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*Research Results*
*Резултати от научни изследвания*

# DENTAL STUDENTS' ATTITUDES TOWARDS SIMULATION TRAINING

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**Abstract.** To effectively integrate modern technologies in dental education, it's important to understand students' attitudes and expectations. A survey conducted at the Faculty of Dental Medicine of MU-Plovdiv from November to December 2024 revealed a clearly expressed positive attitude and high expectations of all students towards introducing high-tech simulation training at the Faculty of Dental Medicine, which is an important predictor of the success and sustainability of innovation. We found no significant differences in opinions among students based on socio-demographic characteristics. Students believe that game elements, haptic technology, and VR/AR can enhance their professional competencies. These expectations could be met and attitudes rewarded if educational policies are directed towards establishing dental simulation centres and implementing simulation training at Bulgarian universities in all its complexity and accompanying activities. The study outlines the leading advantages of simulation training and possible risks as seen by the trainees. It contributes to the understanding of dental students' perceptions regarding high-tech simulation training, thereby enriching the limited existing literature on this topic.

*Keywords:* dental students; medical education; simulation training

## Introduction

The demand for simulation training in the field of dentistry is experiencing a significant surge. With contemporary technological advancements, it is now possible to create engaging learning environments that address several limitations of traditional training methods. These innovative approaches allow for exposure to a diverse array of clinical scenarios, including those that are infrequent or rare, which enhances the breadth of experience students gain (Dharmathilaka et al. 2023; Rumyantseva et al., 2024). These methods enable repetitive practice of

clinical tasks, which is crucial for mastering practical skills within a safe environment that prioritizes patient welfare (Mouatarif et al., 2024; Rumyantseva et al., 2024).

Cutting-edge high-fidelity simulators, paired with sophisticated haptic technology, provide dental students with learning experiences that closely mirror real-life clinical practice. This immersive experience is further enhanced by the integration of augmented reality, which not only enriches educational content but also allows students to visualize complex procedures in an interactive manner (Arul et al., 2024; Felszeghy et al., 2024). The incorporation of gamification strategies into training programs has been shown to significantly boost student engagement and motivation, making the learning process more enjoyable and effective. Studies have shown that students exposed to simulation-based training demonstrate significant improvements in knowledge, performance, and confidence compared to those who undergo traditional training methods (Mouatarif et al., 2024).

As technology becomes increasingly intertwined with the educational landscape, it is also reshaping the didactic characteristics of students. Although it is generally anticipated that students will embrace high-tech training modalities with enthusiasm and ease, it is imperative to assess their attitudes and expectations regarding these methods. Understanding these factors is crucial for the successful implementation of simulation training in dentistry.

The existing literature extensively covers the significance and function of simulation training within dental education; however, there remains a notable deficiency in research focused on students' perspectives, attitudes, and expectations regarding this training modality. Through exploring these viewpoints, we seek to enhance the understanding of how high-tech simulation tools impact the educational experience of dental students.

The objective of this study is to investigate the attitudes of dental students toward training that utilizes advanced high-technology simulators. By exploring their perceptions and expectations, the research aims to provide valuable insights that can guide the development and effectiveness of high-tech training programs in dental education.

**Materials and methods**

The survey was conducted in November-December 2024 at the Faculty of Dental Medicine of Medical University – Plovdiv through anonymous electronic surveys in Google Forms in Bulgarian and English. Five-point Likert scales were used to express agreement and evaluation. Descriptive and non-parametric methods were applied. The level of statistical significance was assumed to be $\alpha=0.05$. The results were processed with IBM SPSS v.23. Central tendencies are presented by mean and standard deviation (M±SD).

**Results**

The socio-demographic characteristics of the sample are presented in Table 1.

**Table 1**. Socio-demographic characteristics of the sample

| Variable | Sample | N | % | M±SD |
|---|---|---|---|---|
| Gender | | | | |
| | Men | 51 | 44,3 | |
| | Women | 64 | 55,7 | |
| Age | | | | 21,64±2,38<br>Min 18<br>Max 29 |
| Language of training | | | | |
| | Bulgarian | 58 | 50,4 | |
| | English | 57 | 49,6 | |
| Year of study | | | | |
| | First | 34 | 29,6 | |
| | Second | 8 | 7,0 | |
| | Third | 15 | 13,0 | |
| | Fourth | 28 | 24,3 | |
| | Fifth | 20 | 17,4 | |
| | Sixth | 10 | 8,7 | |

The students rated the importance of simulation training at 4,43±0,81, on a scale where 1 signifies "not important" and 5 indicates "extremely important." They also demonstrated a keen interest in learning with a high-tech simulator, scoring it a 4,69±0,69, where 1 means "I don't want to at all" and 5 represents "I wish strongly."

We asked the students to what extent their motivation for learning, practical skills, theoretical knowledge, critical thinking skills, emergency response skills and patient communication skills would improve if haptic technology, virtual or augmented reality or gamification were added. Figure 1 presents students' answers, where one stands for "will not improve at all", and 5 stands for "will increase greatly".

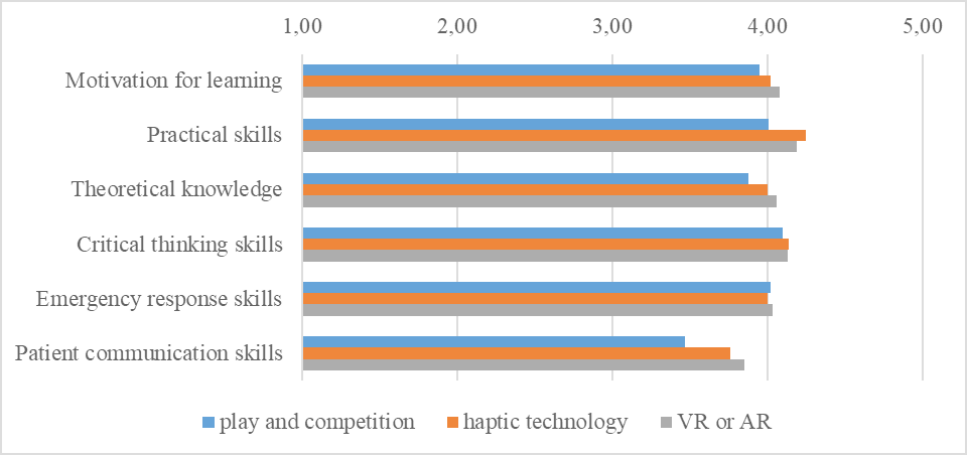



**Figure 1.** Students' expectations for enhancing their competencies through the integration of contemporary technologies into simulations

Students evaluated how well a high-tech simulator replicates the complexity of real clinical situations, giving it an average score of 3.82 ± 0.90, where 1 indicates "It does not replicate at all" and 5 signifies "It replicates with a very high degree of accuracy".

Figure 2 illustrates students' opinions on the place of simulation training within the curriculum

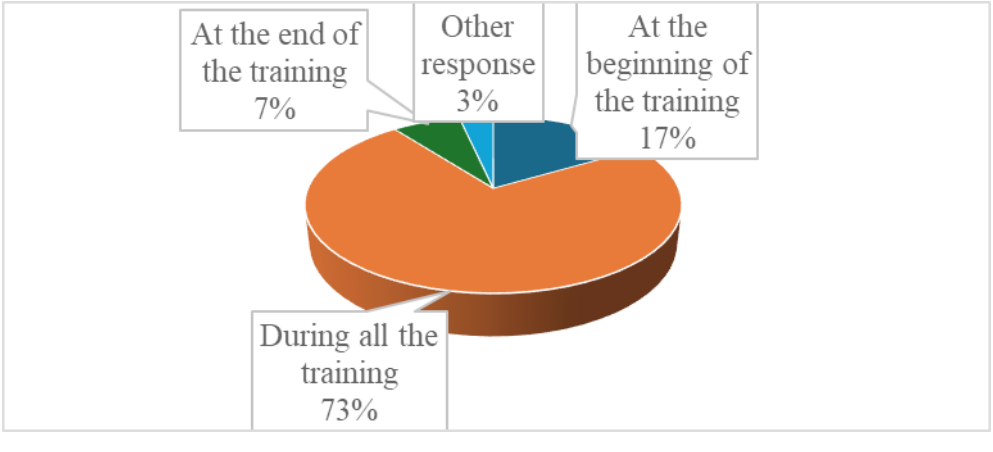



**Figure 2.** Students' views on the place of simulation training in the curriculum

The respondents' opinions on the benefits of simulation training are summarized in Table 2. Table 3 shows the risks related to implementing simulators for learning according to the sample.

**Table 2.** Benefits of simulation training according to the students.

| **Benefits** | **(M±SD)** |
|---|---|
| I won't worry about the patient being a living person | 3,70±1,38 |
| I have the opportunity to repeat the learning scenario | 4,43±0,90 |
| I have the opportunity to study rare clinical cases | 4,41±0,87 |
| I get instant feedback | 4,23±1.10 |
| I learn to respond to emergency situations in a safe environment | 4,37±0,94 |
| I gain more confidence before clinical practice | 4,47±0,81 |

**Table 3.** Risks of simulation training according to the students.

| Risks | *(M±SD)* |
|---|---|
| Technical support gaps | 3,04±1,20 |
| Gaps in regular updates of simulation software | 2,99±1,81 |
| Insufficient preparation of academic staff to teach effectively through simulators | 3,21±1,35 |
| Limited access to simulation equipment | 3,54±1,326 |
| Lack of effective training scenarios | 2,92±1,34 |
| Lack of sufficient training scenarios | 2,96±1,37 |

No statistically significant differences were found in the students' responses according to their socio-demographic characteristics.

**Discussion**

Dental students generally express a strong preference for training with high-tech simulators, as these tools offer numerous educational benefits that enhance their learning experience. A study found that 95.62% of students had a positive attitude towards practical classes conducted in simulation environments (Kaskova et al., 2022). A study conducted among Bulgarian students revealed that nearly 100% of the sample believed that simulation training supported the development of various skills and competencies, and 79.7% of the surveyed dental students support the foundation of a dental simulation centre as this would increase the effectiveness of

training (Grancharov, 2023). These results are in line with our findings. A vast majority of dental students have a positive attitude towards simulation training, with many considering it a necessary component of their education, no matter their age or language of training.

Our results support the notion that simulation training in dental medicine is highly valued by dental students for its ability to enhance both technical and non-technical skills in a controlled, risk-free environment. This educational approach is perceived as a crucial component in bridging the gap between theoretical knowledge and practical application, thereby fostering professional competence. Students appreciate the realistic scenarios possible due to the integration of modern technologies and methodologies such as gaming, haptic and VR into simulation training, which allows them to practice and refine their skills without the immediate pressures of real-life patient interactions. Simulation training is recognized for its effectiveness in integrating theoretical knowledge with practical skills. It allows students to apply what they have learned in lectures to simulated clinical scenarios, enhancing their understanding and retention of information. Students value simulation training for its role in developing a wide range of psychomotor skills necessary for dental procedures, such as crown preparation and tooth decay treatment (Arul et al. 2024). The use of high-fidelity simulations has been shown to significantly improve students' clinical competence and confidence (Mouatarif et al., 2024). Simulation training is also appreciated for its contribution to the development of non-technical skills, such as communication and empathy. These skills are crucial for effective patient care and are often practised through actor simulations and other interactive methods (Antila et al., 2024). High-fidelity simulations are designed to evoke emotions like those experienced in real clinical settings, which helps students become emotionally engaged and better prepared for actual patient interactions (Strub, 2024). The realism of simulation scenarios is highly valued, as it allows students to experience and manage the emotional and behavioural dynamics of patient care (Antila et al., 2024).

Surveys indicate high levels of student satisfaction with simulation training, with many students advocating for its increased integration into the dental curriculum (Mouatarif et al., 2024; Osipov et al., 2024). There are calls for better curricular integration and improvements in the transfer of skills to real clinical practice (Baldoceda & Teragni, 2024). The majority of the students we surveyed consider that simulation training should be implemented throughout the entire course of study. The integration of simulation training into the dental curriculum presents challenges. There is a need for careful sequencing and alignment with traditional teaching methods to ensure that simulations complement rather than replace essential hands-on clinical experiences (Daud et al., 2024).

While simulation training is widely appreciated for its numerous benefits, some students express concerns about its limitations. Our research highlighted two risks

as seen by students – limited access to simulation equipment and insufficient preparation of the teaching staff to teach effectively by simulators. Increased accessibility to simulators is a recommendation that also stands out in Grancharov's research (Grancharov, 2023).

Simulation equipment allows students to practice clinical procedures repeatedly, which is essential for mastering complex skills. Limited access can hinder this repetitive practice, leading to slower skill acquisition and reduced proficiency in clinical tasks (Dharmathilaka et al., 2023, Macías & Coronel, 2024). The lack of simulation tools can result in fewer opportunities for students to engage in hands-on learning, which is critical for developing motor skills and confidence in performing dental procedures (Chopchik et al., 2023). The financial cost of simulation equipment can limit the number of devices available, restricting access for many students. Limited access to technologies such as haptic devices or VR can prevent students from benefiting from modern educational tools (Wojcik et al., 2023), (Leung et al. 2021) and can create disparities in training quality and opportunities among dental schools (Leung et al. 2021). Policymakers are encouraged to ensure equitable access to technology by investing in digital infrastructure and providing training to address educational inequalities (Forhad, 2022) (Matuchniak & Warschauer, 2010). By investing in digital infrastructure and fostering partnerships, educational institutions and policymakers can work towards providing equal opportunities for all students.

Educators need to be proficient in operating simulation technology to effectively guide students. The complexity of virtual reality (VR) and haptic feedback systems requires instructors to have a solid understanding of the technology to troubleshoot issues and provide meaningful feedback to students (Arul et al., 2024) (Oyebisi et al., 2024). Simulation training offers unique pedagogical benefits, such as the integration of theory and practice and the development of complex clinical competencies. Educators must be equipped to design and implement simulation scenarios that align with learning objectives and assess student performance effectively (Mamcarz et al., 2023). The successful integration of simulators into the dental curriculum requires educators to be involved in the curriculum design. This includes determining the appropriate stages for introducing simulation exercises and ensuring that they complement traditional teaching methods (Bakr et al., 2024).

Our study may not be representative, yet it provides important perspectives on dental students' perceptions of advanced simulation training and contributes to the current body of literature on this topic. We anticipate that dental simulation centres at academic institutions will be well received by students, especially if they integrate modern haptic and virtual reality devices and employ gaming and competition as teaching strategies that resonate with the educational preferences of today's learners. Establishing these simulation centres is not a standalone endeavour. It requires educational policy support at national and institutional levels to promote

simulation capabilities, ensuring that all students have equal access, receive training throughout their years of study, and achieve various learning goals. This initiative should also involve preparing academic staff to effectively use simulation techniques, developing learning scenarios that utilize technological resources at most, and seamlessly incorporating practical mimic exercises into the curriculum.

**Conclusion**

The research indicated a distinctly favourable perspective and elevated hopes among all students regarding the implementation of advanced simulation training at the Faculty of Dental Medicine at the Medical University of Plovdiv, which serves as a significant indicator of the innovation's success and sustainability. The fulfillment of these expectations and the reinforcement of attitudes could be achieved if educational policies focus on establishing dental simulation centers and incorporating simulation training comprehensively at Bulgarian universities along with all related activities.

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