Boston University Henry M. Goldman School of Dental Medicine

# A Guide to Implement Digital Technology in US Dental Schools

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## Highlights

- This study will help to create a resource guide for implementation of digital technology within dental schools
- As technology evolves, it is of the upmost importance that dental schools integrate digital dentistry into their pre-doctoral curriculum

## Aims

The aim of this study is to create an applicable resource guide for dental schools that will lead to a pathway of success in implementing digital technology in pre-doctoral curriculum in US dental schools. Understanding how, when, and the cost to implement new technology into pre-doctoral education can integrate these advances in innovation with progressing educational standards of US Dental Schools.

## Introduction

Advancements in digital technology in a multitude of dental applications are transforming the dental landscape. The use of emerging dental technologies in private practice to provide state of the art, quality dental care along with a demand for these services from more informed consumers is currently driving dental institutions to include various forms of these technologies in their curriculum. Dental schools utilize digital dentistry for teaching didactic, preclinical and/or clinical skills based on general guidelines set by the Commission on Dental Accreditation. These guidelines recommend the “application of technology in dental education programs to improve patient care and to revolutionize all aspects of the curriculum, from didactic courses to clinical instruction”(1) and that "graduates should be able to evaluate, assess and apply current and emerging science and technology"(2)

It is important to note that the millennial generation of dental students can quickly adapt and frequently use emerging technologies. Studies comparing dental students vs clinicians find that 76% of students prefer digital impressions vs elastomeric impressions as compared to 48% of practicing dentists(3). Therefore, exposing dental students to digital dentistry will better prepare them for the future.

On the other hand, Incorporating these technologies in dental institutions can be challenging because of costs, variety of applications, and diversity of dental materials, faculty calibration, need for IT/updates, and more.

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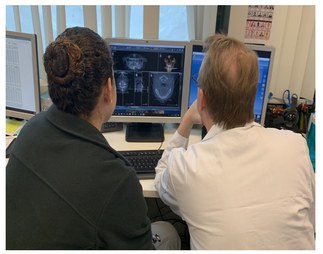
## Materials and Methods

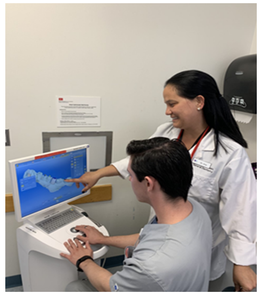
This project includes the review of literature and published research articles available on Digital Dentistry. We studied and evaluated the core data available regarding the key components in ACP such as curriculum, cost, calibration and other factors determining the success of implementation of different applications of digital dentistry in schools and in private offices. As digital technology encompasses a wide variety of applications, we narrowed down to Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) components for this project. CAD systems can be divided into 1) intraoral scanners (IOS) and 2) extraoral scanners (EOS) and CAM systems into 1)milling units and 2) 3-D printing units. We compared various IOS and EOS systems by cost per unit, units per users, faculty calibration, IT support, cost of implementation and procedures of use. We also compared milling units and 3-D printers by cost per unit, units per users/units needed, time for milling/printing, cost of materials and procedures of use. In addition, we compared the utilization of digital technologies through the preclinical didactic, preclinical lab, clinical didactic and clinical patient experience at Boston University to other responding dental schools.

## Conclusions

In conclusion, this guide outlines the key components required for implementation of digital dentistry into US dental schools. It analyzes the different digital dentistry procedures and equipment available that may be implemented based on the needs of each dental school. It also describes the crucial role of Calibration and IT in order to keep up to date with the fast changing and continuously revolutionizing world of digital dentistry. Finally, it assesses the approximate costs of CAD/CAM equipment needed for implementation.

Boston University is at the cutting edge of the digital technology evolution as the first US Dental School to acquire and implement the use of two surgical robotic devices for dental implant surgery. As technology evolves and improves the delivery of patient care, dental schools must supply the demand for knowledge into these areas to an already technologically savvy generation.





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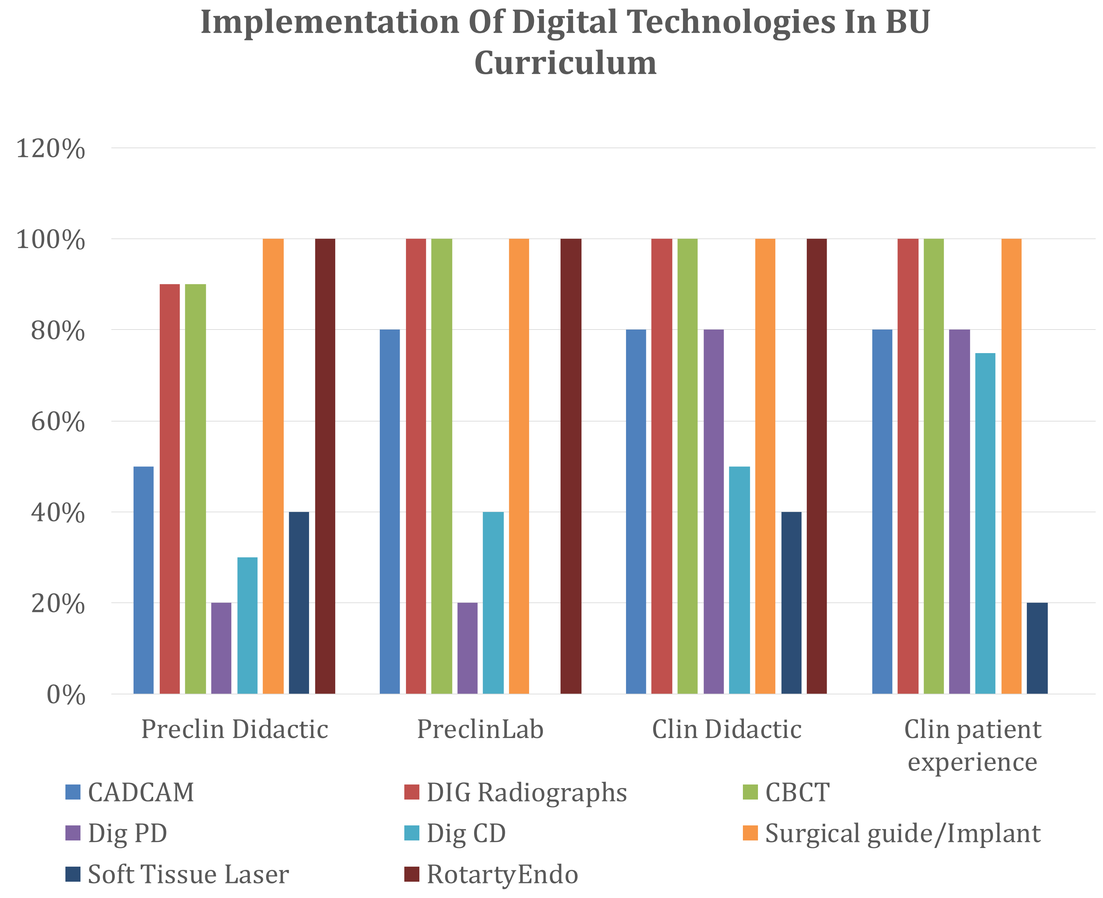
## Results

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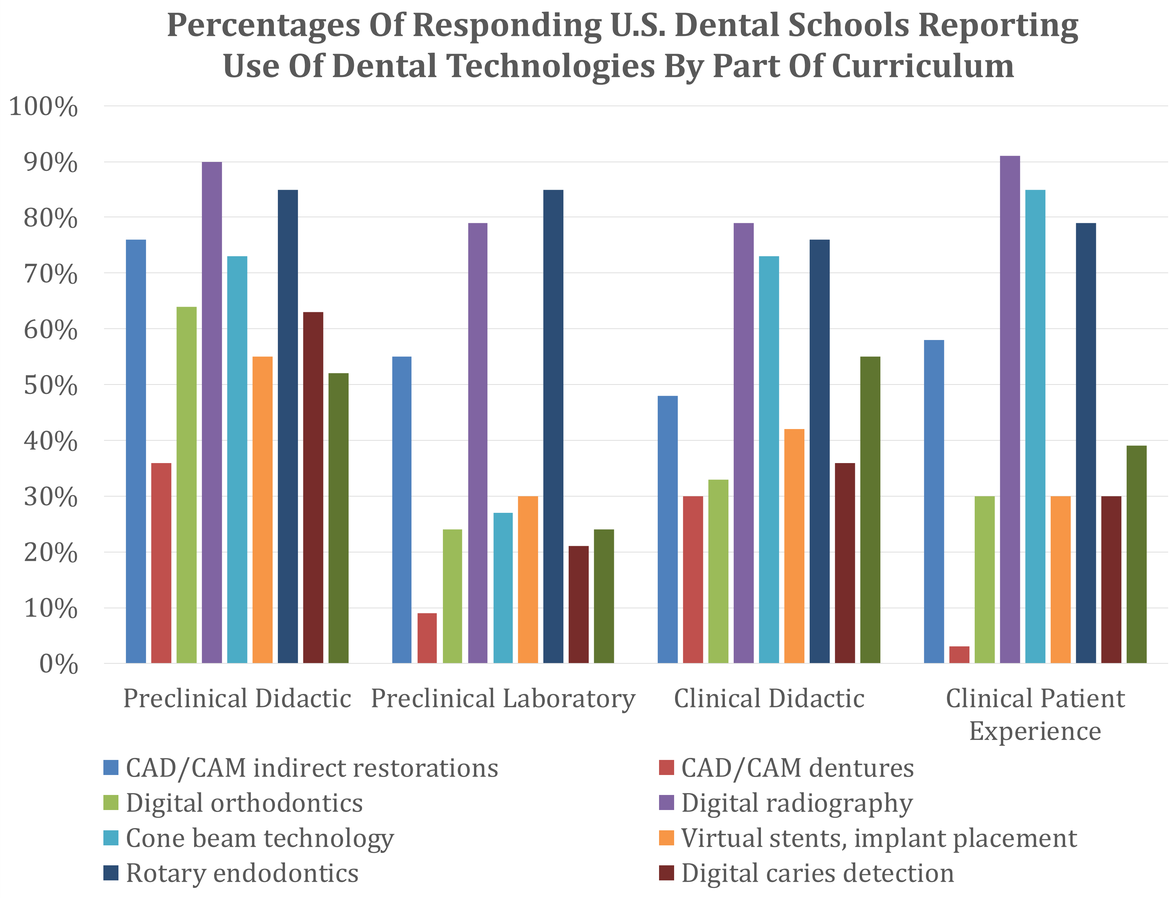

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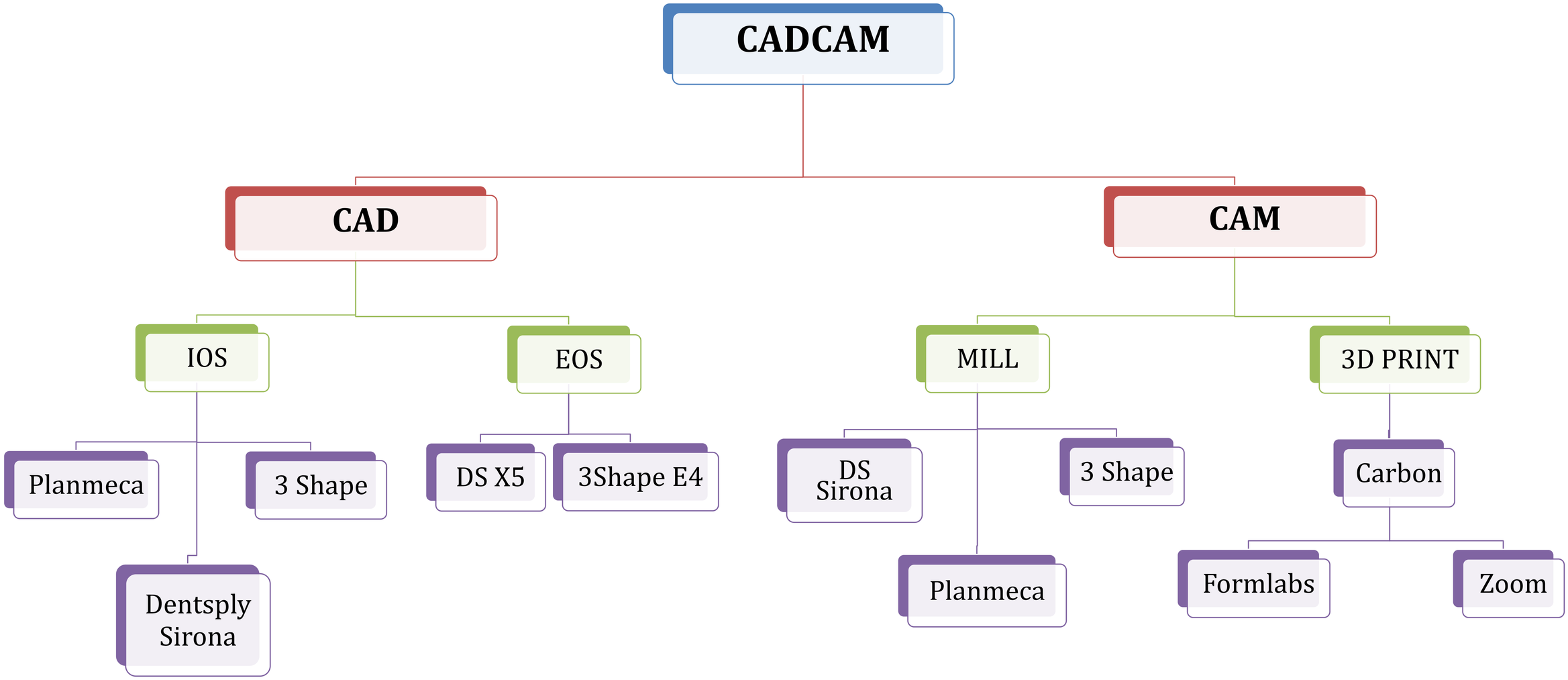

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# CADCAM - CAD

## IOS

| INFO | DENTSPLY SIRONA | DENTSPLY SIRONA | PLANMECA | 3 SHAPE |
|---|---|---|---|---|
| IOS Name | Omnicam | PrimeScan | | |
| Cost/unit | 23K | 70K | 35K | 3 35K 4 70K |
| No. of Users/unit | 4 | 4 | 4 | 4 |
| IT Support needed | Implementation for networking and reservation. Also every year for upgrades | | | |
| Customer support | First line in house IT, second company support. | | | |
| Total cost of implementation | 0 if local about 8 hours of labor | | | |
| Faculty calibration | Every 6 months and for new members | | | |
| Approx. No. OR % of private office using IOS | 22% new dental practices about 12% existing practices. | | | |
| Used for procedures | Crown and Bridge, Ortho, Implant Planning, Dentures (Prime and Trios 4 only) | | | |

## EOS

| INFO | DENTSPLY X5 | 3 SHAPE E4 |
|---|---|---|
| Cost/unit | 66K | 35K |
| No. of units needed | 1-2 | |
| Total cost of implementation | 0 | |
| Faculty/staff calibration | CDTS, Director | |
| Used for procedures | Cr, Br, temps, Dentures, Guides | |
| Approx. no./% of private office using IOS | 1% | |
| IT support | | |

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## CADCAM - CAM

### Milling Unit

| MILLING UNIT | DENTSPLY SIRONA | PLANMECA | 3SHAPE |
|---|---|---|---|
| NAME | MCXL | Open source | Open source |
| COST/UNIT | 30K | 15-20K | 15-20K |
| No. of units needed | 1 per 6 users | | |
| Cost of blocks/material | $40-$80 | | |
| Used for procedure | Cr, Br, temps, dentures, surgical guides | | |
| Time/ single restoration | 5-9 mins | 8-12 mins | 8-12 mins |

### 3D Printing

| 3D PRINTER | FORMLABS | ZOOM | CARBON |
|---|---|---|---|
| NAME of printer | Form 3 | | MD1/MD2 |
| Cost/unit | $4600 | $2800 | 25K/50K per year Lease option only |
| Cost of material | 1 pint resin $90 | | |
| Total cost of implementation | 0 | | |
| Faculty/staff calibration | CDTS/ Director/ Dentists | | |
| Used for procedures Time/ printing restoration | Surgical guides, Dentures, trays, NG | | |
| % of private office using 3d printing IT/customer support | 2% | | |

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