Adopting Holographic Technology and Virtual Reality into the Dental Curricula

Gerald Davis II, D.D.S., M.A.
Meharry Medical College, School of Dentistry

ABSTRACT & HYPOTHESIS

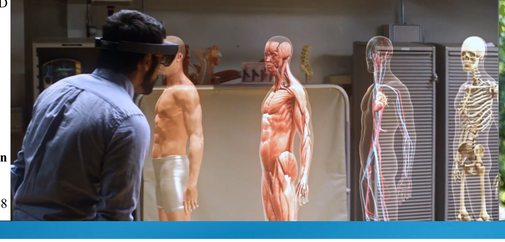
Meharry Medical College School of Dentistry is in the process of expanding its multimillion dollar dental simulation center to include holographic simulation technology. As an approved developer site for the Microsoft HoloLens, the curriculum will be adapted to allow students to gain insight into anatomic structures, surgical techniques for lesions/ implant placement, and local anesthesia administration. An interdisciplinary development team has already been assembled within Meharry; and this team has begun partnering with additional institutions in hopes of having a collaborative approach to advance students' understanding of dental concepts nationwide.

We hypothesize that the Holographic Simulation Center will help students visualize information in a unique and interactive way, thereby improving their: clinical injection techniques, surgical treatment and treatment plans, and NBDE Part I Dental Anatomy and Occlusion performance. Students will also demonstrate improved patient management behaviors and comfort with interprofessional collaboration.

CURRICULUM INTEGRATION TIMELINE BASED ON TECHNOLOGY INTEGRATION MATRIX

Characteristics of the Learning Environment	Levels of Technology Integration Into the Curriculum				
TECHNOLOGY INTEGRATION MATRIX	**Entry** The teacher begins to use technology tools to deliver curriculum content to students.	**Adoption** The teacher directs students in the conventional and procedural use of technology tools.	**Adaptation** The teacher facilitates students in exploring and independently using technology tools.	**Infusion** The teacher provides the learning context and the students choose the technology tools to achieve the outcome.	**Transformation** The teacher encourages the innovative use of technology tools. Technology tools are used to facilitate higher order learning activities that may not have been possible without the use of technology.
Active Students are actively engaged in using technology as a tool rather than passively receiving information from the technology.	Information passively received	Conventional procedural use of tools	Conventional independent use of tools: some student choice and exploration	Choice of tools and regular, self-directed use	Extensive and unconventional use of tools
Collaborative Students use technology tools to collaborate with others rather than working individually at all times.	Individual student use of tools	Collaborative use of tools in conventional ways	Collaborative use of tools; Some student choice and exploration	Choice of tools and regular use for collaboration	Collaboration with peers and outside resources in ways not possible without technology
Constructive Students use technology tools to connect new information to their prior knowledge rather than to passively receive information.	Information delivered to students	Guided, conventional use for building knowledge	Independent use for building knowledge; some student choice and exploration	Choice and regular use for building knowledge	Extensive and unconventional use of technology tools to build knowledge
Authentic Students use technology tools to link learning activities to the world beyond the instructional setting rather than working on decontextualized assignments.	Use unrelated to the world outside of the instructional setting	Guided use in activities with some meaningful context	Independent use in activities connected to students' lives; some student choice and exploration	Choice of tools and regular use in meaningful activities	Innovative use for higher order learning activities in a local or global context
Goal Directed Students use technology tools to set goals, plan activities, monitor progress, and evaluate results rather than simply completing assignments without reflection.	Directions given step-by-step task monitoring	Conventional and procedural use of tools to plan or monitor	Purposeful use of tools to plan and monitor; some student choice and exploration	Flexible and seamless use of tools to plan and monitor	Extensive and higher order use of tools to plan and monitor

Meharry School of Dentistry Timeline	Year 1 (2016-2017)	Year 1 (2016-2017) (Cont'd)	Years 2-3 (2017-2019)	Years 4-5 (2019-2021)	Years 6-8 (2021-2023)
Meharry Medical College Goals: Meharry Medical College has already begun implementing this program. Achievements to date include: . Sep. 2015- Began purchasing and testing 3D design and animation software. . Jan. 2016- Establishing the MMC President's Technology Taskforce (Partnership of OIT, alongside representatives for four domains of technology assessment: clinical, research, teaching, and administrative). . Feb. 2016- Applied for Microsoft HoloLens developer approval . April 2016- Received approval from Microsoft as a Developer Site (Wave 5). . April 2016- Established Interprofessional Collaborative Team . April 2016- Identified a vendor who will donate a 3D printer. . April 2016- Began evaluating file types in commonly used 3D dental applications (Cone Beam CT- DICOM, CAD/CAM, etc.) . May 2016- Purchasing of Vuzix M100 smart glasses . May 2016- Received approval from the MMC Board of Trustees . May 2016- Assisted faculty to test-run Vuzix in gross anatomy laboratory . June 2016- Began developing HoloLens applications using Microsoft software **The color of the cell in the table, corresponds to the years in which that particular aspect of the holographic technology integration process will occur in the curriculum.** Blue: Yr. 1, Purple: Yrs. 2-3, Orange: Yrs. 4-5, Green: Yrs. 6-8	. Receive Microsoft Inc. HoloLens hardware. . Purchase additional computers with Windows 10 for the sole purpose of holographic application development. . Identify 1-2 representatives from each class to utilize the HoloLens for enhancing their ability to analyze: 3D CBCT renderings of surgical sites for addressing pathology and determining dental implant placement. . Instructor guided teaching of Medical and Dental students through demonstrations of: cadaver dissections in gross anatomy lab, dental laboratory procedures, and surgical procedures while wearing smart glasses.	. Formally adopt the holographic technology through the grand opening of the Holographic Simulation Center. . Purchase 3D iSense scanner. . Establish a holographic database image collection. . Begin scanning key images/objects to be added to holographic image database. . Begin engaging our collaborative external partners through plans to implement model at other institutions. . Create comparative dental anatomy application for HoloLens. . Implement student usage of 3D design software for the practice of digitally designing 3D teeth.	. Obtain specialized holographic camera thereby allowing multiple students to view same images as wearer/user simultaneously. . Purchase additional HoloLens units. . Utilize HoloLens while assisting during an oral surgery procedure (after determining best methods for infection control). . Students begin interacting with holographic simulation patients. . Students begin utilizing distance learning and simulated teledentistry through the use of the holographic technology at other institutions. . Formal grades given for HoloLens utilization within several preclinical and behavioral didactic courses: 1) D2 Analytical Reasoning and Critical Thinking, 2) D2 Biomedical Integration, 3) D2 Dental Implantology, 4) D3 Behavioral Management	. Integrate the HoloLens into clinical setting for patient anxiety control measures. . Establish simulated holographic injection technique application with collaborative partners (incorporate 3D printing to tangibly foster this process). . Begin administering formal holographic examinations to assess students' knowledge. . Students are allowed to explore their own ideas for various uses of the technology. . Utilize this technology within the Operating Room (develop any additional applications needed for this process).	. Students develop holographic dental portfolios. . Continue to upgrade all systems/products at least every 3-years. . Quality assurance assessment of surgical cases that utilized holographic technology compared to those that did not.



COLLABORATION & RESOURCES

. Our timeline for accomplishing the integration of holographic technology into the curriculum is based on the Technology Integration Matrix established by University of South Florida.

. Financial Resources will be provided through the Meharry Technology Taskforce Budget. Initially totaling $3,000, the total final estimated cost will approach $100,000. This does not include maintenance upgrades.

. There are three levels of collaboration: Internal Collaboration, Inter-Institutional Collaboration, and Vendor Collaboration. Internal Collaboration consists of faculty (an oral surgeon, prosthodontist, anatomist, and two general dentists), staff (OIT, additional personnel), students (representation from medical, dental, and graduate studies). Inter-institutional Collaboration: Tennessee State University, Mountain View Community College. Vendor Collaboration: Microsoft, etc.

. A team of 15+ people will commit approximately 100 man hours per week total.

OUTCOMES

Outcome measures for the successful Integration of holographic technology into the curriculum include:

. Improved NBDE Part I Student performance on the Dental Anatomy and Occlusion section based on national average

. Improved digital crown design in CERAC with little to no faculty assistance

. Less post-operative complications after oral surgery procedures that utilized CBCT

. Improved first time pass rate performance on Implantology final clinical competency exams

. Decrease in the number of anesthesia carpules students utilize due to inappropriate injection technique

. Faculty and students' improved comfort level with the use of digital 3-D technology

. Development of additional creative uses for holographic technology

. Successful completion of any/and all intended goals listed within the Technology Integration Matrix