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Intelligent Educational Platform for Nail Art Training

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Abstract

This study explores the potential of using simulators in nail art training, integrating artificial intelligence (AI), 3D printing, and the Internet of Things (IoT). The research addresses the challenges of skill variability and safety in traditional nail art education by proposing a methodology that ensures high-precision replication of decorative techniques, modeling of complex cases, and automated feedback with personalized recommendations. The conducted study demonstrates improved accuracy in technique execution, reduced skill acquisition time, and increased learner satisfaction. The findings confirm the hypothesis that integrating digital technologies into nail art training contributes to standardization and enhances the quality of professional preparation, opening opportunities for further commercialization and implementation in beauty industry educational programs. The insights presented in this study are of interest to researchers and professionals in educational technologies, computer modeling, and artificial intelligence, focusing on the development of integrated simulation platforms to improve professional training quality in the beauty industry. The integration of practical techniques, complex scenario modeling with AI-driven feedback, and dynamic progress monitoring with adaptive skill assessment creates new prospects for both theoretical research in interdisciplinary fields and the practical implementation of innovative educational solutions in professional nail art training.

Keywords: *Artificial Intelligence, 3D Printing, Internet of Things, Simulator, Nail Art, Training, Feedback, Modeling, Personalized Recommendations.*

INTRODUCTION

Contemporary trends in digital technology development, including artificial intelligence (AI), the Internet of Things (IoT), and three-dimensional (3D) printing, have significantly transformed various economic sectors, including the beauty industry. The nail art sector, which has traditionally relied on manual techniques, is now facing the necessity of transitioning to standardized, safe, and highly precise training and practice methods. Recent studies demonstrate that the integration of AI and 3D printing not only facilitates the creation of modern products but also enhances educational processes and service quality.

With the rapid advancement of AI technologies and digital educational platforms, current literature exhibits a trend toward integrating practical techniques with high-tech modeling tools to simulate nail art procedures. For instance, publications on AI platforms for training, such as "12 Best AI Platforms for Training in 2025" [1] from training. safetyculture and "AI Sales Training Simulator Agent" [2] from taskade, emphasize the need for simulation systems capable of providing feedback. The authors highlight a research gap in specialized solutions for creative professions, propose the development of integrated systems based on machine learning algorithms, and hypothesize that AI implementation can improve professional training quality through personalized learning. The methodology of these studies is based on an analytical review of existing platforms and a comparative analysis of their functional capabilities, contributing significantly to the practical implementation of adaptive learning systems.

Additionally, the study by Kim N. P., Kim J., and Han M. S. [3] examines the potential integration of 3D printing technologies with traditional nail art methods. This research identifies a gap in the synthesis of digital technologies with practical skills in nail artistry. The study aims to assess the potential of 3D printing for creating innovative decorative nail designs, with its novelty stemming from an interdisciplinary approach that merges engineering methods with cosmetology practices. The authors hypothesize that these technologies will not only expand aesthetic possibilities but also improve specialist training quality, as confirmed by experimental studies and a comparative analysis of traditional and new approaches.

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Safety considerations related to the use of innovative technologies are discussed in the research by Bollard S. M. et al. [4]. The study focuses on assessing the risks of skin diseases caused by the use of UV lamps in manicure procedures, highlighting the research gap in integrating safety assessments into educational platforms. The study's objective is to analyze potential risks, and its novelty lies in a comprehensive approach to evaluating UV radiation exposure using statistical methods. The findings support the hypothesis that proper utilization of modern devices can minimize adverse effects.

The personalization of the educational process is a key focus of the study by Walkington C. and Bernacki M. L. [5]. The authors analyze theoretical and empirical approaches to adaptive learning, identifying a gap in the integration of individualized approaches within complex simulation environments. The study aims to develop models that consider learners' cognitive and behavioral characteristics, with its novelty reflected in the synthesis of theoretical concepts and practical adaptation algorithms. The authors hypothesize that personalized strategies in educational platforms enhance material retention, a claim supported by the study's methodology, which includes an analytical review and empirical validation of proposed models.

Modern trends in user modeling are explored in the work of Tan Z. and Jiang M. [6], which focuses on analyzing the potential of large language models for dynamic adaptation of educational systems. The identified research gap lies in the absence of comprehensive approaches to modeling user profiles in rapidly evolving digital platforms. The study's objective is to develop adaptive models that account for users' multifaceted characteristics, with its novelty defined by the application of advanced big data analysis algorithms for personalized feedback. The authors hypothesize that user modeling can improve the effectiveness of educational systems, a claim supported by analytical and empirical research methods.

The review by Skiba R. [7] analyzes current trends in cosmetology, including sustainability, environmental responsibility, and the integration of innovative technologies into beauty care procedures. This study identifies a research gap in the lack of interdisciplinary approaches that combine ecological standards with digital technologies in educational systems. The study aims to develop a comprehensive understanding of industry development, with its novelty evident in the interdisciplinary integration of these domains. The hypothesis suggests that merging ecological and technological approaches contributes to the creation of more efficient and sustainable educational platforms. The study is methodologically based on a comparative analysis of existing literature and case studies, enriching the theoretical foundation in this field.

Despite significant progress, a research gap remains in the absence of a comprehensive simulator for nail art training that integrates complex case modeling, practical skill assessment, and AI-driven personalized recommendations. Traditional training methods rely heavily on individual instructor experience, leading to inconsistencies in specialist qualifications and an increased risk of procedural errors.

The objective of this study is to analyze the feasibility of developing a simulator designed to train nail technicians in nail art application. The study's novelty lies in the extensive analysis and comparative evaluation of modern research on the development of intelligent educational platforms for simulating nail art application. This approach has made it possible to identify innovative methods for integrating practical techniques, modeling complex scenarios with AI-driven feedback, dynamically monitoring progress, and assessing professional skills with adaptive recommendations, thereby establishing a theoretical foundation for further empirical research in this domain.

The authors hypothesize that the integration of digital technologies in nail art training contributes to standardization and enhances the quality of specialist preparation, opening opportunities for further commercialization and implementation in beauty industry educational programs. The methodological framework is based on the analysis of existing research.

Conceptual Foundations and Modern Theories of Learning

The use of simulators not only enables the replication of real production conditions but also provides automated assessment and instant feedback, facilitating the accelerated acquisition of practical skills. These approaches have advanced further with the integration of AI, which can analyze completed tasks, identify common mistakes, and generate personalized recommendations for each trainee.

3D printing, IoT, and artificial intelligence in this domain demonstrate that modern devices can ensure reproducibility and high precision in the creation of intricate patterns. The implementation of IoT systems enables remote control of the printing process, allowing real-time data transmission and synchronization of hardware modules, which is particularly relevant for educational simulators that require immediate feedback. AI algorithms analyze the parameters of printed samples, comparing them to reference models, and automatically adjust the training process, reducing the subjectivity of traditional methods that depend on the instructor's qualifications [1,2].

The methodological framework and structure of the simulator are based on the principles of modeling, standardization, and continuous assessment of learning outcomes. The stages of simulator development are illustrated in Figure 1.

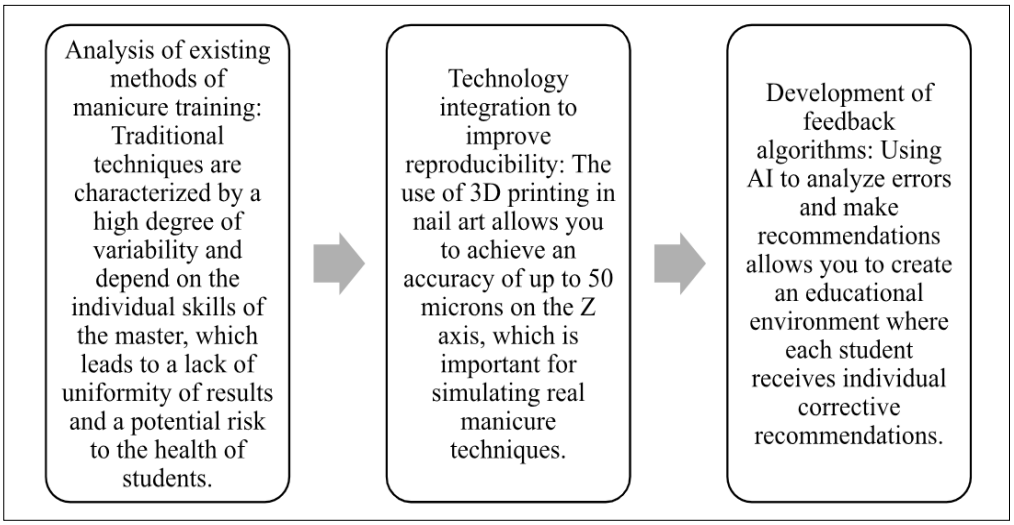

Fig. 1. The stages of development of simulators used in the process of applying nail art [1,2].

This methodology relies on an interdisciplinary approach that combines principles of engineering modeling, educational psychology, and modern information technologies. Such an approach ensures the creation of a simulator capable of not only reproducing complex nail art techniques but also establishing safety and quality standards in the educational process.

To provide a deeper understanding of the subject, a comparative analysis of the parameters of traditional manicure training methods and the proposed simulator, which integrates modern digital technologies, is advisable. The results of this analysis are presented in Table 1.

Table 1. Comparison of traditional methods and a simulator for manicure training using AI, 3D printing, and IoT [1-4,8].

Parameter	Traditional method	Simulator with AI, 3D printing, and IoT
Accuracy and reproducibility	High dependence on skill and subjective assessment	High precision through digital modeling (up to 50 μm)
Safety	Risk of exposure to harmful chemicals and prolonged UV radiation	Minimized chemical exposure through remote control and optimized processes
Personalized learning	Limited individual adjustment	Automated adaptation of methodology for each student based on AI
Feedback speed	Delays due to subjective instructor evaluation	Instant digital feedback with real-time error analysis
Economic efficiency	High costs due to extended training and individual instruction	Cost optimization through process standardization and automation

The presented comparative analysis highlights the advantages of the simulator, which are substantiated by theoretical foundations confirmed by modern research.

Functional Capabilities of the Manicure Training Simulator Using AI

The simulator is designed for practicing manicure techniques, modeling complex cases, providing automated feedback, monitoring student progress, assessing skills, and generating personalized recommendations.

The system architecture is based on a modular structure that integrates both hardware and software components:

Hardware component. The simulator utilizes a 3D printing device capable of achieving up to 50-micron precision along the Z-axis, ensuring high-detail reproduction of manicure techniques. This level of precision enables the recreation of intricate decorative patterns on artificial nails [3]. Additionally, an IoT module powered by a Raspberry Pi microprocessor is integrated, allowing wireless connectivity, real-time data transmission, and remote control of the printing process [2].

Software component. The core of the software system is an AI-driven algorithmic module that analyzes the results of practical work by comparing them with reference models. Machine learning algorithms automatically detect deviations in technique, assess the quality of decorative coatings, and generate recommendations for error correction [5].

The simulator enables the modeling of various manicure scenarios, covering both standard techniques and complex cases, including:

Simulation of different manicure techniques. The system supports the application of decorative elements, ranging from simple color compositions to intricate multi-layered textures that align with modern nail art trends [3].

Modeling complex cases. The simulator replicates the characteristics of curved nail surfaces, adjusting printing parameters to ensure accurate design application on non-

flat surfaces. This approach simulates challenges associated with working on different nail shapes, refining precision control over the technology [7].

Training with feedback, progress tracking, and personalized recommendations are key features of the simulator, ensuring continuous feedback and student progress monitoring:

Analysis of completed work. The AI module evaluates digital images of applied designs, comparing them to predefined reference standards. Based on detected deviations, the system generates a detailed report outlining specific errors and recommendations for improvement [1,6].

Dynamic progress tracking. The system maintains statistical records for each student, enabling the monitoring of skill development over time. Using machine learning algorithms, the training program adapts to the individual characteristics of each learner, ensuring more effective education [2,5].

Personalized recommendations. Based on error analysis and learning progress, the simulator provides customized recommendations to enhance technique execution, allowing trainees to refine their methods and achieve consistent results [4].

A comparative analysis of the functional blocks of the simulator and traditional manicure training methods is presented in Table 2.

Table 2. Functionality of the simulator for manicure training using AI [2,3,7].

Functional block	Description	Advantages of the simulator
System architecture	Integration of a 3D printer with 50 μm precision, IoT module based on Raspberry Pi	High-detail reproduction, remote control, real-time data transmission
Practical technique modeling	Simulation of various manicure techniques and complex cases, including work on curved surfaces	Realistic replication of work conditions, ability to practice complex scenarios
Feedback and monitoring	Automated analysis of completed work using AI, dynamic progress monitoring	Instant assessment, objective error analysis, personalized recommendations, adaptive training program

Thus, the simulator integrates advanced 3D printing, IoT, and AI technologies to create an interactive educational platform capable of replicating real-world manicure practice conditions. This enhances technique reproducibility, ensures timely feedback, and provides personalized learning, offering advantages over traditional training methods. The benefits of the simulator, including improved accuracy, reduced training time, and objective assessment of results, can be incorporated into curricula at specialized manicure colleges and academies. Furthermore, the automated feedback system minimizes dependency on instructor qualifications, making it particularly relevant for large-scale training programs.

CONCLUSION

The integrated system enhances the accuracy of manicure techniques, ensures result reproducibility, and reduces the time required to acquire skills compared to traditional training methods. By utilizing automated analysis of completed work and instant feedback, the simulator standardizes the educational process and adapts it to the individual characteristics of each learner. The findings confirm the hypothesis that digital transformation in beauty industry education can significantly improve the quality of specialist training and reduce operational risks associated with traditional methods.

REFERENCES

1. 12 Best AI platforms for training in 2025. [Electronic resource] Access mode: https://training.safetyculture.com/blog/best-ai-platforms /(accessed: 03/02/2025).
2. AI Sales Training Simulator Agent. [Electronic resource] Access mode: https://www.taskade.com/agents/sales/sales-training-simulator (date of request: 03.03.2025).
3. Kim N. P., Kim J., Han M. S. The convergence of three-dimensional printing and nail-art technology //Journal of Cosmetic Medicine. – 2019. – Vol. 3 (2). – pp. 94-101.
4. Bollard S. M. et al. Skin cancer risk and the use of UV nail lamps //Australasian Journal of Dermatology. – 2018. – Vol. 59 (4). – pp. 348–349.
5. Walkington C., Bernacki M. L. Appraising research on personalized learning: Definitions, theoretical alignment, advancements, and future directions // Journal of research on technology in education. – 2020. – Vol. 52 (3). – pp. 235-252.
6. Kim N. P., Kim J., Han M. S. The convergence of three-dimensional printing and nail-art technology //Journal of Cosmetic Medicine. – 2019. – Т. 3. – №. 2. – pp. 94-101.
7. Tan Z., Jiang M. User modeling in the era of large language models: Current research and future directions //arXiv preprint arXiv:2312.11518. – 2023. – pp. 2-12.
8. Skiba R. Advances in Cosmetology: Beauty Therapy Technology, Treatments, Sustainability, and Holistic Wellness. – After Midnight Publishing, 2025. -– pp. 4-38.