Innovative VR-technology in teaching of mining engineering students

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Our institute, Our vision

Vision 2024: Digital Mine

- 360° mine
- Mine life cycle
- VR goggles, training simulators, educational videos
- Scenario-based learning
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Why VR in teaching?

• Outdated teaching methods
• Lack of 3D visualisation
• Lack of practical experience

Virtual Reality (VR) used to:

• Simulate closeness to reality
• Increase motivation for learning
• Enhance understanding through visualization
• Promote experimental learning
• Enhance process-orientated learning
  – e.g. equipment and safety training

“The transfer of knowledge and principles of professional practice in mining is enriched by using innovative, digital communication media.”
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What is the VR-Mine?

- **Virtual Mine Project**
  - Sponsored by EIT RawMaterials (2018 – 2020)
- **MyScore**
  - Sponsored by DAAD & BMBF (2019 – 2022)
- **Virtual underground mine**
  - Based on a real mine (Mittersill Mine, Austria)
  - Realised with Unity
  - Various scenarios (e.g. Mine Safety)
- **Aims**
  - Application of theoretically acquired knowledge
  - Preparation for later work
  - Learning in a safe environment
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Scenario-based learning

- Introduction to mine safety
- Explosives storage
- Safety hazards
- Maintenance and repair room
- Mine ventilation I + II
- Drilling & blasting
Motion sickness

- Inconsistencies in perception of movement and actual movement
- Symptoms may be delayed after use but disappear by themselves
- Everyone reacts differently

How to deal with motion sickness in exercises with students?

- Enlightenment and slow habituation
- Few rotations of the user
- Max 15 min. sessions, breaks
- Continuous optimisation of the VR environment

Difficulties in teaching with VR (Dörner et al., 2019)

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Have you experienced signs of motion sickness?

- None 13%
- Very mild symptoms 7%
- Mild symptoms 73%
- Strong symptoms 0%
- Very strong symptoms 7%

scale

N = 15

Have you experienced signs of motion sickness?

very strong symptoms 7%

very mild symptoms 7%

mild symptoms 73%

strong symptoms 0%

none 13%

scale
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Evaluation of the VR-Mine experience
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Evaluation of the VR-Mine experience

- How important is a practical application for you?
  - somewhat important: 0%
  - unimportant: 0%
  - not very important: 0%
  - very important: 33%
  - important: 67%

- Have you ever used a VR application?
  - Yes: 72%
  - No: 28%

- Implementing in VR motivated me due to the new technique.
  - strongly disagree: 0%
  - disagree: 18%
  - neutral: 18%
  - agree: 70%
  - strongly agree: 12%
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Evaluation of the VR-Mine experience

I enjoy using new technologies.

N = 18

- strongly agree 33%
- agree 61%
- neutral 0%
- disagree 6%
- strongly disagree

Do you like the concept of the VR-Exercise?

N = 16

- agree 64%
- neutral 12%
- disagree 12%
- totally disagree 0%

I would be interested to use VR-Applications at the institute beyond regular exercise appointments.

N = 17

- agree 64%
- neutral 12%
- disagree 12%
- totally disagree 0%
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Evaluation of the VR-Mine experience: added benefit

- **N = 16**
  - After using the VR mine, I am more aware of safety issues in mining.
    - strongly agree 19%
    - agree 56%
    - neutral 19%
    - disagree 6%
    - strongly disagree 0%

- **N = 16**
  - I think the VR application will help me for my professional life.
    - strongly agree 6%
    - agree 63%
    - neutral 25%
    - disagree 0%
    - strongly disagree 6%

- **N = 16**
  - The VR application helped me understand the subject matter through visualisation.
    - strongly agree 6%
    - agree 75%
    - neutral 6%
    - disagree 13%
    - strongly disagree 0%
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What is planned for the future?

• Further expansion and improvement of the VR-mine
  – Using the feedback of the students

• Analysis of the evaluation results to date and further surveys
  – Effects of the new learning method?
  – Not only evaluate user satisfaction, but:
    - Evaluation of the learning progress
    - Evaluation of added benefit (of the VR exercise)

“Prepare mining students for the job market.”
Questions?

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