



Jodi Pelders
Senior Researcher
CSIR

Jodi Pelders is a researcher in the CSIR's Mining Cluster. She has been involved in conducting research relating to human factors, health and safety in the southern African mining sector for over a decade. Jodi obtained her Master's degree in Ergonomics from Rhodes University, and completed a PhD in Public Health at the University of the Witwatersrand. Her research interests include fatigue management, workplace stress, physiological strain, incident analysis, women in mining, socio-economic and living conditions, and ergonomics, as this relates to mine workers in South Africa. More recently, much of her research involvement has related to modernisation of the mining industry. The research project clients include the Mine Health and Safety Council, Mandela Mining Precinct, and mining houses. Jodi aims to contribute to improving the health, safety, and productivity of individuals, and increasing sustainability in and around mines.

Competency-based training for mine emergency response

*P. Lange, R. Bergh, J. Pelders,
and S. Khan*

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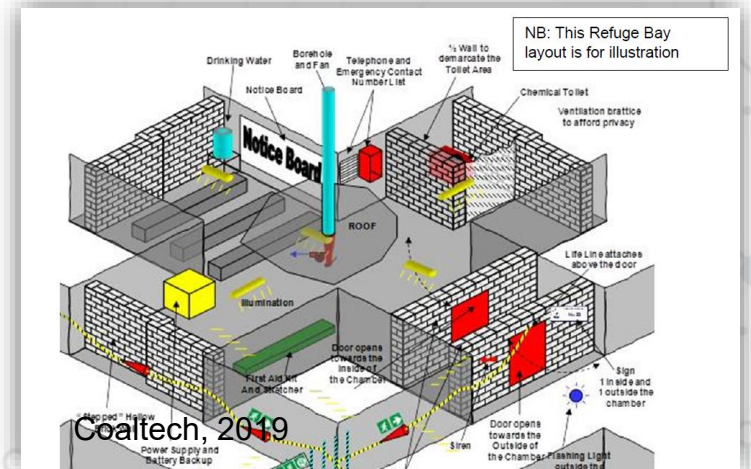
Introduction

- Improved training solutions are needed to improve health and safety awareness and performance
- Technology can be applied to improve training for emergency response in the mining industry
- Innovative multi-modal competency-based training modules have been developed to supplement existing safety awareness training provided by the Kloppersbos fires and explosions test facility



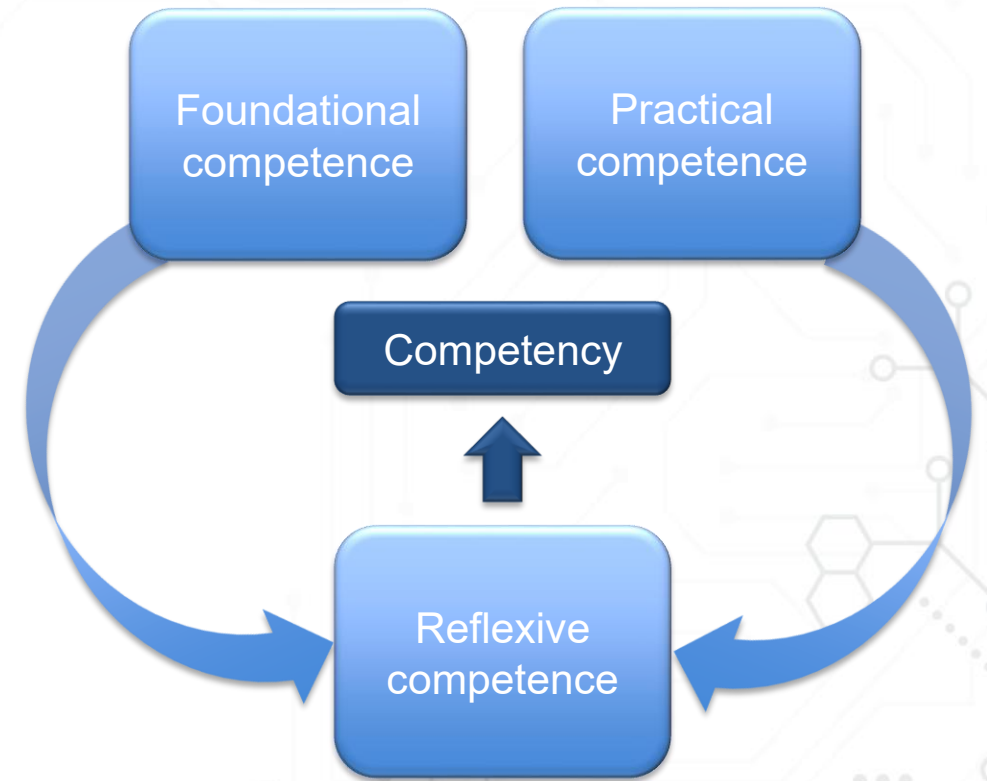
Background

- Mining industry hazards include fires, underground explosions and toxic gases
- Emergency preparedness is important for improved safety outcomes – including relating to self-contained self-rescuers (SCSRs), escape routes, and refuge bays
- Improved training for escape and rescue operations is needed that provides indication of the physical, cognitive, psychological stressors and behavioural responses that would be experienced



Background

- Experiential training is considered an effective means to improve mine emergency training
- Traditional methods, e.g. seminars, posters, manuals, videos and drills, are not highly engaging and lack in the experience of real-life emergency scenarios
- Computer simulation and virtual reality (VR) can provide immersive training. Benefits include realistic experiences, cost-effectiveness, safe environment, range of scenarios, flexibility, tacit knowledge, monitoring and recording, and accurate and immediate feedback



Methods

Stakeholder
workshops

Technology
development

Roadshow

Pilot study

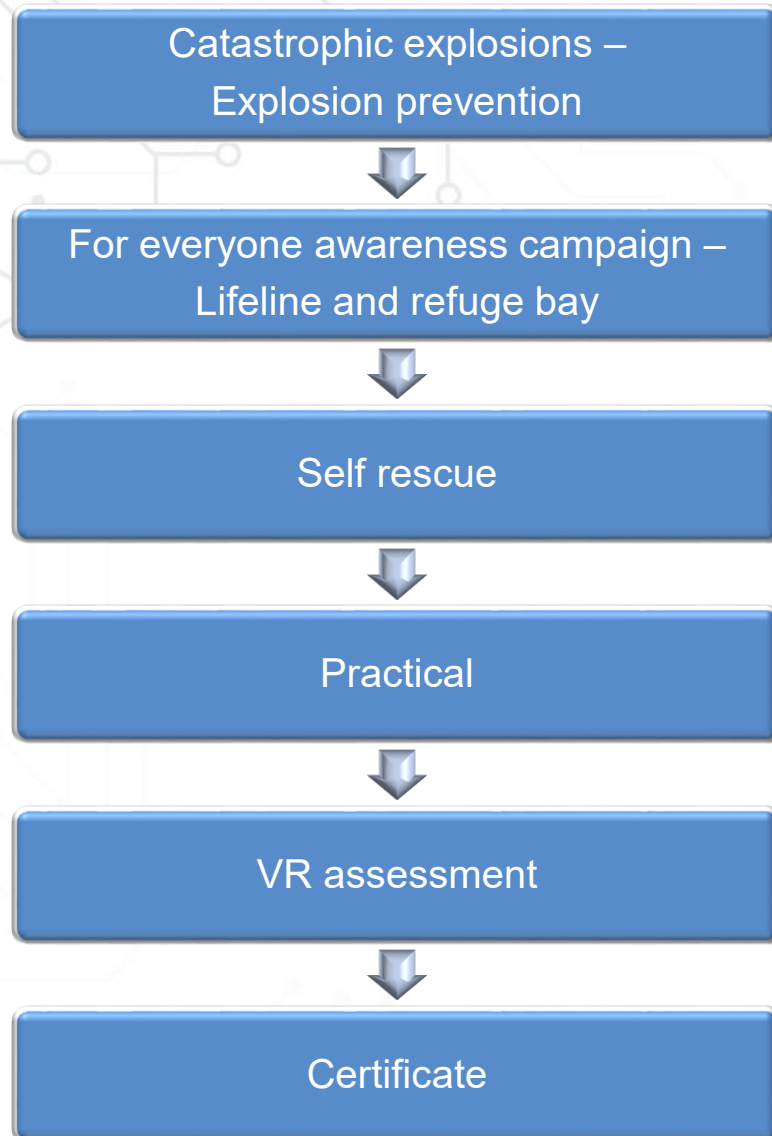


Outputs

- Interactive e-learning modules on basic emergency response procedures
- Real-life experiential training in self-contained self-rescuer (SCSR) donning procedures
- SCSR breathing simulation using the CSIR Expectation Trainer device
- VR training involving simulation of an escape route scenario
- Competency-based assessments



E-learning modules



Let's review: Using Your Short duration SCSR | AfroxPac 35l • The 7 Donning Steps

Fit and adjust neck and waist strap

Lift your *hard hat*, fit neck strap and *immediately* replace hard hat. Tilt head back and *adjust strap* to prevent mouthpiece pulling out. Clip in waist strap and *adjust*.

The complex block contains a review of the 7 donning steps for a Short duration Self-Contained Breathing Respirator (SCSR). On the left, a diagram shows a sequence of 7 numbered steps for donning the device. On the right, a photograph shows a miner in a white shirt and hard hat, actively adjusting the neck strap of a red SCSR. To the right of the photo, text provides specific instructions for fitting the neck and waist straps.

SCSR experiential training

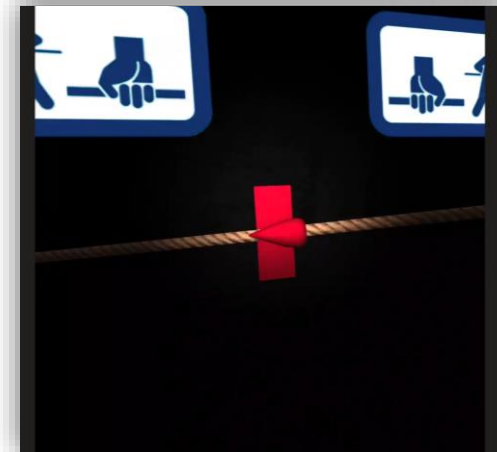
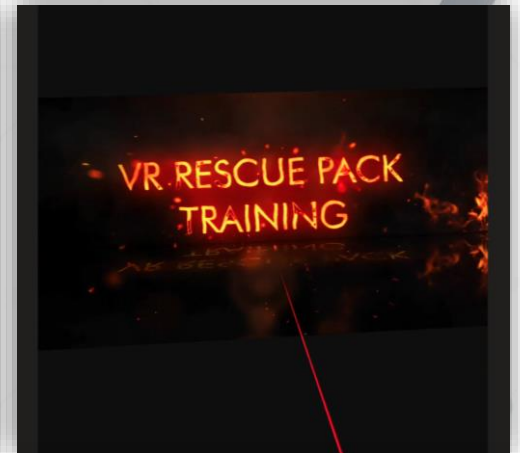
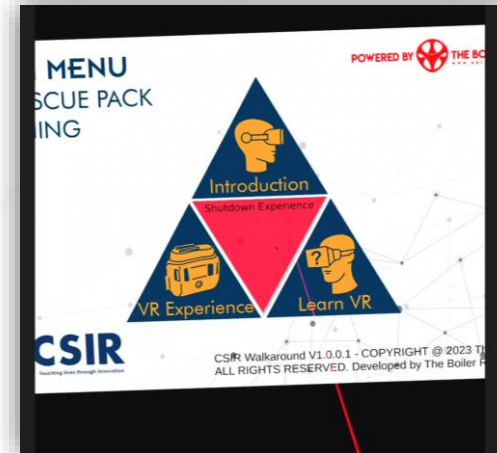
- Training units
- CSIR Expectations Trainer



Outputs – VR training for an emergency escape scenario

- Donning of the SCSR unit
- Finding the lifeline and route to the refuge bay
- Refuge bay procedures

- Activities to complete:
 - Check and test for methane gas
 - Activate the positive vent flow at the borehole
 - Instruction to remove SCSR units
 - Check and apply first aid to any individual in need
 - Take register of team numbers
 - Inform control room of status and needs of the team
 - Check status of toilet facility
 - Keep only one headlight on to preserve and save energy of other lamps
 - Stay calm and wait patiently for rescue team to arrive



Pilot study feedback

- **E-learning:** interesting and easy to follow
- **VR module:** underground mining experience
- **Expectation Trainer:** life-like experience with heat and breathing resistance

Factors to consider:

- Literacy level
- Computer and technology exposure
- Experience in underground mining operation
- Dealing with nausea



Conclusion

- It is expected that this immersive and experiential training approach will improve learning outcomes and lead to improved safety of mine workers in South Africa
- Key safety benefits of multi-modal competency-based training includes:
 - Improved training outcomes
 - Greater knowledge retention, recall and practical application
 - Improved hazard recognition and risk mitigation
 - Reduction in workplace fatalities and injuries
 - Alignment with regulatory and industry safety standards
- It is recommended that this multi-modal competency-based training approach be systematically implemented across all mining operations



The background is a deep blue color with a subtle, intricate pattern of white and light blue lines resembling a circuit board or a network map. A large, thick white arrow points from the left side towards the right, partially overlapping the circuit pattern. The text "Thank you" is centered in the middle of the image.

Thank you