro level

Procedural Learning

Underground Coal Mine Supervisor Training DLSS

Micro level

Electronic Performance Support System

Job Task Analysis

Guided Scenarios and Fatalgram Analysis

Case-Based Reasoning

Principle Learning
Design Approach

Electronic Performance Support System (EPSS)

JTA

Worksheet
- Word Document
- Rank-able Steps
- Add, Modify, Delete Steps (Mine Specific)

Online
- HTML
- Links to 30 CFR
- Links to Relevant Scenarios

Spider
- PDF Document
- Printable Visual Aid
- Ready-Reference

Electronic Performance Support System (EPSS)
Design Approach

Case Based Reasoning (CBR)

Guided Scenarios

- Pre-Shift Examination Scenarios
- On-Shift Examination Scenarios
- Emergency & Unusual Situations Scenarios
How does one take a design strategy that is grounded in EPSS and CBR and implement it in a SCORM compliant LCMS?

- LCMS challenges
- SCORM challenges
- Section 508 challenges
- ID challenges
Corporations involved in developing technology-based training are tapping into the potential of learning object systems for reasons that include:

- Increased efficiency (dev cycle time)
- Increased effectiveness and personalized training
- Consistency of design and dev tasks

(Dabbagh & Bannan-Ritland, 2002)
Workforce Connections

Department of Labor • Learning Content Management System

- Released April 2004
- SCORM & Section 508 compliant
- Structures content as learning objects
- Delivers content
Workforce Connections

- Potential Implementations
- Community of Practice
- Online Coaching
- Website Publishing & Management
- eLearning
- Knowledge Repository

Department of Labor

13 Federal Agencies - 100 DOL Websites

MSHA
Training Academy (Beckley, WV) • WWW
eLearning Features

- Learning Management System (LMS) to document and track student progress
- Integrated video, multiple question formats, multimedia based on bandwidth selection
- Editors can export the content of the repository (except questions and videos, into a SCORM-compliant XML format)
- Non-technical users can update and alter the courses or websites
Object Creation vs. Object Reuse

Workforce Connections creates objects with every paragraph, image, video, and question/answer set entered into the system.

Accessing these objects means searching for the appropriate content within the repository.

What if you searched for ‘Utah Jazz’ on Google and you got the top results for ‘Utah’ and the top results for ‘Jazz’ but not the results for the phrase ‘Utah Jazz’?

“LCMS Challenges

“You can’t use what you can’t find”
LCMS Challenges

“You can’t use what you can’t find”

- Naming conventions
- Planning vs. Reality

Which one is the Pre-Shift Examination Checklist?

- 315fbde59b8df8702506f70a2db035b7.doc
- abb2cace59ad88329f52183ac17ca108.doc
- 67ea281380eb9bc4324ead1125199b14.doc
LCMS Challenges

- Looks aren’t everything, but they’re still important
- Limited skins and formatting options
- LCMS design ultimately restricts our design wants, overriding this creates uncooperative objects
- Limited navigation choices inside and outside of scenarios
- Images & Multimedia
  - The trials of location, sizing and spacing
  - Browser and multimedia incompatibility
Object Creation
Tagging
Granularity
• Developer Ignorance
• No guidelines to follow
• Building non-compliant objects is easy and fun!
• Unaware of granularity convention
Motivation

- Understanding future intentions
- Pedagogical tagging
**Section 508 Challenges**

- **Challenges with Incorporating Flash**
  - Very difficult to convert or develop accessible Flash movies, such as those containing interactive drag-and-drop elements
  - Not all Flash elements are able to be rendered accessible by a screen reader
  - Users of Flash players prior to 6.0 are unable to view any content generated by Flash
  - Even Flash 6.0 only works with one screen reader!
  - Alternative text must be added to all elements in a Flash movie for a screen reader to read them
  - Difficulties for the colorblind if color is used as a primary method of providing direction to the user in a Flash movie
Other technical challenges

Unable to use mouseovers to change content on a page

A learner incapable of using a mouse would be unable to view additional content if progress relies upon mouseovers
Miner 3 has gone to knock the power to the miner, and the buggy operator is warning other miners and getting the section EMT to help you take care of the miner operator. You start checking the miner operator's injuries. The left side of his face is covered with blisters. He is dazed and doesn't recognize you. He is moaning softly. The skin on both his hands and fingers is charred. His coveralls are singed.

What should you do now?
You see an area on the roof measuring approximately three feet thick, six feet wide and 8 feet long that appears to be loose enough to fall at any moment. What steps would you follow to correct the situation? Drag the steps listed on the left to the boxes on the right to show the correct sequence.

Use as many boxes as necessary.

Click the Next (right arrow) button to submit your answer.

- Danger off area
- Call out if in travelway
- Date/Time/Initial
- Arrange for support operation
- Test for methane levels
- Pull down loose rock
- Record information
- Set manual supports
ID Challenges

- HELP! We're stuck inside a SCORM compliant LCMS
- Last year’s team designed relatively more engaging and interactive training content
- This year’s team had to settle for a more traditional approach
- Tradeoffs
  - Less interactivity
  - Less engaging instructional sequence
- Able to develop workarounds in Workforce Connections to successfully implement the training

Conclusion
We were able to stay true to our design, developing sound and effective training content based on ID principles
Welcome to MSHA's Underground Coal Mine Supervisor Training

Our Mission: Improve safety, productivity, and leadership skills for mine supervisors through ‘just-in-time’ job aids and interactive, ‘what if?’ scenarios that challenge, support and engage the professional miner.

This training system serves:
- Underground coal mine supervisor candidates with 1-3 years experience;
- Current supervisors seeking refresher training; and
- Classroom-based trainers looking for online materials.

This training system includes:
JTAs to refresh your knowledge of supervisory duties
Scenarios to sharpen your problem-solving skills by walking through situations and emergencies as they might unfold underground
Resources for a comprehensive list of links to mining regulations, organizations, as well as other training sites
Pre-Shift Examination Job Task Analysis

Using this page

Click on the icon or scroll down for the online view of the Pre-Shift Examination JTA. It lists the specific tasks that an underground coal mine supervisor should do during a Pre-Shift Examination and connects them to the appropriate sections of the Title 30 Code of Federal Regulations (CFR).

Click on the icon to download the worksheet to add, modify and delete steps in the Pre-Shift Examination to use it in your mine.

Click on the icon to download the spider to see the organization of steps to show relationships between the job steps of Pre-Shift Examination.

Click on the icon to explore the Pre-Shift Examination scenarios to enhance your problem-solving skills.

Online View - Pre-Shift Examination Job Task Analysis

Examine the section tail piece | Examine haulway | Examine battery charging station | Examine faces and immediate returns | Monitor roof control requirements | Examine power center | Call results out to the oncoming shift
Escape From a Mine Fire

This guided scenario will help you to construct escape strategies and procedures including choice of routes, use of emergency breathing apparatus, information gathering, and communication. You will learn to order your response priorities to help make effective decisions in emergency situations.

About the Scenario

- **Length and Time:** The scenario consists of fourteen (14) questions. It will take you 40-45 minutes to complete this scenario.
- **Materials/Format:** Paper and pencil/English
- **Prior Knowledge:** Minimum 1 year of underground coal mining experience. Basic knowledge of ventilation practices and the proper use of SCSRs

Learning Outcomes

At the end of the scenario, you will be able to:

- **Recognize** the value of prompt and detailed communication to surface personnel during an emergency
- **Recognize** the purpose and utility of designated assembly points for evacuation of mine sections during emergencies
- **Anticipate** the probable rate and direction of smoke movement through a mine section given only ventilation and air velocity details
- **Select** appropriate escape routes given a section map, section conditions, and details concerning a fire
- **Apply** basic knowledge about oxygen deficiency, SCSRs, and the toxic effects of carbon monoxide
- **Prioritize** emergency actions during a situation including a hostile environment and insufficient time or means for all miners to escape the section
Many government agencies are advocating for SCORM compliance without the necessary workflow in place to support instructional designers and developers.

The parameters are defined at the standards level not at the organizational level.

Organizations are depending on the tool (LCMS) to create learning objects but the tool cannot organize those objects in an effective or meaningful manner.

Reference model has not diffused throughout government agencies.

Everyone is talking the talk but not walking the walk.
As the roles of instructional designers and developers become more intertwined,

Uniform communication guidelines that can be used throughout the design, development, and delivery of learning objects should be provided.

Learning content must be labeled in a consistent way to support the indexing, storage, discovery, and retrieval of learning objects by multiple tools across multiple repositories (Learning Circuits, ASTD, 2005).

More initiatives like CORDRA are needed.
Recommendations

- Learning objects systems must support multiple levels of granularity to afford reusability, flexibility, accessibility and adaptability of learning objects.
  - FIO - fundamental information object
    - Least contextualized (e.g., graphics, video, sound clips, definitions)
  - CIO - Combined information objects
    - More contextualized (e.g., links within a case study to perspectives and themes, more complete learning activities like tutorials, microworlds, and simulations)
- Just-in-time help or guidance
Instructional frameworks or pedagogical models for macro level scaffolding

- Most contextualized

- Implementation of specific instructional approaches (e.g., CSILEs, CFHs, PBL, CBL or guided scenarios, etc.)

- Frameworks provide the context or structure for the learner and is defined as an object within the database.

For more information on this taxonomy see chapter 2.1 in Wiley’s Instructional Use of Learning Objects (2002)
Standards will continue to be a part of all aspects of learning however no standard is perfect for every use.

eLearning standards are constantly evolving so be prepared to continually educate yourself about these developments.
Questions