Preparing Miners and Responders for Emergency Decision-Making

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Locate Everyone
Report
Call EMS
Bring Mine Rescue
Fight Fire
Report Missing
Evacuate
Check Fan
Report to Families
Get Supplies
Reactivate ERP
Find Refuge
Notify MSHA
Stay Together
Set up Command Center

NIOSH Mining

Decision-makers fill many roles as mine emergencies unfold–are they ready?

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First Response:    →    Summon         →    Command
Local                   Help, (Re-)          Center,
Resources               Organize             Surge
(Chaotic)                                    Resources
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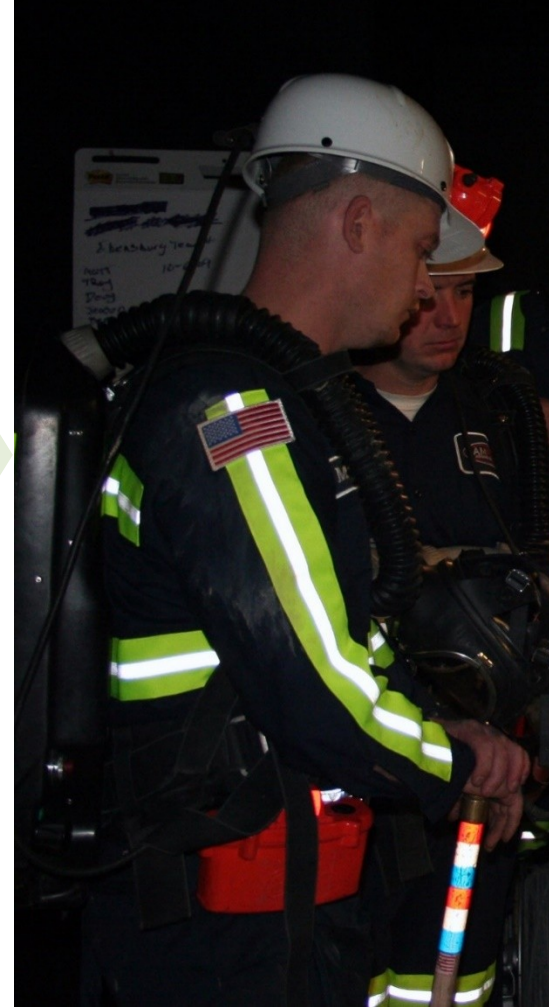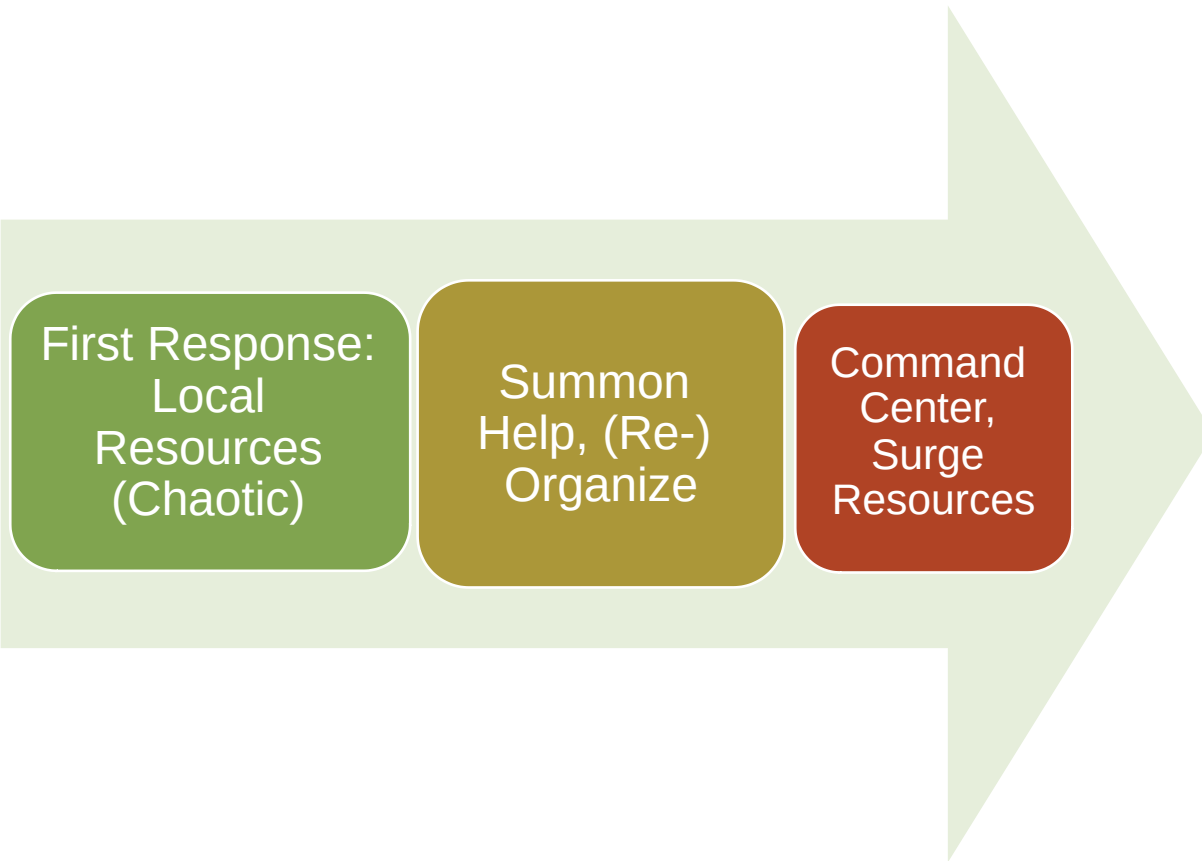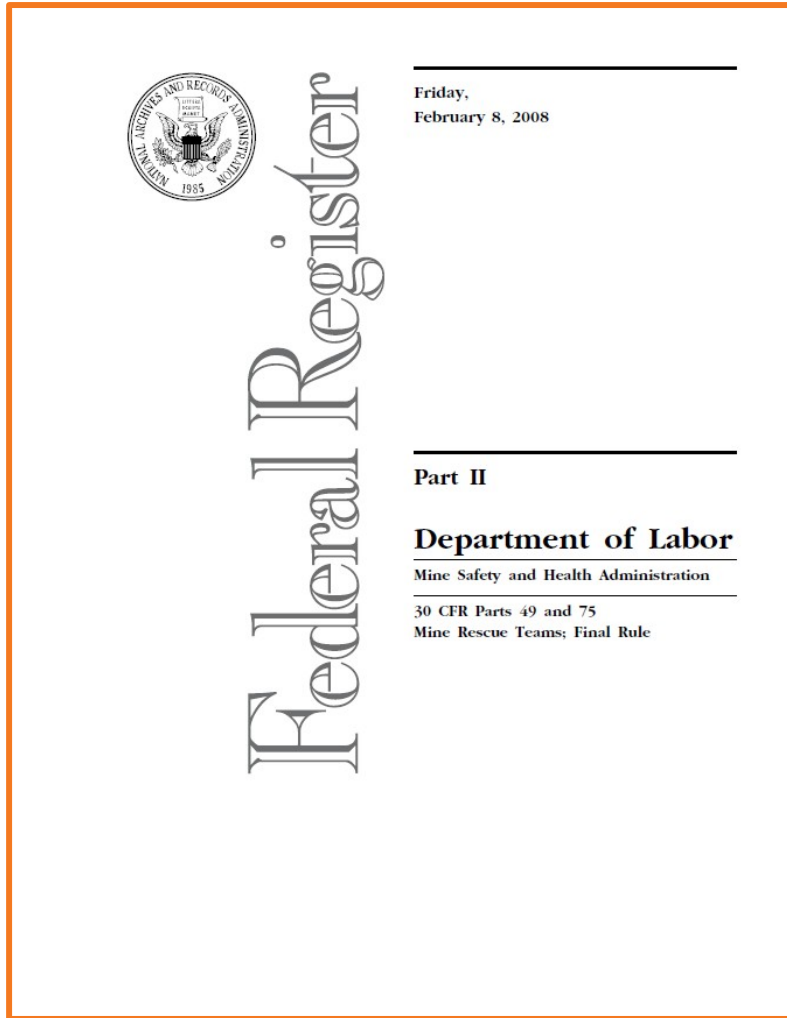

- Miners
- Dispatchers
- Mine Rescue
- Foremen
- Mine Managers
- Responsible Persons

Approaches to Training "Responsible Persons"

30 CFR 75.1501 outlines what that the "responsible person" must see done

Friday,
February 8, 2008

Federal Register

Part II

Department of Labor

Mine Safety and Health Administration

30 CFR Parts 49 and 75
Mine Rescue Teams; Final Rule

- Initiating an emergency mine evacuation
- Establishing security
- Contacting emergency personnel
- Communicating appropriate information related to the emergency
- Coordinating firefighting personnel
- Deploying firefighting equipment
- Organizing a command center
- Providing for mine gas sampling and analysis
- Coordinating mine rescue personnel
- Deploying mine rescue teams
- Establishing a fresh air base

MSHA released Instructional Guide 110, "Responding to a Mine Emergency," in 2008

Responding to a Mine Emergency
Training Responsible Persons at Underground Coal Mines

U.S. Department of Labor
Mine Safety and Health Administration

Instruction Guide Series
IG 110

2008

- Standard materials comply with 30 CFR 75.1501

- No requirement to use this curriculum

- Must cover all 11 elements, but can do so in order chosen by trainer

- Can use any training method

We explored how pieces of the "responsible person system" fit together

Site Visits

Guides, Checklists, Forms

Interviews

Training Materials

ERPs

- Interviewed safety professionals
- Visited
  - communications centers
  - training facilities
- Reviewed ERPs, training materials, checklists, and other guides and forms they'd made to be used in case of an emergency

We studied six mining operations to learn how they choose and develop their personnel

- *Who are your primary RPs?*
- *Who else receives your RP training?*
- *What changes to your training have you made since you started?*
- *What equipment, checklists, and other personnel have you made available to help the RP take charge during an emergency?*

Our findings can be used to evaluate and possibly improve responsible person programs

We learned

who gets trained and how,

three approaches to table top exercises, and

some challenges and things to think about.

Most trained more than "a go-to and a sub per shift" so more people will be prepared

Some mines have surface communication staff take RP training even though they do not plan to use them as RPs.

Managers wanted to spend more time on actions that occur earliest in an emergency

Establishing a fresh air base was not one of them

Some integrated RP with other training, like first aid, CPR, and working with outside help

# Mines use checklists and procedures to guide early emergency response

Technological and other changes have made more situations amenable to procedures

- Better tracking
- Better communications
- Better early-warning systems

- Clearly marked escapeways
- Lifelines
- Regular SCSR caches

- Better able to avoid old workings
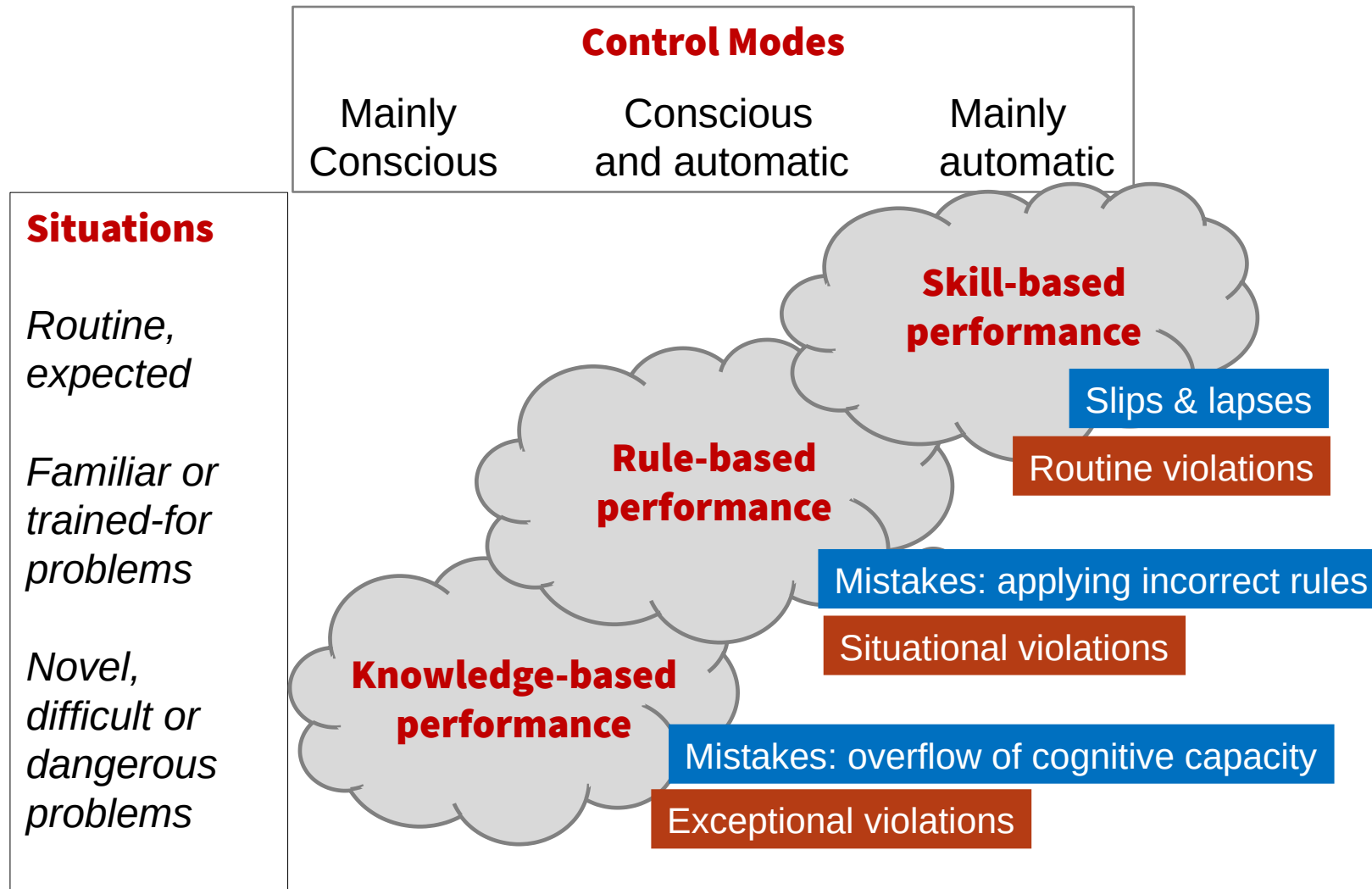- Less trolley, more diesel

- Quarterly training
- All must walk the escapeways
- All practice donning SCSRs
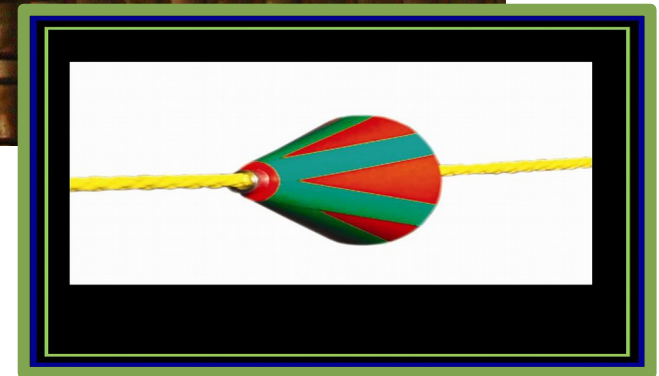
But some situations cannot be covered by a simple procedure – they require judgment

Judgement and decision-making call for greater attention & deeper knowledge

Control Modes

| Mainly Conscious | Conscious and automatic | Mainly automatic |

Situations

Routine, expected

Familiar or trained-for problems

Novel, difficult or dangerous problems

Skill-based performance

Slips & lapses

Routine violations

Rule-based performance

Mistakes: applying incorrect rules

Situational violations

Knowledge-based performance

Mistakes: overflow of cognitive capacity

Exceptional violations

Tabletop simulations are a good way to promote deeper thinking

Three mines used tabletops to train their RPs

Each took a different approach

Approach 1: Exercise as way to organize presentation

- For all RP trainees (go-to, subs, others)
- Simple scenario that presents all 11 elements
- Trainer uses judgment to promote deeper thinking with questions

Approach 2: Exercise as way to consolidate learning

- For all RP trainees (go-to, subs, others)

- Comes after presentation of material, so not required to treat all 11 elements

- Two scenarios – both underground and surface – more extensive, challenging

"we trapped two people … the teams had to figure out how to get to them and get them out safely, and take care of the fire …"

Approach 3: Exercise as way to challenge the go-to RPs

i

> "I told each shift foreman, 'Can you give me your top 5-6 people, the ones you'll be counting on
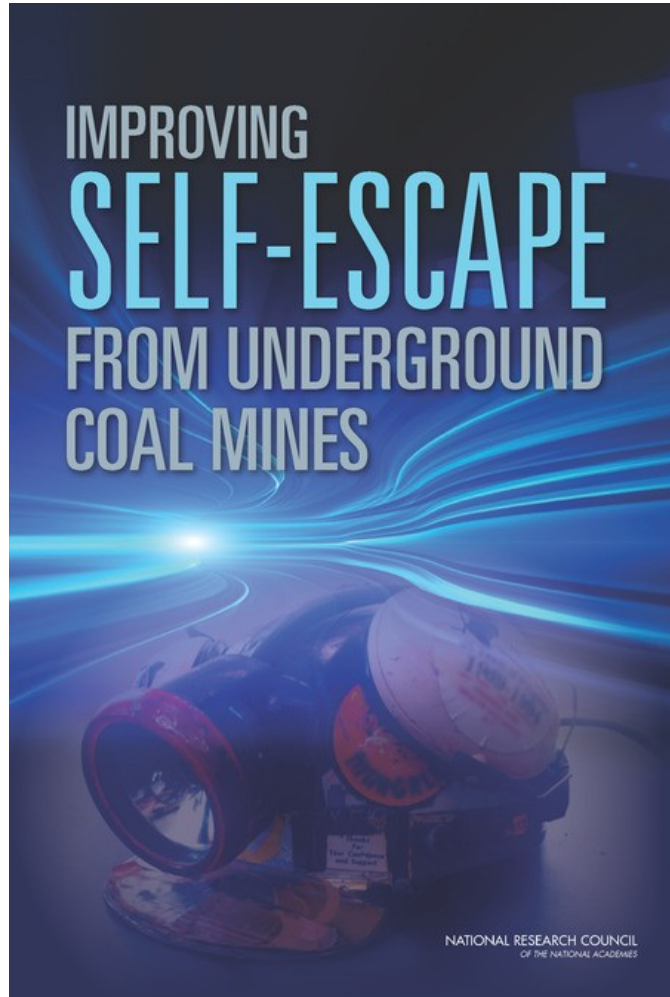>
> I want to give them some extra training.'"

- For go-to RPs only – separate from annual training
- MERD-like, involving role-playing by safety trainers
- Very challenging, based on study of past events
- Dynamically adjustable by trainers

Designing and leading dynamic discussions and exercises requires resources

- People
  - Design and development
  - Set-up
  - Lead
  - Participate

- Time to develop and run

- Expertise
  - Mine emergency response
  - Exercise development
  - Teaching

Refresh training with new content in full exercises or with new modules on critical skills

… like emergency communication

Communication Triangle

https://www.nap.edu/catalog/18300/improving-self-escape-from-underground-coal-mines
https://www.cdc.gov/niosh/mining/works/coversheet838.html

Challenge RPs with a module on handling the complexity of emergency communication
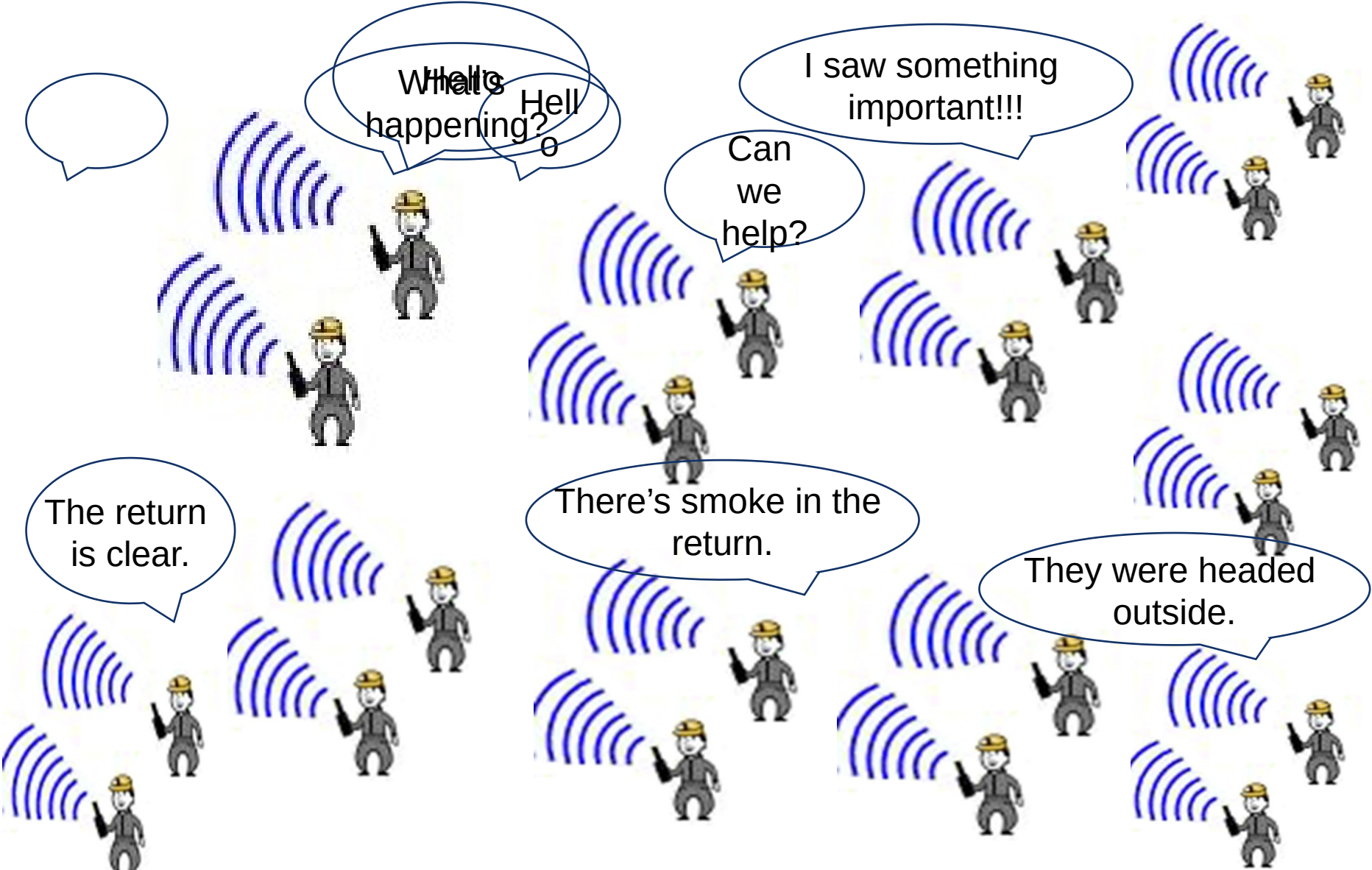
Consider evaluating your RP training and testing your trainees

How can these ideas be implemented to improve your Responsible Person preparation?

- Have surface comm and UG foremen practice working together on early response

- Use procedures and forms to guide the performance of the RPs & those helping the RPs

- Devote extra time to the most critical tasks

- Challenge the most likely RPs

- Devote resources to refreshing your RP training materials

- Assess your training & your RPs

A Tool for Practicing and Assessing Decision-making

Welcome!

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Beta Version 03/07/2019
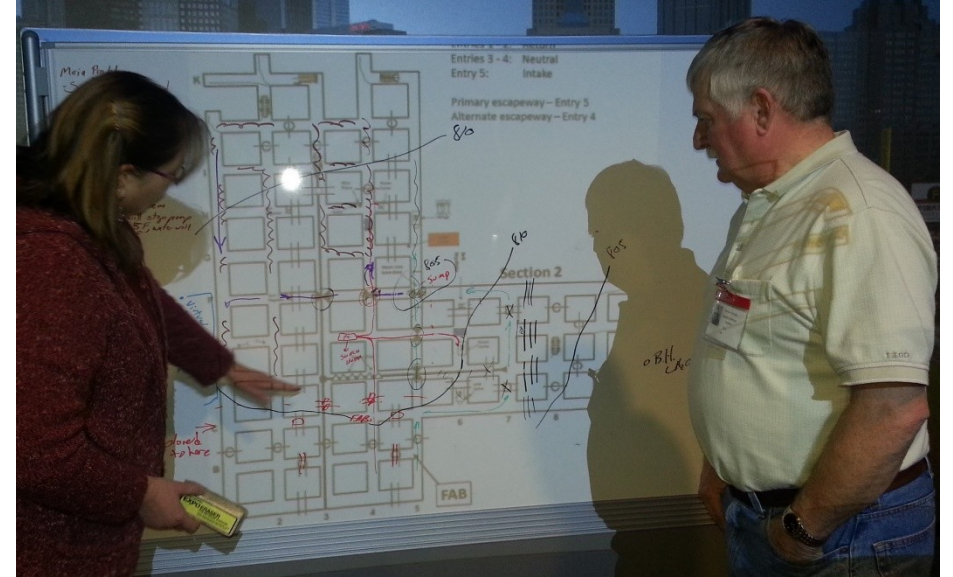
Emergency response environments often have no "correct" answers

Goal – decisions that lead to successful evacuation of underground coal mines

Training Strategy

- Cognitively realistic and engaging simulations that encourage learners to practice making decisions

- Immediate SME-based feedback

Linear narratives simplify complex situations
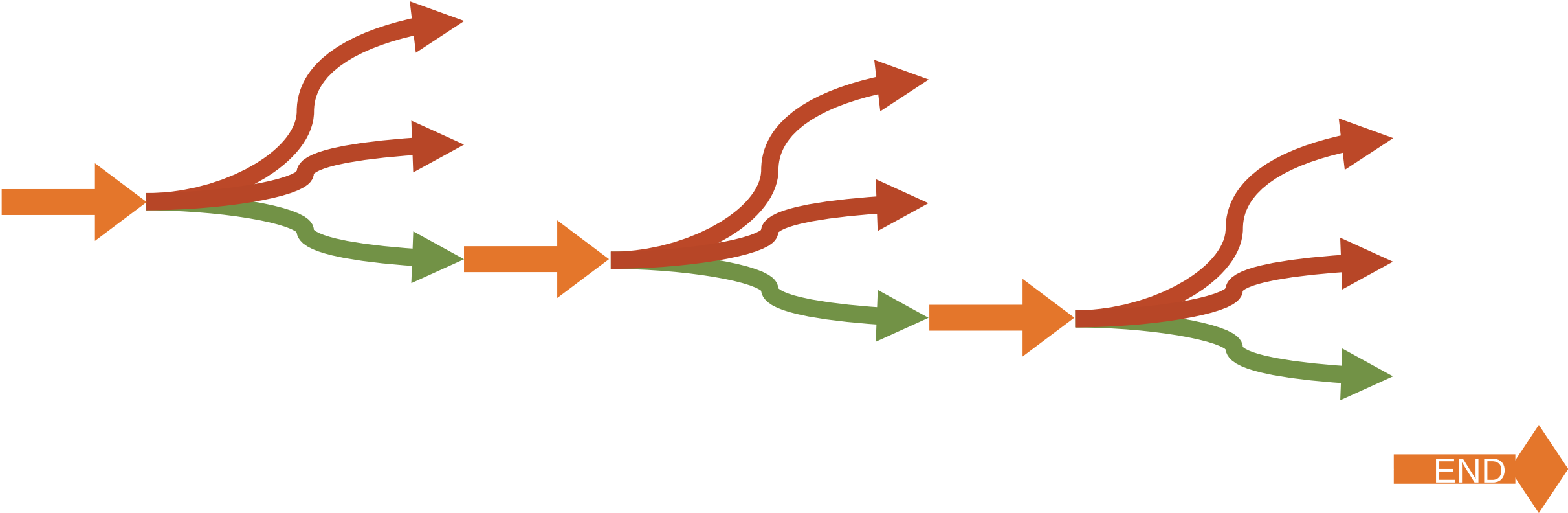
Choose the right answer

Approach 1: Exercise as way to organize presentation

Content → Questions → Standards based feedback → Content → Questions → Standards based feedback → Content → Questions → Standards based feedback → END
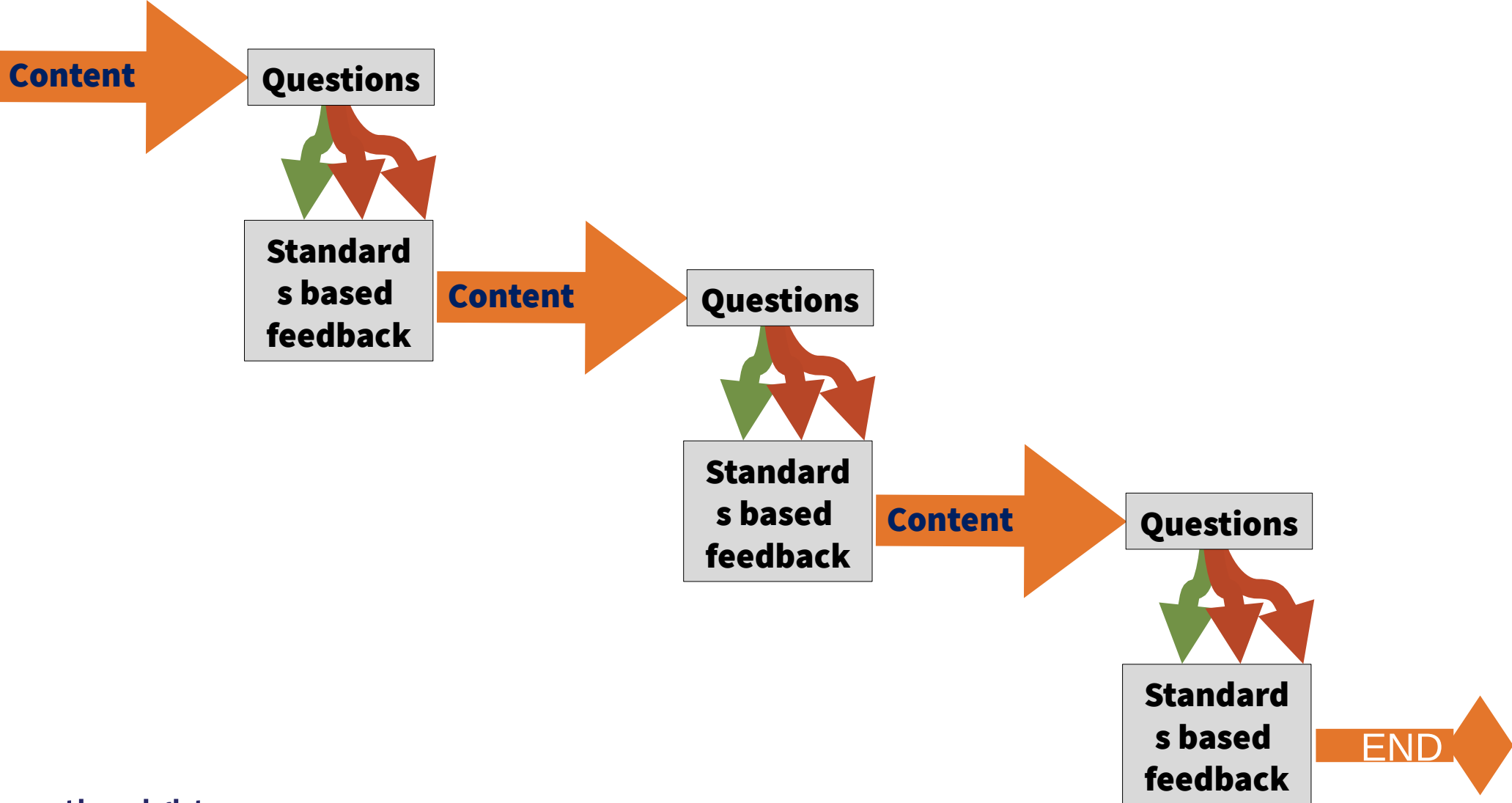
Choose the right answer

Approach 2: Exercise as way to consolidate learning

Information **Question**

feedback **Information** **Question**

Content & Discussion

feedback **Information** **Question**

debriefing

Choose the right answer

Guided Simulation

END
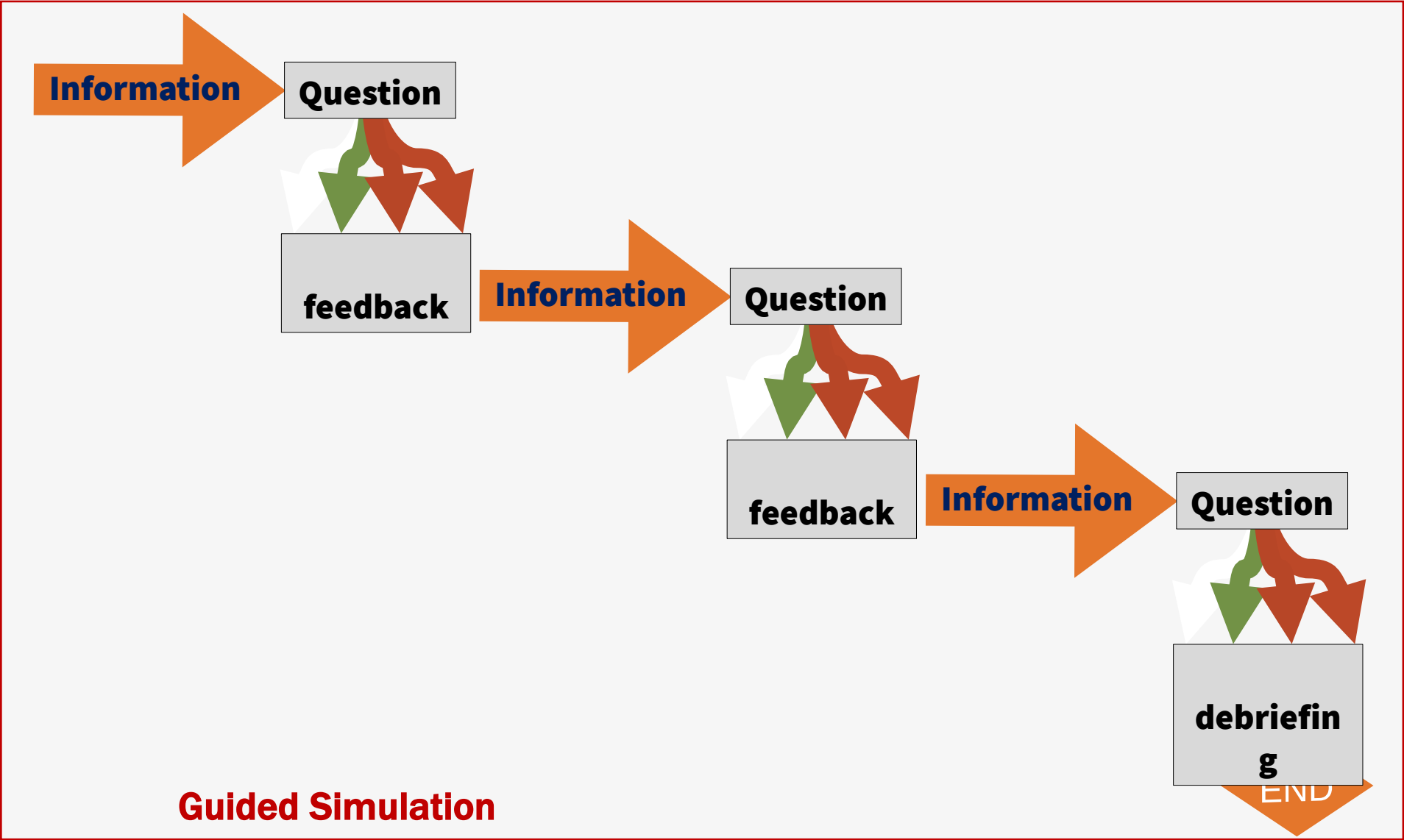
Branching narratives quickly become difficult to design and deliver

END
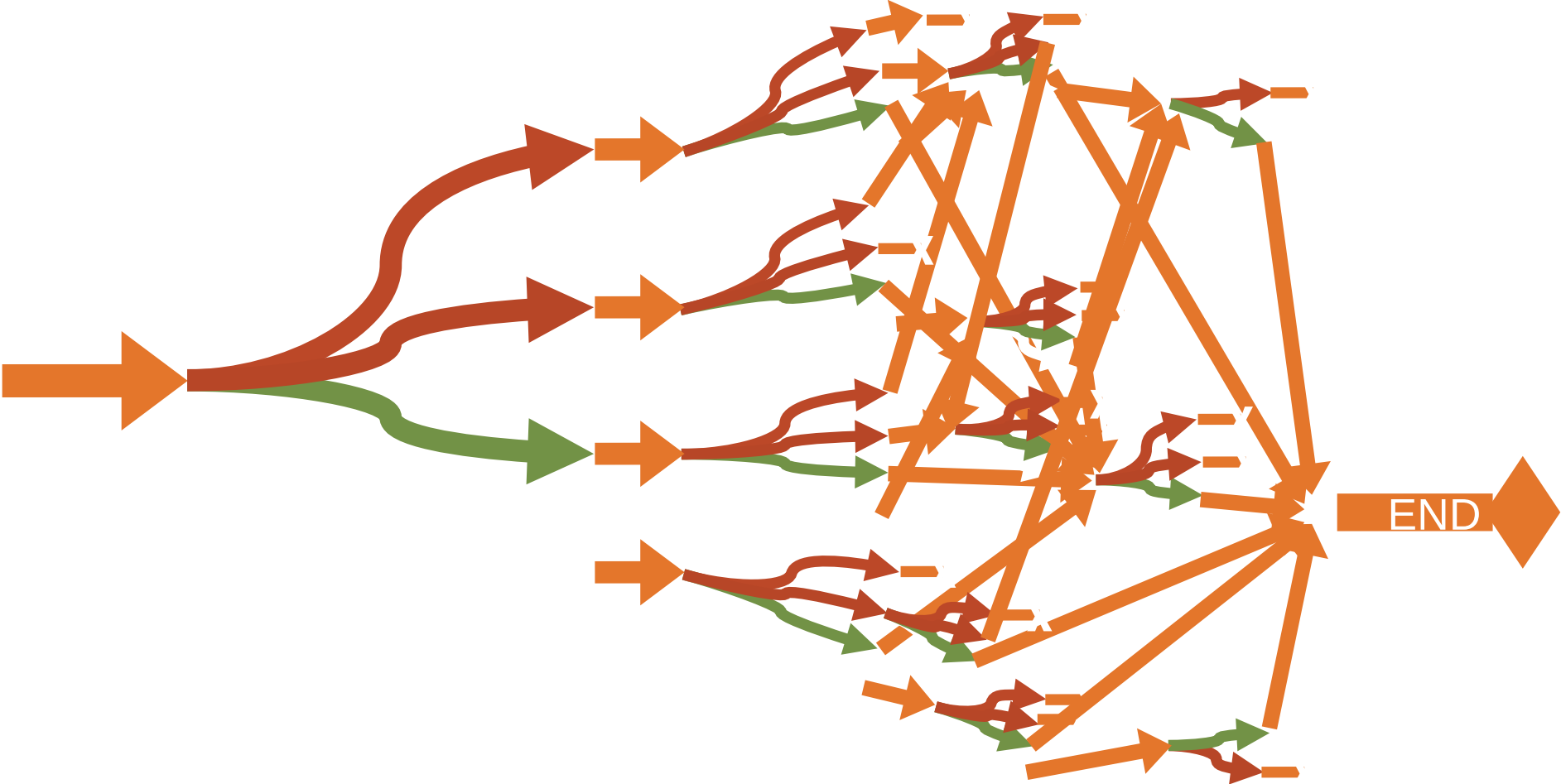
Choose the right answer

Approach 3: Exercise as way to consolidate learning

Self-paced learning

Written Test

scored

Choose the right answer

Information

debriefing

END

Branching Simulation
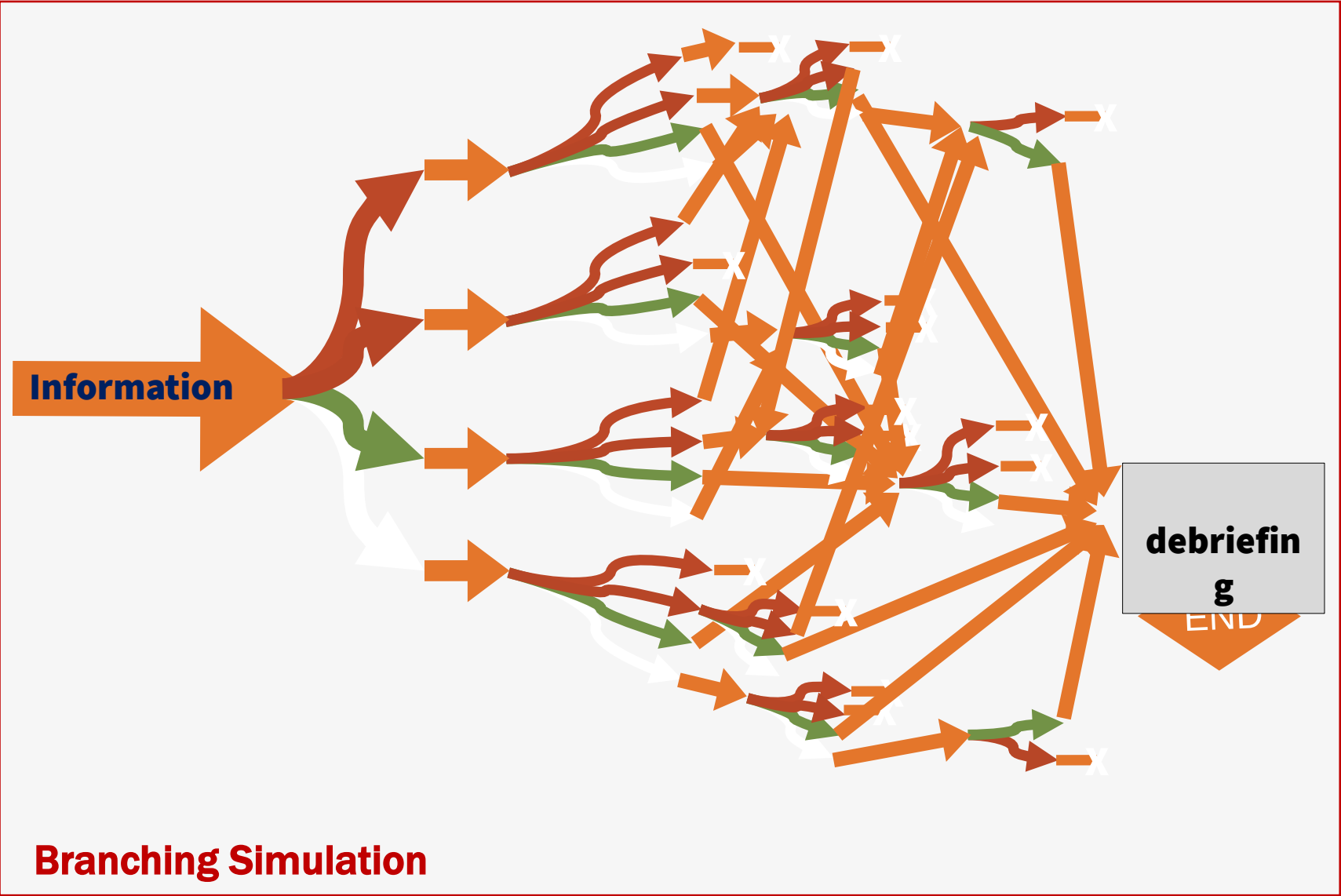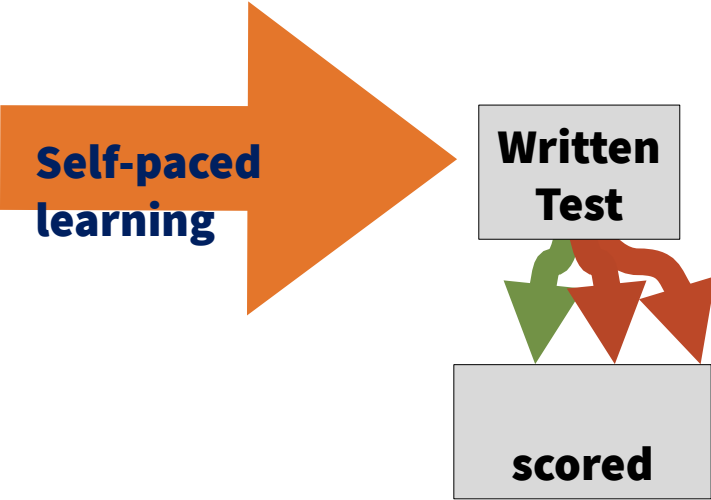
A simple design can be made richer with added information
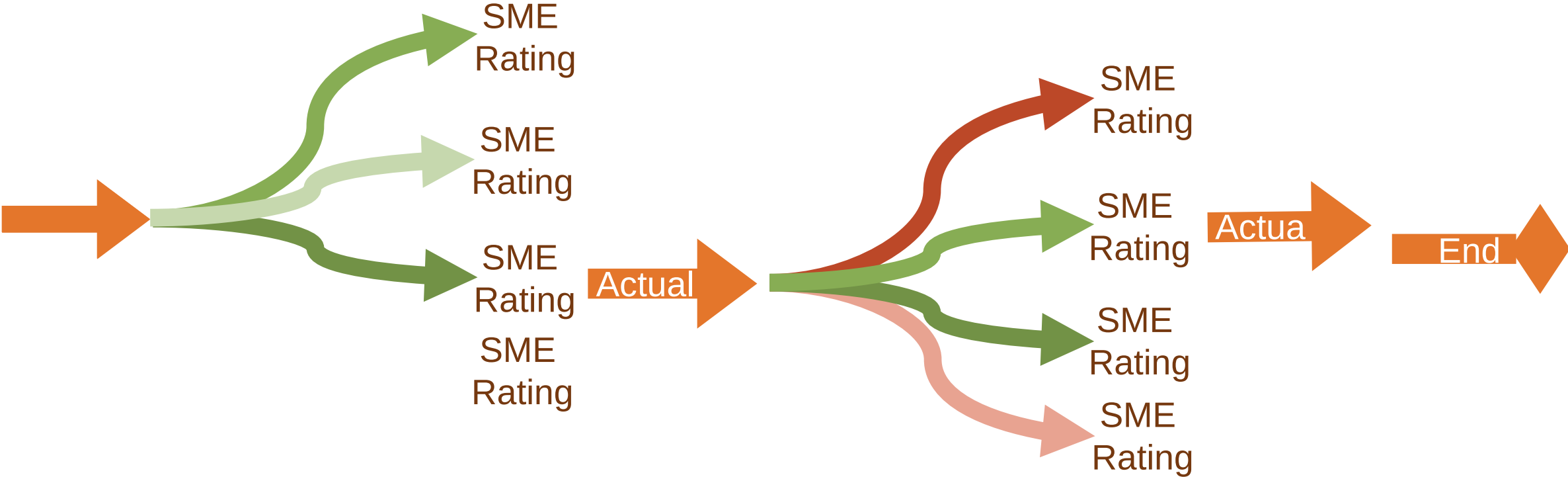
Rate all the options

A simple design with complex content leads to engaged learners

Our training goal is safe and healthy miners

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NIOSH Mining Program

www.cdc.gov/niosh/

Calling All Innovators!

You could *win* the NIOSH Mine Safety and Health Technology Innovations Award**!**

For submission info: go.usa.gov/xKtxe

Welcome!

Emergency Decision-making:
Underground Coal Mine
Escape Scenarios

Beta Version
03/07/2019

Cognitive fidelity requires a believable and detailed context

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Cokedale Mine – Map

One drift and 8 shafts into the Pittsburgh Coal Seam, average 66" thickness

CM operators for development and retreat sections

Entries and crosscuts developed on 16.5' in width

Entries on 64' centers, crosscuts on 96' centers

2 production shifts and one maintenance shift per day, 5 days a week

6,500 daily production

Employees – 339 underground
  and 69 surface

10 working sections,
7 active and 3 spares

Active working sections near fire:

- 7 Butt
- 8 Face Parallel

Mine Information

The scenario begins and the first decision options are given

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Cokedale - 7 Butt: Decision 1-A

Visibility: < 5 ft	SCSRs: Not Donned
5:00 am	Miles: 0.00

- A construction foreman is near the "free entries" by himself.
- He overhears radio chatter from his jeep regarding a trolley switch burning, then sees very thick smoke (visibility < 5 ft) pouring through the free entries.
- He thinks evacuation is necessary for the 8 Parallel and 7 Butt crews.
- He also thinks that the smoke is coming from near Steiner portal, and that the group should escape via the Crystal air shaft.
- He also knows that the maintenance crew in 7 Butt has no access to any communications.

Option A

Explore past the free entries to get more information about the fire

This action would help the group's chances of making it out safely.

Strongly Agree	Agree	Disagree	Strongly Disagree
○	○	○	◉

Four options are given for each key point

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Cokedale - 7 Butt: Decision 1, Review of Options

Visibility: < 5 ft	SCSRs: Not Donned
5:00 am	Miles: 0.00

- A construction foreman is near the "free entries" by himself.
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- He thinks evacuation is necessary for the 8 Parallel and 7 Butt crews.
- He also thinks that the smoke is coming from near Steiner portal, and that the group should escape via the Crystal air shaft.
- He also knows that the maintenance crew in 7 Butt has no access to any communications.

Options A - D

This action would help the group's chances of making it out safely.

Explore past the free entries to get more information about the fire

Call dispatcher, then evacuate by himself

Ride jeep to 7 Butt immediately with evacuation message

Call dispatcher, tell them to get everyone out of 8 face parallel, then ride jeep to 7 butt to alert crew

SME based feedback is provided for each rated option

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Cokedale, 7 Butt, Decision 1 Ratings Review

Visibility: < 5 ft	SCSRs: Not Donned
5:00 am	Miles: 0.00

- A construction foreman is near the "free entries" by himself.
- He overhears radio chatter from his jeep regarding a trolley switch burning, then sees very thick smoke (visibility < 5 ft) pouring through the free entries.
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- He also knows that the maintenance crew in 7 Butt has no access to any communications.

Options A - D

This action would help the group's chances of making it out safely.

(Strongly Agree-1, Agree-2, Disagree-3, Strongly disagree-4)

Explore past the free entries to get more information about the fire

Your Rating: **4**	Expert Rating: **3.13**

Call dispatcher, then evacuate by himself

Your Rating: **3**	Expert Rating: **3.38**

Ride jeep to 7 Butt immediately with evacuation message

Your Rating: **2**	Expert Rating: **2.00**

Call dispatcher, tell them to get everyone out of 8 face parallel, then ride jeep to 7 butt to alert crew

Your Rating: **1**	Expert Rating: **1.50**

The actual (or designer selected) option moves the story forward

Emergency Decision-making: Underground Coal Mine Escape Scenarios

Cokedale, 7 Butt, Decision 1 Ratings Review, Escape Group Choice

Visibility: < 5 ft	SCSRs: Not Donned
5:00 am	Miles: 0.00

- A construction foreman is near the "free entries" by himself.
- He overhears radio chatter from his jeep regarding a trolley switch burning, then sees very thick smoke (visibility < 5 ft) pouring through the free entries.
- He thinks evacuation is necessary for the 8 Parallel and 7 Butt crews.
- He also thinks that the smoke is coming from near Steiner portal, and that the group should escape via the Crystal air shaft.
- He also knows that the maintenance crew in 7 Butt has no access to any communications.

Options A - D

This action would help the group's chances of making it out safely.

(Strongly Agree-1, Agree-2, Disagree-3, Strongly disagree-4)

Explore past the free entries to get more information about the fire

Your Rating: **4**	Expert Rating: **3.13**

Call dispatcher, then evacuate by himself

Your Rating: **3**	Expert Rating: **3.38**

Ride jeep to 7 Butt immediately with evacuation message

Your Rating: **2**	Expert Rating: **2.00**

Call dispatcher, tell them to get everyone out of 8 face parallel, then ride jeep to 7 butt to alert crew

Group Choice

Your Rating: **1**	Expert Rating: **1.50**

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