EMERGING TECHNOLOGIES IN HEALTH PROFESSIONALS' EDUCATION

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AI STATEMENT

The following AI tools have been used in the preparation of the lecture:

- Writing support
  - CurreChat
- Information retrieval
  - ScopusAI
  - Keenious

In addition, permission has been obtained for all images used.

LECTURE OBJECTIVES

- Identify Challenges in Clinical Placements: Recognize the importance of clinical learning and challenges in clinical placements.
- Analyze Emerging Technologies: Examine the impact emerging technologies on health professionals' education and their potential to enhance learning experiences.
- Identify Limitations and Challenges: Discuss the limitations and the challenges associated with integrating emerging technologies into health education.

IDENTIFY CHALLENGES IN CLINICAL PLACEMENTS

HEALTH PROFESSIONS EDUCATION AT A TURNING POINT

- Clinical Practice as the Foundation of Learning
  - Real experiences are crucial for effective learning: learning is primarily based on clinical practice.
  - Participation, supervision, and workplace culture shape professional growth.
  - Effective patient care relies increasingly on teamwork across disciplines.

  (Dornan et al., 2007, Hublin et al., 2023; Reeves et al., 2023; Yardley et al., 2012).
- Challenges in Clinical Placements
  - Limited Availability
  - Quality Variability
  - High Workload and Stress
  - Feedback and Guidance
  - Psychological Safety

NEED FOR EDUCATIONAL REFORM

- Technological acceleration.
- Evolving professional roles.
- Increased interprofessional collaboration.
- Growing concerns about workforce well-being.

(Masters, 2023; Pänkänen et al., 2024; Reeves et aal., 2016; Tolsgaard et al., 2020.)

- Advances in artificial intelligence are changing knowledge construction and assessment.
- Digital learning environments are transforming access to education.
- Learning analytics are enhancing educational strategies.

(Hibbard, 2024; Feigerlova et al., 2025; Masters et al., 2025.)

- Quality of Learning Environments
  - Importance of real experiences and psychological safety.
  - Support and inclusion facilitate feedback, questioning, and learning from mistakes.

(Appelbaum et al., 2018; McClintock et al., 2023; Torralba et al., 2020).

  - Move beyond small changes and isolated innovations.
  - Emphasize flexibility, compassion, and evidence-based practices.
  - Integrate digital tools, mental well-being, and clinical excellence into a cohesive approach.

(Dolmans & Tigelaar, 2012; Engeström & Pyörälä, 2021; Fuller et al., 2022.)

NEED FOR EMERGING TECHNOLOGIES

- Enhanced Learning Environments
- Simulation and Virtual Reality
- Personalized Learning
- Improved Feedback Mechanisms
- Support for Interprofessional Education
- Access to Resources

ANALYZE EMERGING TECHNOLOGIES

THE DIVERSITY OF TERMINOLOGY

The variety of terms used in health professions education research highlights the evolving use of technology in training and the need for clarity in terminology.

Virtual Simulation

- A digital environment that replicates real-life clinical scenarios for training purposes.

Virtual Reality (VR)

- An immersive technology that allows users to interact with a computer-generated environment.

Virtual Patient

- A simulated patient used in training to provide learners with realistic clinical interactions.

Simulation Game

- An interactive game designed to teach clinical skills through simulated scenarios.

Immersive Virtual Reality

- A more advanced form of VR that enhances user engagement through deeper sensory experiences.

Intelligent Virtual Reality

- VR that incorporates artificial intelligence to create dynamic and responsive training environments.

- A significant gap in published studies is **the lack of clear descriptions** of the technological applications used.
- This ambiguity makes it challenging for readers to understand what is actually being studied and how to interpret the results.
- Without detailed explanations of the technologies involved, the applicability and relevance of the findings may be diminished, hindering the advancement of knowledge in health professions education.

INNOVATIVE PEDAGOGICAL DESIGNS

- Implementing innovative **pedagogical approaches** is essential to use emerging technologies effectively, leading to improved educational outcomes (Hemminki-Reijonen et al., 2025).
- Strong **design principles** are vital for creating effective learning experiences. This involves collaboration among educators, researchers, and designers. (Koivisto et al., 2018.)
- Emphasizing Kolb's experiential **learning theory** (1984) in virtual simulations fosters critical thinking and self-reflection, allowing students to apply theoretical knowledge in practical scenarios (Koivisto et al., 2017).

➢ **The integration of emerging technologies aims to create more engaging and impactful learning environments, ultimately enhancing the educational experience for health professionals.**

INTEGATIONS OF ARTIFICIAL INTELLIGENCE

- By utilizing artificial intelligence, virtual simulations adapt to the learner's skills, making the learning experience individualized for each learner (Hamdaoui et al. 2017; Streicher & Smeddinck 2016).
- Integrating GenAI and IVR enhances learning experiences by addressing specific needs of educators and students (Hemminki-Reijonen et al., 2025).
- Incorporating AI education into healthcare training complements both theoretical knowledge and practical, hands-on training (Mendes, 2025; Patil et al., 2025) and communication skills (Vilanti et al., 2025).
- This integration of AI into the learning environment not only enhances the educational experience (Adiguzel et al., 2023) but also aligns with the need for effective interprofessional collaboration and the development of essential skills in modern healthcare practice.

THE IMPACT AND BENEFITS OF EMERGING TECHNOLOGIES IN HEALTH PROFESSIONS EDUCATION

CLINICAL KNOWLEDGE AND SKILLS

1. VR simulations enhance clinical knowledge and skills (Havola et al., 2021; Koivisto et al., 2023, 2024).
2. Simulation games significantly enhance nursing students' surgical knowledge compared to traditional methods (Koivisto et al., 2023).
3. Training in resuscitation protocols through VR simulations (Salovaara-Hiltunen et al., 2019).
4. Research showed a positive correlation between nursing students' theoretical knowledge and practical skills of vitals signs (Rosqvist et al., 2026).
5. Simulation games are shown to effectively enhance nursing students' clinical reasoning skills (Havola et al., 2021).
6. AI Chat Simulation enhances midwifery students clinical reasoning (Dahlqvist et al., submitted).

EMPATHY

- VR provides experiences that foster empathy in students (Mattsson et al., 2024; Mattsson et al., 2025).
- These experiences allow students to recognize and respond to the emotions of virtual patients, fostering empathetic responses (Mattsson et al., 2024).
- However, students experienced barriers to experience empathy, including focus on technique, limited dialogue with the virtual patient and awareness of the virtual patient's artificial nature (Mattsson et al., 2025).

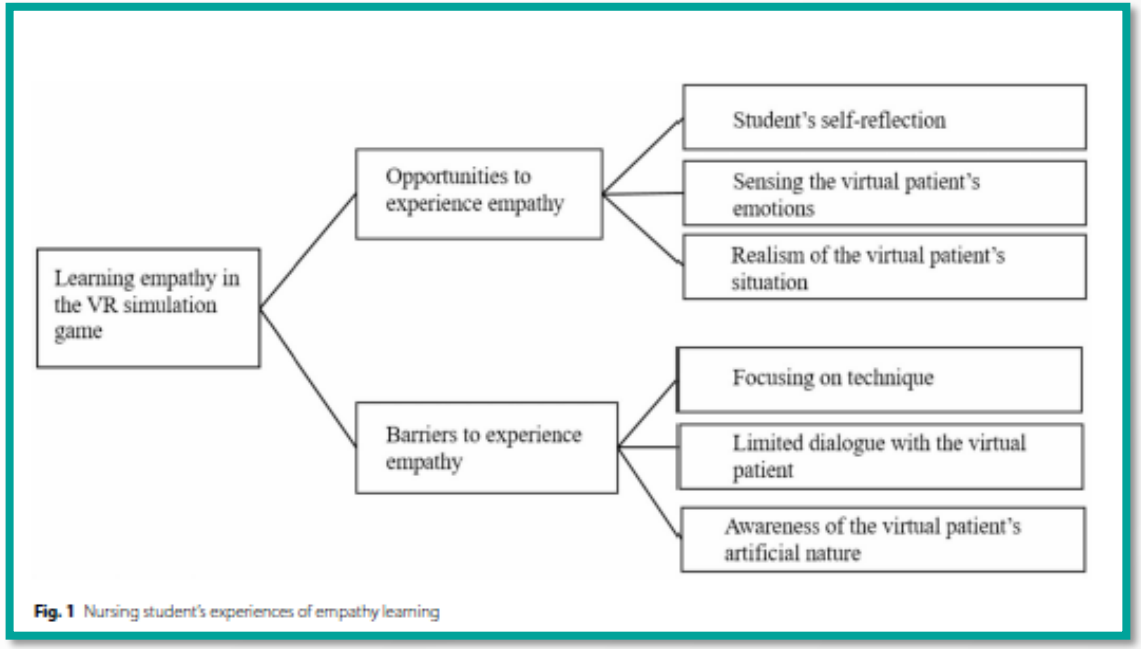


Fig. 1 Nursing student's experiences of empathy learning

Mattsson, K., Haavisto, E., & Koivisto, J. M. (2025). Embracing opportunities and addressing barriers in learning empathy through VR simulation games - a qualitative descriptive study of nursing students' experiences. *BMC nursing*, *24*(1), 991. https://doi.org/10.1186/s12912-025-03639-z

EMPATHY

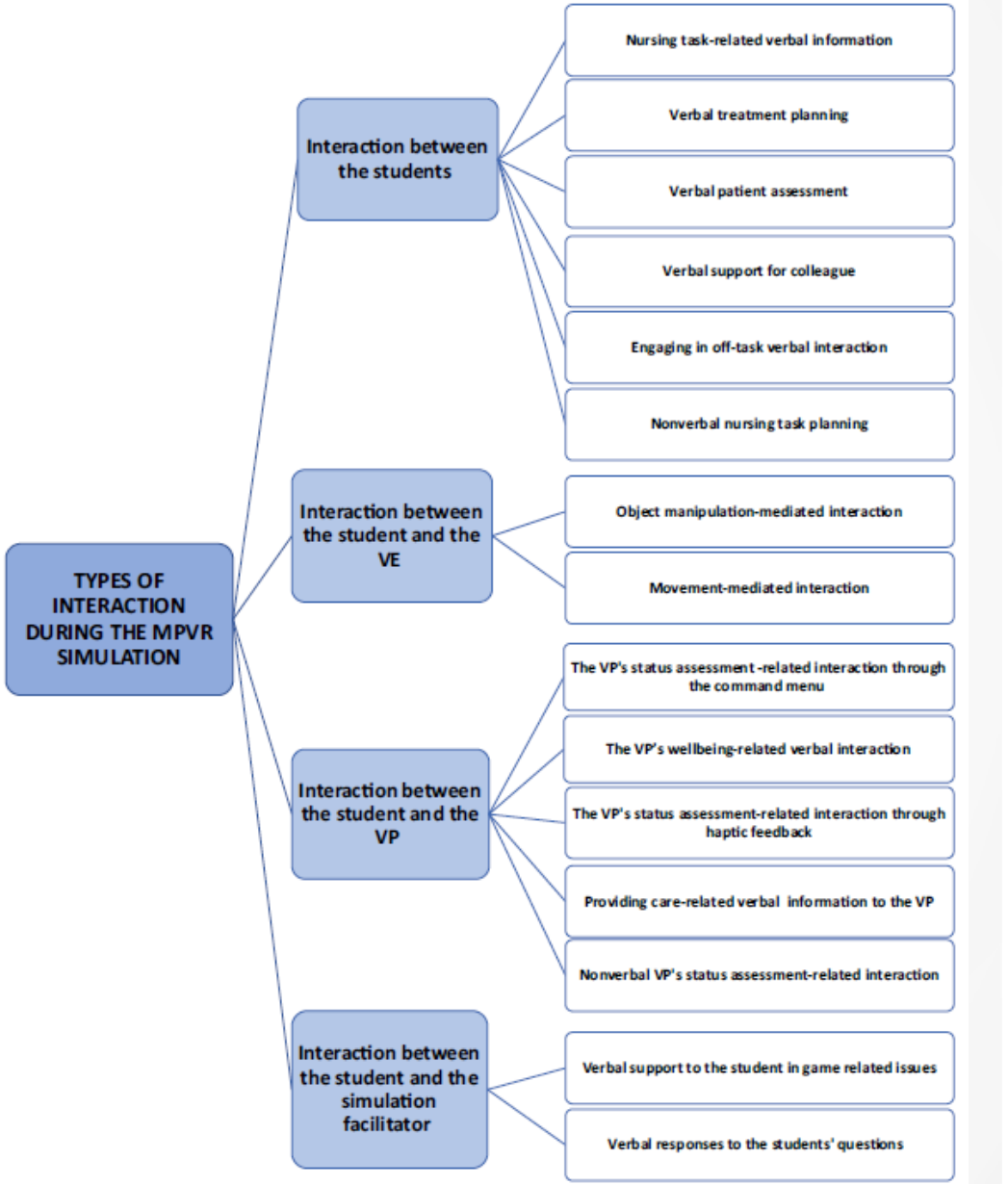
- The immersive VR simulation game with a head-mounted display and hand controllers was employed to explore nursing students' experiences of empathy and user experiences in an immersive VR simulation game (Koivisto et al., 2025).
- The instruments used were the Basic Empathy Scale in Adults (BES-A) (Carre et al., 2013) before the VR simulation gaming session and the Comprehensive State Empathy Scale (CSES) (Levett-Jones et al., 2017) and AttrakDiff 2.0 Scale (Hassenzahl, 2004) after the session.
- Nursing students reported a favorable overall level of empathy experienced in the immersive VR simulation game, with higher pre-game empathy levels slightly correlating with increased feelings of empathy post-game, although the association was not statistically significant (Koivisto et al., 2025).
- The use of the VR simulation provided a positive user experience in all 4 factors of the AttrakDiff 2.0 Scale.

Koivisto JM, Kämäräinen S, Mattsson K, Jumisko-Pyykkö S, Ikonen R, Haavisto E. Exploring Nursing Students' Experiences of Empathy and User Experiences in an Immersive Virtual Reality Simulation Game: Cross-Sectional Study. JMIR Serious Games 2025;13:e62688. doi: 10.2196/62688

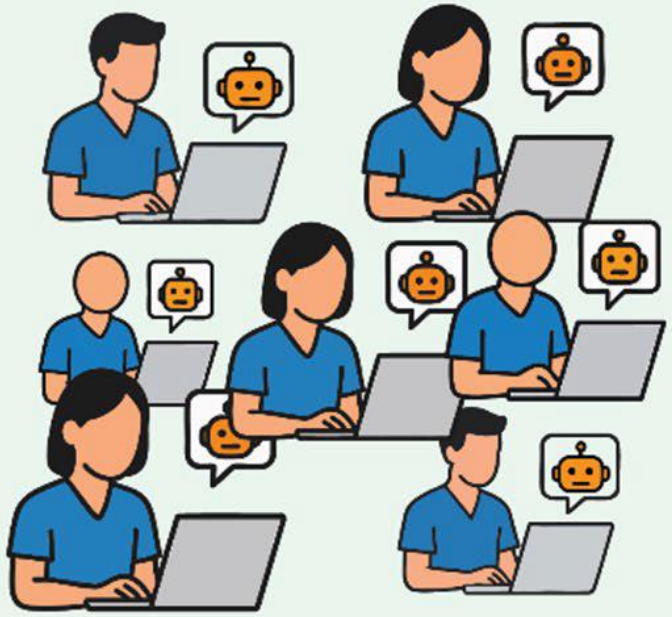
COMMUNICATION SKILLS

- Interaction in multiplayer VR simulations enhances teamwork and nurse-patient communication (Piispanen et al., 2024).
- GenAI facilitates effective communication practices among healthcare students, significantly enhancing their understanding of complex medical terminology and concepts (Vilanti et al., 2025).

- Four types of interaction in a MPVR simulation were identified.
- Interaction consisted of verbal and nonverbal interaction, as well as object manipulation and movement in the VE.
- The reasons for interaction were to coordinate the care, to assess the VP, and to implement VPs' care.



Piispanen, N., Haavisto, E., Hublin, L., Ikonen, R., & Koivisto, J. M. (2024). Nursing students' perceptions of interaction in a multiplayer virtual reality simulation: A qualitative descriptive study. *Nursing open*, *11*(8), e2245. https://doi.org/10.1002/nop2.2245



AI Chat Simulation & NLP Analysis

AI-driven chat scenarios in contraception education were developed, allowing learners to practice clinical conversations in a safe, controlled environment. A novel use of NLP method is used to analyse chat dialogues in health care education.

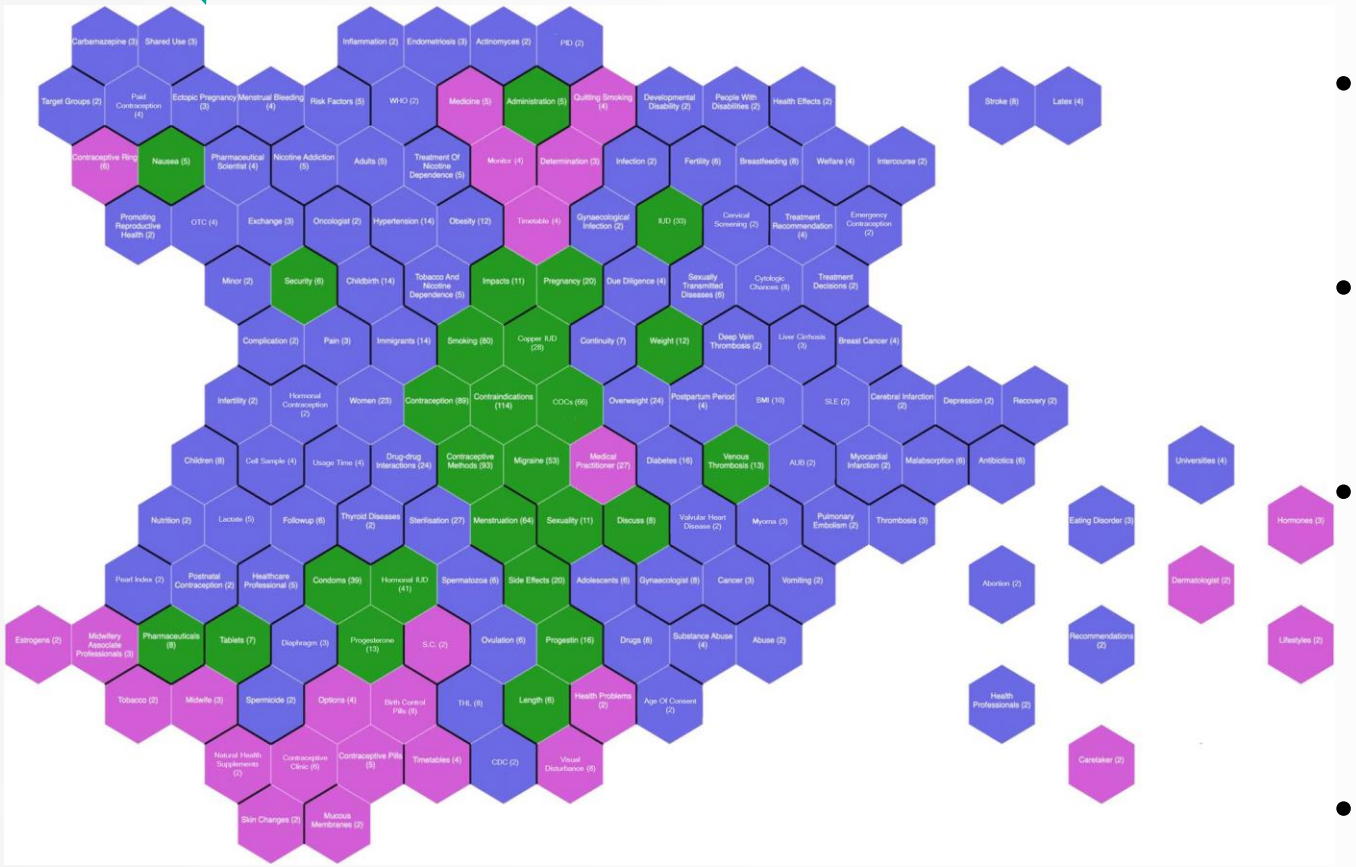
Gap Analysis & Guideline Alignment

Systematic GAP analysis compares AI patient chat dialogues with the Current Care Guideline to identify and address discrepancies, ensuring the curriculum aligns with evidence-based standards.

Learner Engagement & Skill Boost

Interactive virtual simulations foster deeper engagement by situating students in realistic patient-care dialogues. Real-time feedback via checkmark-annotated prompts accelerates mastery of communication skills and clinical guideline application.

Vilanti, T., Luiro, K., Dahlqvist, I., Piipponen, J., Hemminki-Reijonen, U., Tkalcan, S., Ketamo, H. & Koivisto J-M. 2025. Contraception-related topics in chat dialogues between healthcare students and generative AI patients: a natural language processing analysis. BMC Med Educ 25, 1458. https://doi.org/10.1186/s12909-025-08032-7



- Integration and analysis of students' dialogues using MeSH terminology and work-related topics in conjunction with the Current Care Guideline for Contraception.
- The color-coded system illustrates the alignment of discussed topics with the guidelines.
- Green represents the topics that the students discussed that are aligned with the Current Care Guideline.
- Pink represents topics that are valid in terms of MeSH and work-related topics and were discussed but are not relevant in terms of the Current Care Guideline.
- Blue represents topics that are relevant in terms of the Current Care Guideline but were not mentioned in the chat dialogues.

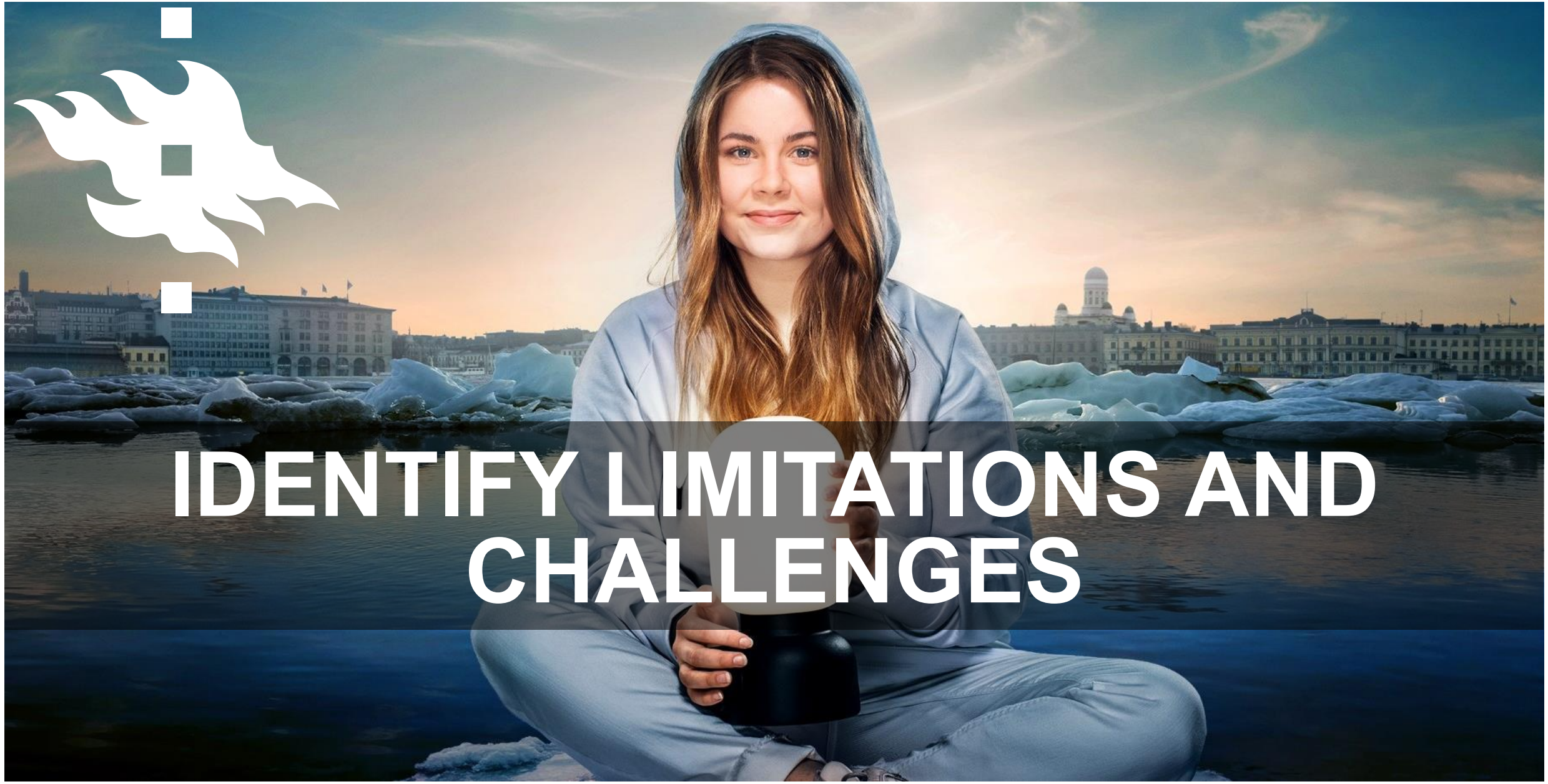
Vilanti, T., Luiro, K., Dahlqvist, I., Piipponen, J., Hemminki-Reijonen, U., Tkalcan, S., Ketamo, H. & Koivisto J-M. 2025. Contraception-related topics in chat dialogues between healthcare students and generative AI patients: a natural language processing analysis. BMC Med Educ 25, 1458. https://doi.org/10.1186/s12909-025-08032-7

ASSESSMENT

- Applications collect data on the learner's actions and behavior during performance (game metrics) (Drachen et al. 2013).
- By collecting and analyzing game metrics, it is possible to demonstrate the learner's engagement, behavior, learning, knowledge, and skills.
- Game metrics can objectively assess nursing students' knowledge and performance, facilitating targeted support (Koivisto et al., 2024).
  - A statistically significant association was found between the mean score from the game metrics and the total score of the knowledge test ($p < 0.0072$), indicating that higher mean scores correlate with better surgical nursing knowledge among students.
- Rosqvist et al. (2026) found that students who excel in vital signs theoretical knowledge in the knowledge test also demonstrate proficiency in practical skills in the skill test (simulation game).

USER EXPERIENCE AND ENGAGEMENT

- User experience in immersive VR simulations is crucial for effective learning (Koivisto et al., 2025; Koivisto et al., 2023; Mäkinen et al., 2020; Mäkinen et al., 2023).
- Understanding how students engage with these technologies informs the design and implementation of future educational tools.



IDENTIFY LIMITATIONS AND CHALLENGES

LIMITATIONS AND CHALLENGES OF EMERGING TECHNOLOGIES IN EDUCATION

- Access and Equity
  - Not all students have equal access to emerging technologies, leading to disparities in learning opportunities and outcomes.
- Data Privacy and Security
  - The use of technology in education raises concerns about student data privacy and the security of personal information.
- Quality of Content
  - The effectiveness of emerging technologies can be compromised if the content or learning materials are not evidence based, high quality or relevance.
  - In studies, the poorly described technology used complicates the application of results in practice.

- Technical Issues
  - Reliability and technical glitches can disrupt the learning process and hinder the effective use of technology.
- Training and Support
  - Educators may require additional training and support to effectively integrate new technologies into their teaching practices.
- Resistance to Change
  - Some educators and institutions may be resistant to adopting new technologies due to comfort with traditional methods or skepticism about effectiveness.-
- Integration into Curriculum
  - Successfully integrating emerging technologies into the curriculum can be challenging, requiring alignment with educational goals and standards.

FUTURE DIRECTIONS

Future Directions

- Establish Consistent Definitions for Key Concepts
- Clarify Technology Description in Research
- Focus on Quality Content
- Integrate Technologies into Curriculum
- Utilize Implementation Research in Integration
- Improve Technical Support
- Invest in Training and Professional Development
- Strengthen Organizational Support

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