Digitalization in Education: Learning with Immersive Technologies

Polina Häfner
Vita

Born in Omurtag, Bulgaria
Bachelor from TU Sofia FDIBA in Informatics
Diploma from KIT in Informatics
PhD at IMI, KIT
Postdoctoral Researcher at IMI, KIT

Main research topics
- Immersive Technologies in Engineering
- Immersive and Intelligent Learning Environments
Challenges

- Rising globalization and digitalization
  - Transformation of jobs
  - Automation of skills
- Companies globally struggle to find skilled job candidates
  - From STEM areas (Science, Technology, Engineering, Mathematics)
  - New 21st century (soft) skills
    - Problem-solving
    - Decision-making
    - Creativity
    - Cross-team functionality and communication
    - Technological Adaptability
- Employees want to stay competitive on the labor market
Motivation

- Paradigm Shift – from knowledge to interpret/analyze/apply

- Searching for further educational methods, practices and media, which implies the need of digitalization

- Improving the learning process with tools and methods that are
  - Adequate
  - State-of-the-art
  - Tailored
  - Pleasurable
Motivation: Technical Experts

- Immersive technologies
  - High potential for educational purposes
  - Increasing affordability and usability of hardware and software

- Challenges
  - High demand of VR/AR developers and products
  - Still highly complex development, high efforts and costs

- Questions arise
  - When to use immersive technology?
  - How to integrate it into the learning process?
  - Increase the efficiency of the authoring of immersive applications
Immersive Technologies

Key characteristics: Immersion, presence, interaction and intelligence
Immersive Learning Environments

Exploration

Source: Linde [6]

Experimentation

Source: MIT Media Lab [8]

Training

Source: Lincoln Electric Companies [7]

Construction

Source: IMI KIT
## Lifecycle of an Educational Program using Immersive Technologies

<table>
<thead>
<tr>
<th>Layer</th>
<th>(Re-)Analysis</th>
<th>Design</th>
<th>Development</th>
<th>Implementation</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Educational</td>
<td>Needs Analysis</td>
<td>Instructional Design</td>
<td>Preparation</td>
<td>Deployment</td>
<td>Summative Evaluation</td>
</tr>
<tr>
<td>Technology</td>
<td>Technology Analysis</td>
<td>Solution Concepts</td>
<td>Preparation &amp; Implementat.</td>
<td>Technology Usage</td>
<td>Technology Evaluation</td>
</tr>
<tr>
<td>Management</td>
<td>Strategic Planning</td>
<td>Economical Analysis</td>
<td>Project Management</td>
<td>Management</td>
<td>Overall Evaluation</td>
</tr>
</tbody>
</table>
Roles

for the design, development and implementation of an immersive learning application

Instructional Designers
*Educators, teachers, didactician, pedagogues*

Domain Experts
*Teachers, scientists, engineers, etc.*

Deliverer of Instructions
*Educators, teachers, supervisors, tutors*

Decision-makers
*Heads of organisation, chiefs, managers*

Technology Experts
*Immersive technology experts, developers, IT system administrators*

Learners
*Pupils, students, trainees, workers*
Decision-Making Process

- **Key characteristics**
  - 12 steps to decision
  - In-depth analysis and economic effectiveness
  - Alternative IT solution concepts

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Holistic Approach for Authoring Immersive and Smart Environments for the Integration in Engineering Education, Polina Häfner
Development of Immersive Learning Worlds

Authoring of Immersive Applications

Agile Software Development

Vision → Iteration → ... → Iteration N

Design

Analysis

Planning

Implementation

Testing & Integration

Maintenance

Implementation subprocess in one iteration

Asset Modelling and Creation

Export

Data Interfaces

Import

Application Logic

Scene Setup

Hardware Interface

Add Behaviour

User Interaction

Testing

Performance Optimisation

Deployment on the Immersive Hardware

Iterative Development of Immersive Learning Worlds
Let’s make the future of learning together!

Contacts

Polina Häfner

Address: Kriegstr.77, D-76133 Karlsruhe

Tel.: +49 721 608-44157

E-mail: polina.haefner@kit.edu

Web: http://www.imi.kit.edu/21_1806.php

Youtube channel: https://www.youtube.com/channel/UCjAWBnlgHxloswxZvyoCQCQ
Virtual Reality Practical Course at KIT

- **Target group**
  - Higher education level
  - Multidisciplinary
  - Multi-aged
  - Intercultural students

- **Main characteristics**
  - Setting of individual learning goals through introductory talks and questionnaires
  - Covering all „Six kinds of significant learning”
    - Construction ILE method
    - Blended-learning approach
    - Problem-based learning approach
    - Both autonomous and teamwork
  - Extensive assessment (self-reflection) and feedback evaluation

<table>
<thead>
<tr>
<th>Learning Goals</th>
<th>Six kinds of learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn about virtual reality theory, hardware, software</td>
<td>Foundational knowledge</td>
</tr>
<tr>
<td>Learn about a STEM subject as project use case</td>
<td>Foundational knowledge</td>
</tr>
<tr>
<td>Able to operate and use hardware and software for Virtual Reality applications</td>
<td>Application</td>
</tr>
<tr>
<td>Gain and use programming skills</td>
<td>Application</td>
</tr>
<tr>
<td>Project management and marketing</td>
<td>Application</td>
</tr>
<tr>
<td>Time management</td>
<td>Application</td>
</tr>
<tr>
<td>Problem solving</td>
<td>Application and Integration</td>
</tr>
<tr>
<td>Methodical approach to practical engineering problems</td>
<td>Integration</td>
</tr>
<tr>
<td>Interdisciplinary and intercultural teamwork</td>
<td>Human dimension and Caring</td>
</tr>
<tr>
<td>Both autonomous and group work</td>
<td>Human dimension and Caring</td>
</tr>
</tbody>
</table>
| Self reflection and further after course activities like publications, work as research assistant etc. | Learning how to learn
Project-Based Learning with Construction Worlds

- **Soft Skills**
  - Problem-solving
  - Decision-making
  - Critical thinking
  - Collaboration, teamwork
  - Communication
  - Management, leadership
  - Self-reflection

- **Scalable**
- **Sustainable projects**
Virtual Reality-based Workshop in Schools

- **MINT-Box Project**
  - Funded by Baden-Württemberg Foundation
  - Delivered in Einstein Gymnasium in Kehl

- **Target group**
  - Secondary education level
  - Multi-aged students from grades 9 through 12
  - VR-Toolbox for teachers

- **Results**
  - Experience physical and technical phenomena
    - Newton mechanics, energy, control Loops
  - Programming skills through visual scripting
  - Partially usage of experimental and construction VR environment
  - High engagement through VR technology

- **Issues**
  - Extensive training of teachers necessary
  - Not affordable immersive technologies
Immersive Driving Simulator

DriveSim project
- Easy access for driving instructors and students in China
- Immersive and realistic driving simulation with real vehicle

Intelligent tutoring system
- Customized learning
- Evaluation of driving behavior
  - Task generation and evaluation
  - Tracking of user performance
  - Feedback generation

Source: IMI KIT
Bibliography


