REIMAGINING DENTAL EDUCATION: A VIRTUAL REALITY JOURNEY FROM KUOPIO, FINLAND

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SUMMARY

A study conducted at the Institute of Dentistry University of Eastern Finland in Kuopio has shed new light on the effectiveness of virtual reality (VR) haptic-reinforced preclinical training in dental education. The research is now in preprint format in the International Journal of Computerized Dentistry, co-authored by two 5th year dental students **Kiia Manninen** and **Mandi Mäenpää**. It explores the integration of cutting-edge technology with traditional teaching methods.

The study, which began in 2022, involved 40 preclinical dental students split into two groups. One group started with VR haptic training, while the other began with conventional plastic tooth models. Halfway through the course, the groups switched methods.

Key Findings

- **Improved Learning Outcomes:** The research revealed that combining VR haptics with conventional tooth preparation exercises can enhance students' learning outcomes.
- **Increased Confidence:** Over two-thirds of the students reported improved self-confidence after practicing in the VR haptic environment.
- **Practical Benefits:** Students appreciated the practicality of the exercises and the immediate feedback provided by the VR equipment.
- **Clinical Measurements:** The group that started with VR haptic training showed more consistent and closer-to-ideal tooth preparations in their final exams, with less damage to neighboring teeth.

Implications for Dental Education

The study highlights the potential of VR haptic technology to revolutionize dental education. It offers students the opportunity to practice unlimited times in a low-stress environment, complementing traditional hands-on training. Kiia Manninen emphasized the benefits of VR haptic practice, including its flexibility and the ability for students to train at their convenience. While the research demonstrates promising results, it also notes that further studies are needed to fully integrate VR haptics as a primary learning method in preclinical dental education, according to Mandi Mäenpää.

This pioneering research not only contributes to the field of dental education but also showcases the potential for student involvement in cutting-edge research, paving the way for future innovations in dental training methodologies.

Preamble

Two dental students from the University of Eastern Finland's Institute of Dentistry in Kuopio have made significant contributions to the field of dental education through their involvement in groundbreaking virtual reality (VR) haptic research. Kiia Manninen and Mandi Mäenpää, who initially did not know about the technology's potential, have become co-authors on an evidence-based research paper soon to be published in the International Journal of Computerized Dentistry. The journey began in 2022, just after when the institute acquired Finland's first VR-haptic Simodont® by Nissin Dental Trainers. Initially doubtful about the technology's ability to replicate the sensation of using a real drill, the students quickly discovered its potential.

A Study by Our VR-Haptic Thinkers That Changed Everything…

In 2022, their supervisors Dr. Outi Huhtela and Dr. Szabolcs Felszeghy, members of the UEF VR-Haptic Thinkers, curious about the buzz surrounding new VR and haptic technology, initiated a study to explore the effectiveness of virtual reality haptic training. They divided 40 preclinical students into two groups on a prosthodontic course. One group began with VR haptic training, while the other continued with traditional plastic tooth exercises. Midway through the study, the groups switched their training methods. The results were fascinating:

- **Confidence Boost:** More than two-thirds of the students reported feeling more confident in their skills after practicing in the virtual environment.
- **Enhanced Precision:** Students who started with VR haptic training demonstrated greater accuracy in tooth preparations and caused less damage to adjacent teeth during their final exam.
- **Flexible Practice:** The VR system allowed students to practice at their convenience without depleting physical resources, eliminating the struggle over limited lab time.
- **Instant Feedback:** The VR haptic system provided immediate feedback, akin to having an instructor with x-ray vision guiding students through their exercises.
- **Low-Stress Environment:** Mistakes made in the VR setting didn't result in wasted materials or embarrassment; students could simply click to retry and improve their performance.

This study highlights the potential of VR haptic technology to enhance learning outcomes in preclinical education, making training more effective and accessible.

Conclusion: An Ongoing Dental Revolution

Reflecting on our journey, it is incredible to see how far we've come as students involved in this analysis for our paper – Kiia stated. We transitioned from initial skeptics to passionate advocates, witnessing firsthand the transformative power of VR haptics in dental education. This isn't just about cutting-edge technology; it's about cultivating a better, more confident about the future generation of dental students – said Mäenpää. As they prepare for the end of their clinical phase, their excitement remained palpable. With patient-specific VR haptic 3D scan and print training on the horizon, we're not merely learning dentistry; Institute of Dentistry, University of Eastern Finland, is redefining it. So, to all future dental students: get ready! The future of dental education is here, and it's virtually and haptically amazing.

Check This Out, Too!

They collected and analyzed the final exam Frasaco® teeth from both experimental groups, gaining insights into oral scanning, digital dentistry, virtual reality, and haptics that exceeded their expectations. Here's some evidence of their efforts: teeth, statistics, and digital scans! They came, they scanned, they were conquered. Be sure to check out our paper when it's published!

Mission Impossible? Nay: Mission, Possible!

As we wrap this up, let's take a moment to appreciate the magic of technology and the power of student voices, they're the ones that matter!

The Future Is Here and Now, and We Go With It!

As the study concluded, Ms. Manninen and Ms. Mäenpää recognized that they had evolved beyond mere students; they had become pioneers in shaping the future of dental education in Kuopio. Their aspirations didn't stop there. They envisioned a groundbreaking integration of AI, oral scans, and 3D printing alongside VR haptics—this combination is poised to make a significant impact. and the

project was initiated last year. Pioneering Dental Education With Finland's First High-End 3D Printing Technology-Empowered Dental Education is here, thanks to our institution's support and an Apollonia Grant awarded to our supervisor Dr. Felszeghy (Grants awarded for dentistry researchers | University of Eastern Finland).

In this coming clinical study at the Institute of Dentistry, University of Eastern Finland, with active participation of our 3rd year dental students, **Eetu Mikkonen, Pinja Siponen**, **Patrick Stenfors**, and **Vilja Juutinen**, the early clinical adoption and integration of AI-assisted generation of haptic reinforced virtual reality and physical 3D models based on intraoral scans of patients' oral structures during a clinical prosthodontics course will be tested.

Our 3rd year students have begun collecting data of quantitative measures of our existing preclinical data to compare it to our future data from the clinical phase. Anonymous, voluntary surveys will be also administrated to students on clinical prosthodontic courses in 2025 spring. We wish to know whether the utilization of such new teaching and training scenario leads to improved understanding of dental anatomy and prosthodontic treatments in both students and their patients treated by 4th and 5th year students at the Institute of Dentistry, UEF.

This study will also aim to evaluate the correlation between the use of patient-specific VR haptic models and physical 3D prints in dental training and improvement in fine motor skills among prospective clinical dental trainees. Additionally, the general perceptions of the use of patient-specific VR haptic procedures and 3D-printed models will be assessed, including the effects of this new workflow on student and patient anxiety and attitudes within a training scenario.

The knowledge we aim to obtain might help our clinical dental education operate more efficiently and effectively. Reducing the amount of stress experienced by preclinical students would be helpful in assisting them in completing their clinical learning. Patient-specific VR haptic- and 3D print-based exercises might also lower tooth preparation mistakes done by students. With a data-driven, transparent system for assessing, storing, and managing the collected assets and the students' and patients' anxiety statuses, we'll also be able to get a comprehensive view of these two groups' emotional states and behavioral attitudes. This might help students learn the required protocols and initiatives in a better way than earlier, improving the quality of work they can deliver.

Also, we hope to see improvements in patient management before their treatments during the prosthodontic clinical training.

Importantly, VR haptics and 3D-printed tooth models are not intended to replace traditional preclinical and clinical methods; rather, they are meant to serve as an exceptional complement. These new approaches will provide the best of both worlds: the precision and repeatability offered by digital technology combined with the unparalleled realism of hands-on practice.

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