Using CTA to improve operator control room performance

NERC Human Performance Seminar
March 26, 27, 28, 2013

Rusty Rae, Alstom ATI; Dick Clark, USC; Bror Saxberg, Kaplan
Today's program

- Introductions
- Filling the gap
- The case for cognitive task analysis
- Q&A
Operator experience in the control room

Experience

Time


Retirement rush

401K whammy

GAP

KAPLAN

USC UNIVERSITY OF SOUTHERN CALIFORNIA

GRID Technical Institute

ALSTOM
How do we keep on keeping the lights on?

- NERC Certification
- NERC required JTA
- 32 hours of EOPS Simulation

Does this meet readiness requirements?
Knowledge and wisdom

‘The young man knows the rules, but the old man knows the exceptions’

~Oliver Wendell Holmes Sr.
Knowledge and wisdom

Wisdom consists of the anticipation of consequences.

~Norman Cousins
Wisdom comes from experience and experience comes from making mistakes
How do we get 15 years of experience in 5 years?

- Capture the know how of experienced operators
- Develop simulations based on this analysis
- Develop a culture of deliberate practice among staff
Cognitive Task Analysis (CTA) can facilitate capturing know-how/ know-when knowledge

CTA combines structured interviews and other approaches to capture the cognitive strategies that highly successful experts apply to solve problems and perform complex tasks.

70% of work expertise – esp. the “when and how” to do things - is automated and non conscious – and so not easy to pass on
Based on structured interviews with top experts identified with data, not opinion.

Interviews identify key decisions and tasks and the steps behind these.

Interviews are refined to a “gold standard” and used to drive instruction.
Cognitive Task Analysis fills the gap in what experts teach about their expertise.

CTA helps learner move from 30% to 70-80% of expert decision-making and analysis strategies.

- Expertise remaining to be discovered: 20%
- What can be discovered by CTA: 50%
- What experts teach: 30%
- Expert performance: 100%

CTA unlocks 50% more of the knowledge required to be an expert in a field.
Integrate with evidence-based data in ADDIE framework

Cognitive Task Analysis

Evidence-Based Instructional Design

Design, Development, Implementation

Rapidly test and scale learning innovations

Measure & Evaluate Adapt to Learners

Adapt to Learners

Evaluate
Which a well-designed CTA aligns with very well

<table>
<thead>
<tr>
<th>CTA Report</th>
<th>GEL* Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Objective</td>
<td>Learning objective</td>
</tr>
<tr>
<td>Benefits &amp; Risks (Reasons)</td>
<td>Reason (benefits &amp; risks)</td>
</tr>
<tr>
<td>Main Tasks &amp; Procedures</td>
<td>Overview</td>
</tr>
<tr>
<td>Prerequisite Skills/Knowledge</td>
<td>Prior Knowledge</td>
</tr>
<tr>
<td>Concepts, Processes, Principles</td>
<td>New Conceptual Knowledge</td>
</tr>
<tr>
<td>Action &amp; Decision Steps</td>
<td>Demonstration</td>
</tr>
<tr>
<td>Problems from SMEs</td>
<td>Practice</td>
</tr>
<tr>
<td>Checklist from Steps</td>
<td>Feedback</td>
</tr>
</tbody>
</table>

* GEL: Guided Experiential Learning
Use of CTA in medical training

Medical school surgical instruction

CTA-trained surgeons had 34% greater performance gains and 25% more conceptual knowledge from pre to post test.

Also made no harmful errors whereas controls committed serious errors.
CTA did require 85% more front-end time for design and development.

New course presentation required half the time with 35% gain in test scores on the performance post test.
Use of CTA in medical training

Medical school surgical instruction

When two simulator designs were tested with the surgery CTA information (evidence-based versus “Kolb type” problem-based learning)

EB + CTA led to 26% more learning, 37% more transfer and 30% fewer minor errors.
Cautions: Limitations of CTA

- Requires participation by experts for whom we have reliable and valid evidence of a consistently successful work record.

- 100+ different versions of CTA exist but only 6 have been tested and only three of the six produced maximum results.
  - Most CTA versions were designed for machine learning and/or AI applications – not training.
CTA has benefits for employers and employees

- Captures skills of most senior problem-solvers before they leave/retire
- More complete identification of key tasks and decisions (especially about when to do tasks) than a typical job task analysis – and what’s not needed
- Decreases error rates on the job
- Reduces training time from traditional training
- Improves motivation – training closely matches tasks, ties to success
- Increases employers’ understanding of jobs and barriers to good work - tends to change job descriptions and increases productivity even further
CTA expert identified activities | Modules in Paralegal Curriculum
---|---
Intake interview | Unit 1: Justin King Case
 | Unit 2: Pre-Complaint Investigation
Identify conflicts | Not taught
Determine and comply pre-litigation notices or demands | Not taught
Draft and file a complaint | Unit 3: Drafting the Complaint
 | Unit 4: Pre-Answer Investigation
 | Unit 5: Draft the Answer
Motion/Pleadings | Not taught
Discovery | Unit 6: Discovery I
 | Unit 7: Discovery II
Pre-trial | Unit 8: Pretrial Motions and Settlements
 | Unit 9: Getting Ready for Trial
Trial | Not taught
Post trial | Not taught
Settlement | Not taught
Appellate filings and hearings | Not taught
Technology Tools: e-Discovery | Not taught
Technology tools: Litigation Tools | Not taught
From fighter pilots to chicken sexers use CTAs

- Commanding Generals
- Trauma Surgeons
- Radiological Cardiologists
- Neonatal Nurses
- Fighter Pilots
- SWAT Teams
- Emergency Room Teams
- Blackjack (21) winners
- Nuclear Generator Design Engineers
- Chicken Sexers
Many lines of evidence for effectiveness of CTA…

Typically 30% – 50% learning gains with CTA

Meta Analysis of studies:

- **Lee (2004)** - 34 studies averaged 47% performance increase.
- **Tofel-Grehl (2011)** 57 comparisons averaged 30% learning increase over controls using conservative analysis – some much more effective.

Patent examiners finish **75%** faster (6 mo. vs. 2 yrs.)
- Production increase 200%+ mistakes down 65%
Case Study: The European Patent Office

Situation: Existing training model required two years of full-time apprenticeship before patent examiners were allowed to examine a patent application independently; considerable amount of time from experienced examiners also needed to serve as mentors.

Solution: Cognitive task analysis was used to develop a new training system.
European patent examiners
First, CTA interviews outline the range of tasks/decisions

Preparing search reports
- Analyzing applications
  - Determining mean features of invention
  - Determining described invention
  - Finding lack of unity
- Performing searches
  - Classifying applications
  - Determining search strategies
  - Using search tools
- Writing pre-examination results
  - Determining claimed subject matter
  - Evaluating search results
  - Selecting relevant documents
  - Comparing documents with invention
  - Identifying relevant EPC requirements
  - Comparing relevant documents with invention

Performing substantive examinations
- Issues communications or votes (including pre-examination results)
- Re-examining applications
  - Examining amendments
  - Discussing with applicant
  - Writing further communication(s)

Performing substantive examinations
- Determining claimed subject matter
- Determining novelty & inventive steps
- Identifying relevant EPC requirements
Then, more CTA interviews split apart tasks into steps

1. Start
   - Read application
   - Specify classes, keywords, databases
   - Search with program to retrieve documents
   - Perform examination

2. Are there major defects?
   - Yes: Write draft communication
   - No: Write draft vote

3. Write search report
   - Stop

4. Start
   - Build first impression, by looking at drawings, main claims, and the first page
   - If you read an application, then
     - Start with studying the drawings and put them next to the text.
     - Start with reading the main claims.

5. Get a grip on an application by reading the whole thing minus claims
   - If you read an application, then
     - Highlight/underline passages that refer to prior art, technical effects, and formal defects.
     - First study any independent claims if reference is made to such claims in the text.
     - Focus attention on detailed descriptions related to drawings.
     - Use any references that are made to prior art as input or starting point for your search.
     - Only study dependent claims after you understand the application.

6. Stop
Results of CTA

- Productivity of new examiners was increased **200%** above their former production and above the average for all examiners…

- …while decreasing errors **65%**, and…

- …based upon results of training decision made to reduce training from 2 years to **6 months**
The end of the beginning

Q & A
For additional information:

- http://www.cogtech.usc.edu
  Access ‘publications’ page
- Contact Bror Saxberg:
  Email: bror.saxberg@kaplan.com
- Contact Rusty Rae:
  Email: rusty.rae@alstom.com