Potentials and Challenges of Using Mixed Reality in Mining Education

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About the author

Since November 2017, Lea Daling works as a research associate at the Chair of Information Management in Mechanical Engineering (RWTH Aachen University).

Ms Daling is part of the research group "Digital Transformation in Working Environments". With a professional background as a psychologist, Ms Daling researches and works at the interface between human and technology.

A special focus of her research is on digital technologies such as augmented and virtual reality - as well as their implementation and evaluation in educational and professional contexts.

The MiReBooks Project

This work is part of the project **“Mixed Reality Books (MiReBooks)”** and was funded by the EIT RAW Materials.

- In MiReBooks, a series of mixed reality based interactive mining handbooks will be produced as a new digital standard for higher mining education throughout Europe.
- MiReBooks allows teachers to work directly with AR or 360° images during their lectures as well as making self-study more interactive for students.
- With MiReBooks, students can learn in a more effective way by using visual and interactive materials.

Find out more: https://mirebooks.com

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Conference presentation by Lea Daling | IMA-RWTH Aachen University | 11.2020 | lea.daling@ima.rwth-aachen.de

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Agenda

Introduction

Mixed Reality and its Application in Mining Engineering Education

Interview-Study

Method and Design of a Europe-wide Interview Study

Results & Critical Reflection

Discussion of Challenges and Opportunities of MR in Mining Engineering Education

Introduction – Mixed Reality and its Application in Mining Engineering Education

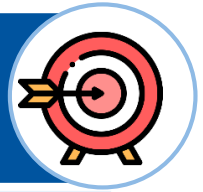
Challenges in Mining

- Mining is becoming less attractive for students → declining student numbers
- Mining engineering graduates often have little understanding of how to transfer their theoretical knowledge into practice

Mixed Reality in Education

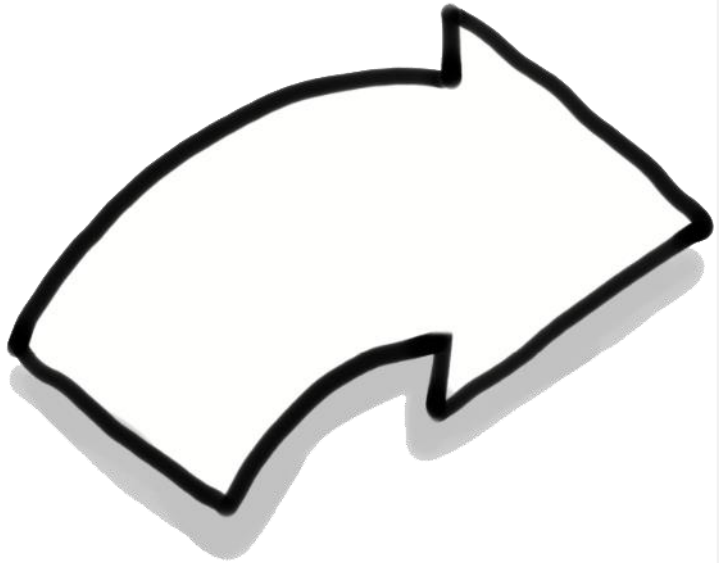
- MR tools are increasingly finding their way into education
- MR offers new “opportunities for enhancing both motivation and learning across a range of subject areas, student developmental levels, and educational settings” (Dede et al., 2017)
- The replication of real processes in simulated environments can support the training of relevant behavior for performance in work or personal life

The MiReBooks Project



- MiReBooks produces a series of Virtual Reality (VR) and Augmented Reality (AR) based interactive mining handbooks as a new digital standard for higher mining education across Europe
- The project aims to change the way students are taught by empowering teachers to engage their students more effectively and provide them with a wider repertoire of content and better understanding

Introduction – Mixed Reality and its Application in Mining Engineering Education



Aim of this research:

- To give an overview of the potentials and threats of using Mixed Reality (MR) based technologies in mining education.

Method:

- An interview study with 39 participants (teachers and students) was conducted across Europe to assess
  - the need,
  - possible application scenarios, as well as
  - opportunities and risks

  of MR in teaching.

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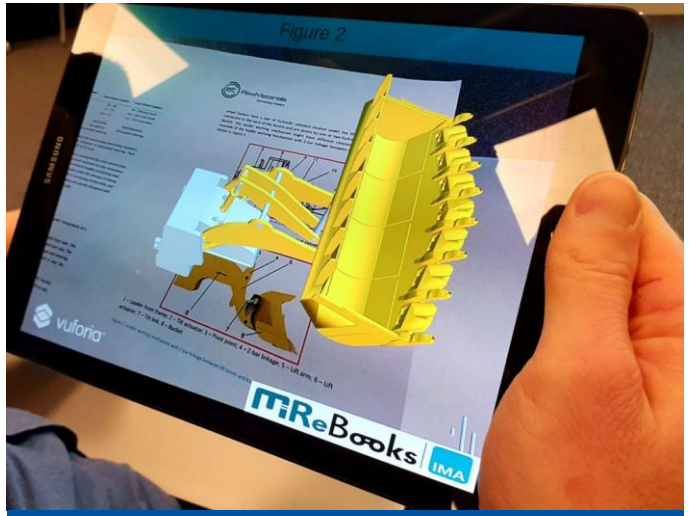
Interview Basis: MR Test Lectures in the MiReBooks project

MR Technologies used in the MiReBooks Test Lectures



3D Models (AR)

3D environment (VR)

360° Video

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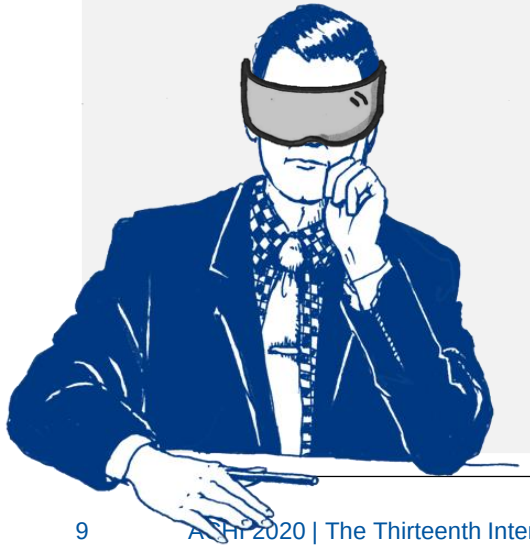
Method: Study Design

Participants

Experienced Teachers (3)

- Held at least one of four different MiReBooks test lectures (using MR technologies)



Experienced Teachers (3)

- Have no prior experience using MR in teaching

Method: Study Design

Participants

Experienced Students (21)

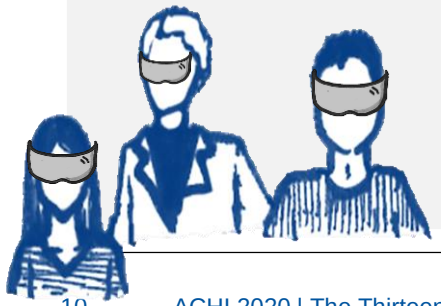
- Took part in at least one of four different MiReBooks test lectures (using MR technologies)

Inxperienced Students (12)

- Have no prior experience using MR in their studies

Participants were from Germany, Austria, Estonia, Sweden

All students were from different semesters, but they had to be enrolled in a mining-related subject



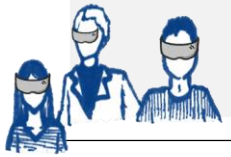
Method: Study Design

Interview Focus

Interview Focus
- Experiences with MR
- Reflection of the test lecture
- Necessary preparation and optimal teaching conditions using MR

Interview Focus
- current use of media
- interest in using MR
- Requirements enabling teachers to give their own lectures with MR

Interview Focus:
- Experiences with MR
- MR in comparison to classical lectures Advantages, Disadvantages and possible difficulties using MR



Interview Focus:
- Feedback about their experiences with current teaching methods
- General expectations with regard to benefits or threats using MR

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Method: Study Design

Qualitative Content Analysis

categories from interview guidelines

↓

data

↓

sub-categories

↓

substance of the analyzed content

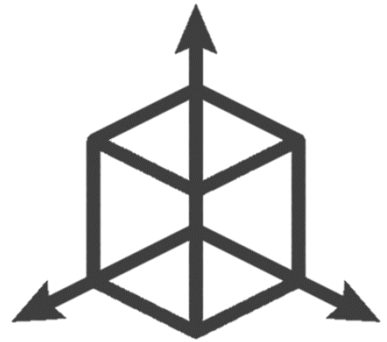
TABLE I. OVERVIEW OF DERIVED CATEGORIES

Categories	Sub-categories
Currently used media	Classical methods and media
Changes in the learning experience	General benefits of MR
	Guidance through the lecture
	Individual learning needs
Application scenarios	Target group
	Use cases
	Alternative to field trips
Lessons learned from test lectures	Preparation for conducting MR lectures
	Technical aspects
	Integration of MR in the lecture
	Financial aspects
	Availability of MR content

Results: Currently Used Media

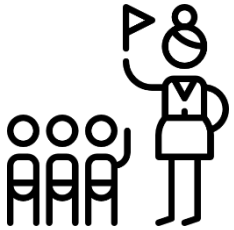
Pictures & Graphs (15)

Texts & Manuals (12)



3D Animations (6)

Videos & Films (11)



Excursions & visits to mines (11)

(N=15)

Results: Changes in the learning experience due to MR

General benefits of MR

„more practical understanding“

„feeling of reality“

„better imagination of machines and processes“

MR leads to a comprehensive learning experience

Individual learning needs

- Time is needed to get used to technology
- MR opens up different “paths” of teaching

Main Benefit: MR offers a more individual learning environment

Main Challenge: everyone has their own pace and type of learning

Guidance through the lecture

- restricted eye-contact during VR-Use
- MR can be „overwhelming“ for students
- Visual cue points and clear instructions are helpful

Main Benefit: Teacher are able to track student’s progress

Main Challenge:Difficult to lead everyone to the same learning goal

Results: Application scenarios of MR

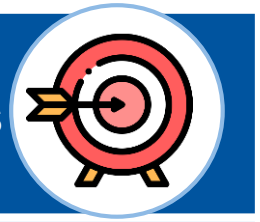
Target Group

- inexperienced students are most likely to benefit from MR-based experiences (get an overview)
- other students could benefit from more advanced and interactive settings

Use Cases

- Visualization of scenarios
  (underground mining, open pit mining or blasting)
- detailed practical processes,
  (e.g. functioning or operation of machines)
- “virtual add-on” to excursions

Alternative to field trips



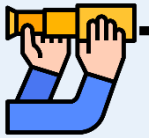
- Better overview
  (structures, sizes, machines)
- Different perspectives
- Game-based immersive learning
- Excursion - expensive, far away or dangerous

Classical methods stay relevant, e.g. for scientific basics and theoretical subjects

Results: Lessons Learned from MR Test Lectures (I)

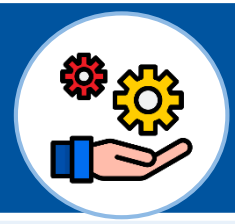
Need for Preparation

- Familiarizing with technology and teaching materials
- personal workshop trainings / online offers



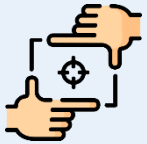
➔ Foresee problems

Need for Technical Assistance



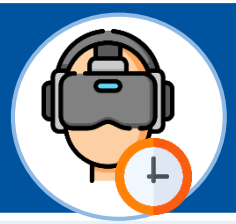
- Setting up the systems
- charging & maintenance
- solving technical issues in class

➔ teacher can focus completely on teaching of the content.



Results: Lessons Learned from MR Test Lectures (II)

Recommendation on Usage Time



- Duration
  - max. 30min in 90min class
  - 4-6 360° videos, each 2-4min
- Frequency
- Amount of devices

➔ Beneficial regarding lecture and content

Open Questions

- Financial aspects

- Availability of MR content

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Conclusion and Outlook

Conclusion

- 39 persons with and without experience with MR were interviewed across Europe
- Especially teachers see the potential of MR in offering experiences in otherwie hardly accessible settings
- Students had the impression to get a more practical and deeper understanding of the content through the use of MR technologies
- Students as well as teachers see the possibility of enhancing motivation through the use of MR
- Classical methods will nevertheless stay relevant for mining engineering education

Outlook: Future Steps & Research

- ➢ Transparency about the possibilities of MR technologies should be established
- ➢ Low-threshold tools and platforms in order to use MR for teaching purposes should be developed
- ➢ There should be more research on collaborative solutions and scenarios in MR to enforce communication between students.

Many Thanks for Your Attention!

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