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# The Implementation of CAD/CAM Technology at Schools of Dentistry: A Short Communication

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**Abstract**

This short communication aimed to acquire and transmit information about inserting CAD/CAM technology in the dental school's curriculum to better prepare dental students for new approaches. The CAD/CAM system implementation has occurred slowly in the dental curriculum at universities. In 2012, authors evaluated the use of CEREC, showing an educational tool impacting the cost-effectivity for patients. A similar result was found in 2013, with an appreciation of the marginal fit and esthetic obtained. In 2014, CAD/CAM was incorporated into the predoctoral curriculum at the Indiana University School of Dentistry, showing good or excellent overall learning. In 2017, a CAD/CAM system was implemented at the University of Illinois at Chicago College of Dentistry's predoctoral implant program, which had an increased preference and proportion of implant restorations made digitally. In 2018, a German dental school used CAD/CAM in the curriculum of prosthetic education, obtaining a clear tendency for the use of this technology. In 2023, pre-doctoral dental students in the U.S.A. received a questionnaire that significantly improved their knowledge and attitude to using this technology; otherwise, student satisfaction was non-significant. In conclusion, integrating CAD/CAM technology into the curriculum has become an essential component of modern dental education.

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Technological advances, such as using software to assess laboratory work and simulate clinical scenarios,[1-3] have increased the predictability of treatments and quality outcomes. Implementing the computer-aided design/computer-aided manufacturing (CAD/CAM) system in the clinical

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dental field has revolutionized dentistry, enabling dentists to promptly create precise and accurate restorations, prostheses, and orthodontic appliances. This technology has also changed how dental education is delivered, as it has become an essential part of the curriculum in many dental schools worldwide. Since this technology has been well received and widely applied in private dental offices[4] with positive feedback, there is a modification in the perception and practice model. This fact has led to revisions in the dental school curriculum in order to incorporate new technologies into the teaching of dental students,[5,6] which is crucial for their future clinical practice.

CAD/CAM technology in dental education curricula has several benefits. Firstly, it provides dental students with hands-on experience in digital dentistry, preparing them for the technological advancements in the field. Secondly, it enhances the quality of dental education by enabling students to produce high-quality restorations with precision and accuracy. Finally, it reduces the time required to fabricate restorations, essential in clinical practice, where time is valuable.

However, its implementation has happened slowly, mainly when the subject is the insertion into the dental curriculum at universities. Since the 2010s, articles have demonstrated the results of its application in the academic environment. In 2012, the authors[7] presented the CEREC ("CEramic REConstruction") introduction at the University of Tennessee College of Dentistry. It was the first university in the U.S.A. to embrace and integrate this technology into the curriculum. The authors concluded this technology is an educational tool and impacts the cost-effectivity of patients. In 2013, there was the evaluation of dental students over one year who developed and provided 125 all-ceramic crowns to the patients.[8] The students worked on the design, milling, sintering, and stain of the CAD/CAM restorations. The results showed a significant reduction in the lab costs and increased faculty appreciation of the marginal fit and esthetic obtained. These same authors, in 2014, evaluated students[9] presenting to the incorporation of CAD/CAM into the predoctoral curriculum at the Indiana University School of Dentistry, showing after one year of the implementation. The overall learning was considered good or excellent by 80% of the students, and 43% judged themselves prepared to fabricate a crown independently.

In 2017, another study[6] presented the implementation of a CAD/CAM system in the University of Illinois at Chicago College of Dentistry's predoctoral implant program. The outcome showed an increased preference and proportion of implant restorations made digitally compared to the traditional way. In 2018, other authors10 evaluated the implementation of the technology in the curriculum of prosthetic education at a German dental school. More the 90% of the students participated in the CAD/CAM inclusion, indicating considerable interest and good clinical performance. The conclusion showed a clear tendency to use CAD/CAM to prepare restorations digitally.

Towers *et al*.[11] studied students' perception of virtual reality (VR) and 3D-printing combination for operative teaching. The results highlighted students' value for technology and innovative teaching methods translatable to clinical settings. The study also highlighted the importance of educator support. The impact of the teaching on the clinical procedure and the patient are notable, mainly to provide a valuable contribution to increasing students' confidence and preparedness.

Another recent study, published in 2023,[12] aimed to evaluate the pre-doctoral dental students' CAD/CAM-related education, knowledge, attitudes, and professional behavior. In addition, the authors contrasted the relationships among the years in dental school. 17 out of 68 US dental schools (25%) participated in a web-based anonymous survey (358 dental students). The questions asked about the subject and percentual obtained were: simulated exercises (86.9%), video demonstrations (81.8%), demonstrations during a lecture (76.4%) or for smaller groups of students (69.2%), hands-on (65.6%), and individual instruction (50.4%). It was possible to verify significant improvement in the knowledge and attitude front to the use of CAD/CAM technology ($p<0.001$ and $p<0.05$, respectively); otherwise, student satisfaction was non-significant.

**Conclusion**

In conclusion, integrating CAD/CAM technology into the curriculum has become an essential

component of modern dental education. It provides dental students with hands-on experience in digital dentistry, enhances the quality of dental education, and prepares students for the technological advancements in the field. Furthermore, it has been shown to improve clinical skills and increase confidence in dental students, which is crucial for their future clinical practice.

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No

**References**

1. S.R. Desai, K.D. Koulgikar, N.R. Alqhtani, A.R. Alqahtani, A.S. Alqahtani, A. Alenazi, A. Heboyan, G.V.O. Fernandes, M. Mustafa. Three-Dimensional FEA Analysis of the Stress Distribution on Titanium and Graphene Frameworks Supported by 3 or 6-Implant Models. Biomimetics. 8, 15 (2023). doi.org/10.3390/biomimetics8010015
2. G.V.O. Fernandes. *Editorial. J. Dent. Oral Sci.* 3(2), 1 (2021). doi.org/10.37191/Mapsci-2582-3736-3(2)-090
3. T. Marques, S. Ramos, N.B.M.d. Santos, T. Borges, J. Montero, A. Correia, G.V.d.O. Fernandes. A 3D Digital Analysis of the Hard Palate Wound Healing after Free Gingival Graft Harvest: *A Pilot Study in the Short Term.* Dent. J. 10, 109 (2022). doi.org/10.3390/dj10060109
4. M.B. Blatz, J. Conejo. The current state of chairside digital dentistry and materials. *Dent. Clin.* 63(2), 175-197 (2019).
5. M.A. Schlenz, K. Michel, K. Wegner, A. Schmidt, P. Rehmann, B. Wöstmann. Undergraduate dental students' perspective on the implementation of digital dentistry in the preclinical curriculum: a questionnaire survey. *BMC Oral Health.* 20, 1-10 (2020).
6. F.S. Afshari, C. Sukotjo, M.F. Alfaro, J. McCombs, S.D. Campbell, K.L. Knoernschild, J.C.-C. Yuan. Integration of digital dentistry into a predoctoral implant program: program description, rationale, and utilization trends. *J. Dent. Educ.* 81(8), 986-994 (2017).
7. M. Dehghan, J.F. Simon, J. Harrison. Integrating the CEREC technology at UT College of Dentistry. *J. Tenn. Dent. Assoc.* 92(1),19-21; quiz 21-22 (2012).
8. W.D. Browning, P. Reifeis, L. Willis, M.L. Kirkup. Including CAD/CAM dentistry in a dental school curriculum. *J. Indiana Dent. Assoc.* 92(4), 40-45,47 (2013).
9. P.E. Reifeis, M.L. Kirkup, L.H. Willis, W.D. Browning. Introducing CAD/CAM into a predoctoral dental curriculum: a case study. *Dent. Educ*. 78(10),1432-1441 (2014).
10. R. Schweyen, F. Beuer, M. Bochskanl, J. Hey. Implementing a new curriculum for computer-assisted restorations in prosthetic dentistry. *Eur. J. Dent. Educ.* 22(2), e237-e247 (2018). doi.org/10.1111/eje.12278
11. A. Towers, J. Dixon, J. Field, R. Martin, N. Martin. Combining virtual reality and 3D-printed models to simulate patient-specific dental operative procedures - A study exploring student perceptions. *Eur. J. Dent. Educ.* 26(2), 393-403 (2022). doi: 10.1111/eje.12715
12. F.J. Alhamed, G.F. Neiva, S.-Y. Bak, E. Karl, M.R. Inglehart. Pre-doctoral dental students' computer-aided design/computer-aided manufacturing-related education, knowledge, attitudes and behavior: A national survey. *J. Dent. Educ.* 87(4), 562-571 (2023). doi: 10.1002/jdd.13144