Underground Coal Mine Supervisor Training

GMU Immersion Team 12.08.2006
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http://msha.immersion.gmu.edu
Agenda

- Instructional Design Process
- Performance Challenge
- Needs Analysis
- Task Analysis
- Design Approach
- Training System
- Workforce Connections
- Training System
- Fall Semester Conclusion
Instructional Design Process

Integrative Learning Design Framework for Online Learning
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
Estimated U.S. Coal Mine Employment (2004 - 2025)

- **East**: Blue line, remains constant.
- **West**: Green line, increases slightly.
- **Total**: Red line, increases slightly.

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 these skills will be gained in advance of employment is a continuous challenge.”

- Bruce Watzman, V.P. of Safety, Health & Human Resources for the National Mining Association
Challenge
Formally develop underground coal mine supervisor training program

Statement of Work
Arrive on Section • On-Shift Examination
Pre-Shift Examination • End-Shift Examination
Emergency & Unusual Situations • Training Responsibilities

All instructional content shall reside inside a Workforce Connections instance
• Desired Performance
  • Coal Mines
    • Maintain an experienced workforce capable of performing job tasks safely and efficiently.
Desired Performance (cont.)

- Miners and Supervisors

- Mine supervisors would possess good overall knowledge of the mining processes:

<table>
<thead>
<tr>
<th>Safety Issues</th>
<th>Management Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulations</td>
<td>Organizational Skills</td>
</tr>
<tr>
<td>Technical Skills</td>
<td>Logical thinking / Problem-Solving</td>
</tr>
</tbody>
</table>
Needs Analysis

Root-Cause Determination of High-Priority Needs

- Current Conditions
  - Workforce
    - Shortage of adequate supervisors or potential supervisors.
  - Training
    - Mentoring and OJT training are preferred
    - Small mines may contract outside training
    - Job Task Analysis (JTA) tool in-place
Gaps

- Fewer experienced miners available for supervisory positions
- Mine accidents increasing
- Management skills increasingly needed
- Smaller mines may have no formal training resources
Needs Analysis

- Learner Analysis
  - Miner with 1-3 years experience
  - Mine supervisor seeking refresher training (professional development)
  - Training professional
- Root-Cause Determination of High-Priority Needs
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- **Job Task Analysis**
  - Analyzed CONSOL & Excel Mine JTA spiders

  Result: Generic JTAs for 12 Supervisor Duties

- **Cognitive Task Analysis**
  - Determined the level of progressive mental activity needed to complete tasks

  Result:
  - Procedural vs Principle
  - Problem-Solving
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

Learning Hierarchy Analysis

- Problem Solving
- Rule Using
- Concrete Concept
- Discrimination

Intellectual Skills Domain

Last Year

- Overall job performed by supervisors including emergency response

Tasks performed by supervisors

Results
- Prerequisites
- Skills Matrix
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

Supervisor Rule-Using Matrix

<table>
<thead>
<tr>
<th>Requires Problem-Solving Skills</th>
<th>Requires Procedural Rule-Using Skills</th>
<th>Requires Principle Rule-Using Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Duty</td>
<td>Overall Job Performed by Supervisor</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Self-Assessment and Personal Fitness</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Start-of-Shift Activities</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Prior to Entering the Mine</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Entering the Mine</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Traveling to the Section</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>Arrive on Section</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>Section Observation</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>Conduct On-Shift Examination</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>Conduct Pre-Shift Examination</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>Conduct End-Shift Examination</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>Emergency &amp; Unusual Situations</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>Training Responsibilities</td>
</tr>
</tbody>
</table>

Last Year
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- Analyzed the JTAs
- Analyzed Prior Content
- Information Processing Analysis
- Existing human performance
- Sequence of operations and decisions
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- Prototype Formative Evaluation
  - Gerald Nicholson, CONSOL Energy
  - David McCullough, CONSOL Energy
  - Hershiel Hayden, Jr., VA Dept. of Mines, Minerals & Energy
  - Frank Linkous, VA Dept. of Mines, Minerals & Energy

Course Validation Criteria

| Content | Objectives | Test Items | Navigation | Functionality |
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- Prototype Feedback
- Instructional Content
- Ease of Use
- Overall Impressions

“Organized, focused approach. Concept can be expanded to the many relevant training needs and subjects for mine [supervisors].”

“I liked the design and ease of use. Good layout.”
Evaluating and Developing new content

- National Institute of Occupational Safety & Health (NIOSH) latent imaging exercises
- Fire-Boss scenarios (WVU Mining Extension Service)
- West Virginia Underground Coal Mine Supervisor Study Guide
- MSHA media catalog
- Training Resources Applied to Mining (TRAM) Conference
- Cumberland Coal Mine visit
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- **Evaluating** and **Developing** new content
- Subject Matter Expert (SME) interviews

Paul Bizich  Don Conrad
Jerry Vance  Sharon Cook
Mike Rutledge
SME Synthesis

- Progress from simple exercises to more complex
- Multiple JTA views are appropriate
- Scenarios should emphasize connections between incidents and the violations
- Ensure the training is engaging, interactive, and activity-based
SME Synthesis (continued)

- Connect training to certification sources
- Gear training to small mines
- Provide training materials for trainers
- Emphasize the JTA as a training tool
### Task Analysis

**Process of Analyzing and Articulating Optimal Learner Performance**

#### Supervisor Problem-Solving Matrix

<table>
<thead>
<tr>
<th>Duty</th>
<th>Requires Procedural Rule-Using Skills</th>
<th>Requires Principle Rule Using Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Arrive on Section</td>
<td>Fire Hazards</td>
</tr>
<tr>
<td>8</td>
<td>Conduct On-Shift Examination</td>
<td>Gas Testing &amp; Ventilation</td>
</tr>
<tr>
<td>9</td>
<td>Conduct Pre-Shift Examination</td>
<td>Roof &amp; Rib Control</td>
</tr>
<tr>
<td>10</td>
<td>Conduct End-Shift Examination</td>
<td>Dust Control</td>
</tr>
<tr>
<td>11</td>
<td>Emergency &amp; Unusual Situations</td>
<td>Guarding</td>
</tr>
<tr>
<td>12</td>
<td>Training Responsibilities</td>
<td>Recordkeeping</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean Up</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Emergency &amp; Unusual Situations</td>
</tr>
</tbody>
</table>
Task Analysis

Process of Analyzing and Articulating Optimal Learner Performance

- Content Analysis
- Aligned JTAs with principle learning
- Scenario selection
- Alignment with supervisor duties
- SME verification
Learning Outcomes

JTAs

Scenarios

In the worksheet JTAs, supervisor will be able to add, modify, or delete steps to customize the JTA to mine operations.

EXAMPLE

Analyze ventilation maps and schematics to determine airflow.

Diagnose ventilation problems and errors given a set of air quantity and quality measurements.
Distributed Learning Support System

Overall Supervisor Training (Problem Solving)

- Gagné’s 9 Events of Instruction
- Scenario & Case-Based Learning

- Duties 1-10 (Procedure)
- Duty 12 (Principle)
- Duty 11 (Problem-Solving)

Last Year

Macro level

Micro level
Design Approach

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

Macro level

- Underground Coal Mine Supervisor Training
  - DLSS
  - Procedural Learning

Micro level

- Electronic Performance Support System
- Job Task Analysis
- Guided Scenarios and Fatalgram Analysis
- Case-Based Reasoning
- Principle Learning

Design Approach

- Underground Coal Mine Supervisor Training -
  Distributed Learning Support System (DLSS)

- Multiple users
- Multiple uses

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

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

- Electronic Performance Support System -
Job Task Analysis (JTA)

• Job aid for **observation, evaluation**
• Can be made **mine specific**
• **Priority** ranking available
• Training or teaching **outline**
Design Approach

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

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

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

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

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

Case-Based Reasoning

Scenarios

Goal-Based

Guided Scenarios

Open-Ended

Fatalgram Analysis
• SCORM & Section 508 compliant
• Structures content as learning objects
• Delivers content
Training System

http://supervisor.mineindustry.com
Limitations of Workforce Connections

- Look and feel (skins) not configurable by training developer
- Section 508 compliance prevents more interactive training possibilities
- Flash
- Few image options (location, sizing)
Fall Semester Conclusion

- Formative Evaluation
- Design Documents
- Training System
- Delivered to MSHA and SME’s (12.15.06)
- Online survey (submit by 01.22.07)
• Spring Semester Tasks
  • Refine training according to evaluations
  • Meet with SMEs (01.28.07) about additional scenario development
  • Deliver training content for remaining duties (Arrive on Section • End-Shift • On-Shift)
  • Develop innovative instructional strategy for “Training Responsibilities” duty
Thank You!

Terry Chapman  Coal River Energy
David McCullough  CONSOL Energy
Gerald Nicholson  CONSOL Energy
Michael Konosky  Cumberland Coal Mine
John Dzurino  Cumberland Coal Mine
Bob Williams  Cumberland Coal Mine
Vinny Shulz  Cumberland Coal Mine
Will Peratino  Department of Labor
Tyrone Coleman  International Coal Group
Mark Kilkenny  Kilkenny Instructor
Paul Bizich  MSHA
Don Conrad  MSHA
Jerry Vance  MSHA
Sharon Cook  MSHA
James Young  MSHA
Tom Macleod  MSHA
Courtney Cox  PowerTrain
Kevin Betner  State of West Virginia
Hershiel Hayden, Jr.  VA Department of Mines
Frank Linkous  VA Department of Mines
Mike Rutledge  WV Office of Miners Health
Steve Cox  WV Office of Miners Health
Willie Barker  WV Office of Miners Health
Questions