

8-25-2016

# USAGE FREQUENCY OF SUPPLEMENTAL MULTIMEDIA RESOURCES TO COMPLEMENT STUDENT LEARNING PREFERENCES

Diana Elaine Graham

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This thesis is approved, and it is acceptable in quality and form for publication:

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**USAGE FREQUENCY OF SUPPLEMENTAL MULTIMEDIA RESOURCES TO  
COMPLEMENT STUDENT LEARNING PREFERENCES**

**BY**

**DIANA ELAINE GRAHAM**

**B. S., DENTAL HYGIENE, UNIVERSITY OF NEW MEXICO**

**THESIS**

Submitted in Partial Fulfillment of the  
Requirements for the Degree of

**Master of Science  
Dental Hygiene**

The University of New Mexico  
Albuquerque, New Mexico

**July 2016**

## **DEDICATION**

This thesis is dedicated to:

### **My husband Zachary Graham –**

Zach, you are my hero and my all-time favorite part of life. Thank you for your love, unwavering support, cheering me on, coaching me through confidence interval calculations, and being confident in my abilities.

I'm so lucky I get to be your wife, I love you.

### **My family and friends–**

I'm thankful to my parents who gave me the opportunities for higher education and the motivation to work hard for whatever I wanted to achieve. To both my parents and the whole Graham-Fam, all that Zach and I are, we owe to you.

Thank you from the bottom of our hearts.

My siblings (both blood and gained by marriage) and friends, thank you for the fun and laughter to fill the much-needed stress relief. Oh, the adventures we will have now!

### **My work family –**

Missy, Stephanie, Lisa E, Ingrid, Emilia, Johanna, Lisa M, Jennifer, and Lisa K: Each of you has held me up in some way along this journey. Whether it was not letting me give up, covering me so I can write my life away, hanging literal carrots above my head at my desk with the word Master's, or typing 363 emails from a listserv (Thank you Ingrid!), I would be nowhere without you. I am the luckiest girl alive to know and work with such bright, intelligent, and kind young women. I don't deserve you, but I'm glad I have you anyway. I owe you all the gratitude this world has to offer. This thesis is dedicated to each of you. And may we never forget, we are

**“Always Better Together!”**

## ACKNOWLEDGEMENTS

This thesis has been an uphill passage to the very end, but it was not completed alone. I want to take the opportunity to acknowledge those who have impacted my research journey.

I first want to express my gratitude to my thesis committee for their guidance and supportive counsel. To my Committee Chair Christine Nathe, RDH, MS – I want to warmly acknowledge your patience with me as I ebbed and flowed throughout my graduate education. Your leadership has made a lasting impression and will forever impact my professional endeavors. Dr. Charles Tatlock, DMD, MPH – your research insight and verbiage repertoire is astonishing; thank you for your valuable intellectual recommendations. Paige Jensen, RDH, MS – I want to thank you also for your valuable recommendations, constant enthusiasm, and most importantly, your friendship.

You each have had progressive involvement in my professional development and your contributions will stay with me throughout my career. Thank you.

Melissa Plese, RDH, MS – Never have I had such a supportive, intelligent, and generous mentor like you. You saw potential in me, and because of you, I am part of an infallible team. Thank you for mentoring my growth and development as an educator and teammate as you set a new standard for dental hygiene education. Your leadership is astonishing, and I am in awe of you daily.

Stephanie Baca, RDH, MS – You have got to be one of the smartest people on the planet. I learn something new from you every day. Thank you for your helpful advice, stimulating ideas, and oh, all those parking passes!

Lisa Esparza, RDH, MS – Your way with people is inspiring, and your love for laughter is infectious. Thank you for reviewing my survey and showing me that one does not simply “whip up” statistically sound research questions. And thank you for the never-ending support and encouraging me to take the time I needed to achieve this accomplishment.

You three believed in me, and often times, I have no idea why. Most importantly, you are forever my friends. I hope I’m half the woman you are when I grow up. Again I say, I owe you all the gratitude this world has to offer. And may we never forget, we are

**“Always Better Together!”**

John Pesko, Ph.D. candidate and consultant for the UNM Statistics Counseling Clinic, you are a statistical genius. Thank you for teaching this science-minded dental hygienist that statistics is not impossible. I appreciate your patience with my constant emails and comprehension obstacles as well as your effective instruction modalities.

Terri Nelson, thank you for editing my thesis in the early stages of development. It was so beneficial to have someone outside of the specialty review my work for audience comprehension. I am thankful for a friend like you and appreciate your valuable intelligent advice.

And lastly, Susan Jones, RDH, MS, my colleague and friend, thank you for taking the time out of your busy professional life to edit my thesis; you are brilliant and I was honored to have your input. You have left a positive imprint on my life, and I will never be able to fully express my gratitude for your time and your friendship.

*“A river cuts through a rock not because of its power, but its persistence.”*

**Jim Watkins**

*“I’m a success today because I had a friend who believed in me, and I didn’t have the heart to let him down.”*

**Abraham Lincoln**

# **USAGE FREQUENCY OF SUPPLEMENTAL MULTIMEDIA RESOURCES TO COMPLEMENT STUDENT LEARNING PREFERENCES**

**by**

**Diana Elaine Graham**

**B. S., Dental Hygiene, University of New Mexico, 2009**

**M. S., Dental Hygiene, University of New Mexico, 2016**

## **ABSTRACT**

Implementing multimedia learning can be an effective way to teach difficult concepts to a diverse student audience with various learning styles. The objective of this study was to quantify the use of multimedia resources as well as the most common avenues of delivery in dental hygiene (DH) education. In addition, this study evaluated any educational delivery methods that may be required by the responding programs to determine if MMR use is standard practice in DH education.

This study followed a descriptive quantitative primary research approach. Invitation to participate in a 42-item electronic survey facilitated through *SurveyMonkey* was emailed to 316 U.S. DH program directors (PDs) of all degree levels. The questionnaire addressed faculty classroom facilitation including types of digital resources, the frequency of use, and barriers faculty face in creating or directing access to multimedia resources (MMR). To assess faculty use of MMR as a standard practice, the survey evaluated existing requirements regarding digital resources.

78 PDs completed the survey yielding a 25% response rate. A high majority reported using video formats: 59 (76%) reported using *YouTube* videos and 60% reported using faculty created videos. Fifty-one percent of faculty post lecture podcasts and 44% of

programs are using e-textbooks. While 51% indicated there were no barriers experienced using MMR, 43% cited slow internet connections. The results showed a high percentage (79%) of PDs feel the use of MMR will become standard practice for dental hygiene education with confidence interval values of  $.713 \leq p \leq .871$  for .90 levels. Conversely, only 23% of PDs stated they do not require faculty members to use MMRs in their respective courses yielding confidence interval values of  $.697 \leq p \leq .858$  for a .90 confidence level.

These findings deliver insight into the most common media instructional strategies and are significant to DH education due to the increasing faculty awareness of the evolving learning style preferences for current DH students that include multimedia resources, especially video formats, for curricular supplementation.



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## CHAPTER 1: INTRODUCTION

As the world embarks upon sixteen years into the new millennium, it is a common observation that technology is the driving force of many aspects of daily living. As technology has drastically changed lives within the past decade, so has it begun to change the higher education system. Collegiate students are entering an era where they are no longer bound to a classroom or library to review materials from an instructor, as most data is available through a continuous digital connection. Recent research on education methodologies is discovering that college students' learning styles are evolving with this digital age and requires audile and visual modalities be included, if not fully replace, traditional classroom lecture. Cognitivists explained that the addition of multimedia in the classroom will improve the learning process of students as they *see* concepts in action (Michelich, 2002). Since the new generation of learners identifies with this digital era and demands the use of technology in the classroom, teaching modalities must adapt to become compatible with digital multimedia resources. This study will examine the use of supplemental multimedia resources in the dental hygiene education curriculum through surveying dental hygiene program directors across the country.

### ***Statement of the Problem***

The following question guided the research:

*“Has the use of supplemental multimedia resources become standard for dental hygiene classroom education to support learning preferences of the digital age millennial collegiate student?”*

This general question absorbed the following related question:

*“Are dental hygiene program faculty mandated to use various formats of multimedia as supplementation to classroom lectures?”*

### ***Significance of the Problem***

As the current generation of learners demands the use of technology in the classroom, teaching modalities are evolving to be compatible with digital multimedia resources. This allows instructional materials traditionally distributed solely in the classroom to now be readily available outside of the classroom. Students’ quest for digital knowledge and evolving learning styles is at the forefront of education research and was addressed at the 2014 American Dental Education Association’s (ADEA) annual conference, *“The Science of Learning”*. As dental hygiene educators face the challenge of teaching a generation that has grown up using the internet, the curriculum must move forward to meet the evolving needs of student learning.

Recent educators’ gatherings relay consistent reports of teaching obstacles with students in higher education to include: the lack of motivation, initiative, and self-regulated research to promote life-long learning. Often, the dental hygiene educational curriculum is presented in static, text-book reading format, the least preferred way of the newest generation attending these institutions. During traditional lectures, professors often rely on static PowerPoint slides to present materials. This fails to compensate for the dynamics of the development, pathology, and treatment of oral health (Miller, 2014). Educators face the challenge of having to teach a generation that has grown-up using the Internet. The average student from this generation has not known life without computers or gone without instant gratification of instant knowledge. The current generations of college students are more visually literate and are more inclined to piece information

together from multiple resources than have a linear track of learning (Oblinger & Oblinger, 2005). Since lack of self-directed textbook dissection is an observed student obstacle, educators must now take a new approach to change the realm of higher education teaching.

Audio narration and vivid animation can help students visualize conceptual information (SEG Research, 2008). Dr. Miller, Assistant Professor at the University of Louisville, observes student transitions from the first semester of Anatomy and Physiology which involves memorization of basic terms, such as skeletal muscle, to the second semester, that moves towards basic functions including cardiac and respiratory physiology. While some students transition well, others have difficulty visualizing all steps of a process or integrating how multiple variables can affect the outcome (Miller, 2014). This is parallel to the challenges that dental hygiene students face in the various stages of their education. Courses such as *Dental* or *Oral Anatomy*, though difficult, can be mastered with dedication and memorization of key concepts. Many students find difficulty progressing from concept to application when performing dental hygiene clinical assessments of the hard tissue and surrounding periodontium.

Multimedia learning can be an effective way to teach difficult concepts to a diverse student audience with a variety of learning style preferences. Online modules, such as videos, could be used as course supplements to facilitate the learning style and convenience of today's collegiate student, as well as saving valuable class time for more difficult objectives. The addition of multimedia in the classroom may improve the learning process of students as they are able to *see* the concept in action thus supporting the overall visual learning style preference of the new generation of collegiate students

(Michelich, 2002). Dental hygiene educators can use this knowledge to guide their use of technological decisions. By creating these resources, professors can augment text-based material and simulate the subject matter of objectives that may be difficult for students to visualize otherwise. Supplemental videos provide educators the opportunity to motivate student learning by bringing educational concepts alive, which brings interactivity to an otherwise stagnant text material (Hartsell & Yuen, 2006).

Traditional curriculum objectives in dental hygiene education programs propose vast amounts of content to learners in restricted lecture times. The courses offered through these professional programs include many hours of clinical rotations requiring essential critical thinking skills for patient care. However, traditional didactic lectures are currently limited in their ability to address these complicated issues in a timely manner due to restricted classroom hours each week. Online multimedia materials, such as instructional videos, can be advantageous as they not only allow the professor to reach many students but also allow for necessary individual repetition of complex material” (Miller, 2014). Mastery of all concepts is critical for successful completion of a dental hygiene program. Recent research proposes active learning in the classroom is the key avenue to promote critical thinking and concept mastery.

A common proposal of collegiate level educators is to redefine the inner workings of the classroom to facilitate active learning, giving students time to collaborate with peers, and assessing for student competence, as opposed to simply delivering information. Dental hygiene professors must stimulate active learning in the classroom with objectives that include self-directed learning of evidence based patient care to more



adequately promote students' clinical critical thinking skills. This will, in turn, allow the students to be more engaged in their learning process.

This research study will attempt to identify what (and how often) multimedia resources are being used as supplement in the dental hygiene classroom. In addition, this study will evaluate if any educational delivery methods are required by the responding programs. These questions will assess the use of multimedia through a series of questions, facilitated through an online survey, to program directors of dental hygiene programs across the United States. It will also quantify the use of multimedia resources in the curriculum as well as their most common avenues of delivery. Results of this research study will deliver insight into the most common curricular instructional strategies based on responding dental hygiene programs.

### ***Operational Definitions***

#### **Multimedia Resources (MMR)**

Formatted content that uses multiple forms of formatting: text, audio, still images, animation, video, or interactivity content forms

#### **Asynchronous Learning/Study**

Students learning or reviewing material outside the constraints of physical class time; Allows opportunity for not going at the same rate or exactly together with something else

#### **Commission on Dental Accreditation (CODA)**

The American Dental Association, Commission on Dental Accreditation serves the oral health care needs of the public through the development and administration of standards that foster continuous quality improvement of dental and dental-related educational programs (ADA, 2015)

#### **Learning Preference**

An individual's unique approach to learning based on strengths, weaknesses, and preferences and used in the process of learning and assimilation of information

## **CHAPTER 2: REVIEW OF LITERATURE**

### ***Introduction***

The new generation of student learners strongly identifies with the evolving digital era and demands the use of technology in their classroom. In 2012, over 73% of the population of collegiate student enrollment comprised of the millennial generation. This group represents distinct learning preferences that are changing the environment of the collegiate classroom (NCES, 2013). By defining the qualities of specific generational learning preferences, availability of multimedia resources, and mobile learning, this review of literature will seek to identify the efficacy, advantages, and disadvantages of professors adapting their current teaching modalities to include the use of multimedia resources as an adjunct to the classroom. If digital multimedia resources can significantly increase student interest by enabling visual learning, academic institutions must be ready to facilitate the evolution of curriculum delivery away from standalone, traditional lecture format.

### ***Review of Literature***

#### ***Generational Demographics of Current Collegiate Enrollment***

The past three American generations have been studied at length in academic literature reviewing generational differences in evaluation of economic practices, academic cognitive abilities, and social characteristics. Though not all theorists are consistent with name labels or years included in each generation, the most common definitions are: Generation X, born from 1965 to 1979, Millennial or Generation Y, born from 1980-1997, and the up and coming, Generation Z, born 1998 to current day (Robey-Graham, 2008) . Generational differences are theorized to encompass a 20-year time

frame and persons born during this interval share common characteristics (Barbour, 2009). Borges et. al summarizes the Howe and Strauss statement that people within a generation will share similar characteristics because their environment shapes their views of the world (Borges N. J., Manuel, Elam, & Jones, 2010). A look at these generations and their characteristics may help better understand the evolving needs of today's collegiate students.

Defined by cynicism, Generation X students have a stereotype of being me-oriented entrepreneurs who are independent, pragmatic and skeptical (Lancaster & Stillman, 2003; Robey-Graham, 2008). Their respect is earned by character and relationships rather than positions or job titles. This generation mistook familiarity with diversity for acceptance and respect. Educators find difficulty in helping these students see issues of oppression and social constructs because they often view it as "not their problem." Generation X individuals tend to trust only those who they know personally and especially distrust those closely connected to formal organizations. This generation's character cynicism heightens feelings of distrust (Robey-Graham, 2008). These Generation X characteristics are valid concerns as the number of nontraditional students currently enrolled in collegiate courses is higher than ever.

Contrastingly, millennial students are seen as structured rule followers who are confident, pressured, achieving, team-oriented and respectful. In addition, Millennials are thought to be community-focused problem solvers who want to address and right societal issues. Lancaster and Stillman theorize that, compared with previous generations, Millennials have a greater need to belong to social groups, to share with others, stronger team instincts, tighter peer bonds, and a greater need to achieve and succeed (Lancaster &

Stillman, 2003). Others suggest that Millennials may have less need to influence others and ensure that their ideas prevail compared with Generation X students. One study compared responses of Generation X students with those of millennial students on a 16 Personality Factors (16PF) questionnaire. Observed results noted that millennial students scored higher on several personality factors including perfectionism; rule consciousness; sensitivity; and warmth. Generation X students scored higher on self-reliance (Borges N. J., Manuel, Elam, & Jones, 2006). Four years later, the same researchers conducted a study theorizing that current, younger generations would score higher on cognitive ability during efforts to compare motives of medical school students between Generation X and Millennials. Specific motives for

- achievement – surpassing excellence standards
- affiliation – sharing with others and restoring positive relationships
- and power – the desire to influence others, were evaluated.

Generation X-ers scored higher on the motive of power while Millennials had a higher affinity for achievement and affiliation (Borges N. J., Manuel, Elam, & Jones, 2010). As 73% of all students enrolled in college in the year 2012 identified as Millennials, their learning preferences and personality characteristics are the most crucial for educators to understand.

Presently, children ages 17 and below belong to Generation Z. Though this generation is still fairly new to their predecessors in the millennial generation, many unique characteristics are surfacing. Generation Z students are technology fluent; these children and teenagers will not be able to distinguish the difference between offline and online since mobile devices keep them connected the majority of the time. This

generation is expected to possess a global mindset as they are highly connected to multicultural influences. Being raised with technology at hand, they are continually connected. A recent survey involving 400 adults (age 18 and above), 200 teenagers between the ages of 13-17, and 200 children between the ages of 8-12, showed the majority (72%), reported using television multiple times per day. In the teenage population specifically, 76% reported using their mobile cell phones multiple times per day, and 50% used a computer or laptop several times a day. Generation Z is equally emotionally attached to their technology; between 75-78% of respondents reported they would miss their devices greatly if they were taken away (Palley, 2012). Their reluctance to disconnect will be evident in their educational environment. With the oldest of this generation ready to enroll in postsecondary education, professors are confronted with an imminent timeline to create learning materials that comply with Generation Z demands.

Current student enrollment in postsecondary academic institutions is largely comprised of Generation X and Millennials. The National Institute of Educational Sciences has tracked a 24% increase in new enrollment in postsecondary degree-granting institutions from 16.6 million students to 20.6 million from 2002-2012. The percentage of 18 to 24-year-olds enrolled in college rose from 37% in 2002 to 41% in 2012. Of the 20.6 million students enrolled in degree-seeking institutions in the United States, roughly 216,000 were between the ages of 14-17; however 73% of enrolled students can be identified in the millennial generation age range of 18-29 with over 15.1 million students. Just fewer than 1.7 million of students enrolled in college in 2012 belong to Generation X (the age range in the survey fell between the age limits for the generational definitions restricting concrete statics data). Lastly, in the same year, 3.5 million students enrolled in

degree-seeking institutions were age 35 or older, limiting discernment of concrete Generation X or later generational data (NCES, 2013). By defining the demographics of the collegiate atmosphere, and further understanding generational characteristics of students, professors can attempt to evolve their teaching methodologies to keep pace with the quickly transforming student learning methods.

### *A Closer Look at the Millennial Generation*

To understand the evolution of learning style preferences in today's average college student, there are several factors of this generation, referred to as Millennials, which should be evaluated. Of the 21 million students enrolled in American colleges and universities in 2014, the average age of students enrolled was 25 (NCES, 2012). The millennial generation ranges in age from age 19 – 36 and is also referred to as “Gen Y” or “Gen Me” (Pew Research Center, 2014). In February of 2014, the Pew Research Center conducted a survey of 1821 adults nationwide and concluded several identifiers for this generation. Millennials are independent with the highest level of disaffiliation on record. With increasing detachment from political parties (50% are political independents) and religious affiliations, Millennials are unattached to their learning institutions, in the traditional sense, and require the ability to learn on their own timelines. In general, this generation is “relatively unattached ... [They are] linked-in to social media, burdened by debt, distrustful of people, in no rush to marry, and optimistic about the future” (Pew Research Center, 2014). Of the respondent millennial generation, 26% were married, 69% say they want to marry, but feel they lack what is required, especially pertaining to a solid economic foundation. Today, Generation Y marriage rates are higher among those with larger incomes and more education. They are also the most racially diverse

generation in American history. Specifically, 43% are non-white; a factor that researchers say explains their political liberalism. Only 19% of Millennials think people are trustworthy in comparison to 31% of Generation X (ages 34 – 54), and 40% of Boomers (ages 55-64) (Pew Research Center, 2014).

Millennials are the first in the modern era to have higher student loan debt, poverty, unemployment, and lower levels of wealth and personal income than their immediate predecessor generations. However, they are shown to be optimists about the economy so they continue to enroll in college. This generation has taken the lead in using the new platforms of technology to place themselves at the center of self-created networks for social media to network with friends, colleagues, and affinity groups. For example, 81% are on *Facebook*, the world's most popular social networking site (Pew Research Center, 2014). In order for an instructor to cultivate habits of success in their students, it would fare well to understand the inner workings of the general habits, personality traits, and learning preferences of the average collegiate student.

### *Learning Styles*

Examining the science of learning is crucial to understanding the need for evidence-based principles in the design of effective instruction and how it applies to healthcare professors. Multimedia learning is explained through the cognitive theory of multimedia learning as information processing through words and pictures and holds high relevance in medical education. This theory of learning maintains three research-supported principles: 1) the *dual channels principle*: a proposal that people have different channels of information processing for verbal and pictorial material, 2) the *limited capacity principle*: learners can only process a few elements in each channel at one time,

and 3) the *active processing principle*: meaningful learning only happens when someone is engaged in a cognitive process of organizing into cognitive representation, being attentive to relevant material, and integrating with prior knowledge. Those three principles allow three types of human information processing: 1) sensory memory that holds an exact sensory copy of presented material for an averaged  $\frac{1}{4}$  of a second, 2) working memory, a more processed version of material for a short time, less than 30 seconds, and can only process a few pieces of information at a time, and 3) long-term memory that holds the learner's entire wealth of knowledge (Mayer, 2010).

Since working memory process has limited capacity, information must be grouped together in order to effectively retain learned material. The cognitive theory of multimedia learning continues to explain that information dissemination via a multimedia resource (MMR) is received first by the eyes and ears and stored in sensory memory. If the learner starts *selecting words or images* important to the task, then it is moved to working memory as sounds and images. The learner then *organizes words* by rearranging words into a cognitive model, *organizing images* by rearranging for optimal memory retention. Lastly, the learner begins to *integrate* both verbal and pictorial models of the multimedia source with prior knowledge for maximum learning and long-term memory (Mayer, 2003; Mayer, 2010).

Learners may need assistance in carrying out the cognitive process for memory retention of presented information; this is crucial information for professor's instructional modalities. Creating MMR for instructional objectives will also eliminate the extraneous process in learning, where cognitive processing that does not pertain to the learning objective occurs as a result of poor instructional design. An example of extraneous



processing is when the text explanation of an objective is on one page, and the illustration on another. Cognitive processing is wasted by alternating between the pages. If too much extraneous processing is allowed, there is not enough remaining capacity for productive cognitive processes. An essential quality of the use of MMR is that it activates the generative cognitive process which aims to make sense of the presented material, and its commitment to long-term memory is regulated by the student's motivation to learn the material. Understanding the cognitive theory of multimedia learning offers insight to effective instructional design in the use of MMR in the classroom (Mayer, 2010).

Adult learners are primarily independent and self-directed in what they learn. A study conducted in 2002 regarding attitudes of student learners determined a student preference for web-based learning (WBL) over text material; the most significant factor of learning satisfaction was downloading speed (McCann, Schneiderman, & Hinton, 2010). In a research study comparing the effects of educational interventions on competence of nurses in giving patient education with gastroscopy procedures, the experimental group of nurses was given a multimedia CD-ROM to learn from and the comparative group of nurses was only given a pocket text booklet. The average learning satisfaction of the nurses with the multimedia CD-ROM group was significantly higher than that of the group only receiving the pocket booklet with text for their first post-test after intervention (Kao, Hsu, Hsied, & Huang, 2012).

#### *Learning Preferences of Specific Generations*

Effective teaching can be challenging as student learning is multifactorial. Learning style inventories are information processing models that aim to identify a student's preferred intellectual approach in assimilating and processing information.

There are several learning style indices used in higher education models to determine a student's preferred learning style. The VARK, one of the most popular and introduced by Fleming, identifies a learner into one of the following four preferred learning modes: visual (V), aural (A), read/write (R), and kinesthetic (K) to describe how a student uses their senses in information gathering. Visual learners process information more effectively when graphic images and videos are used while auditory learner preferences give attention to the spoken word and prefer to listen more than taking notes. Read/Write learners prefer to read printed text and are exceptional at taking notes while kinesthetic preferences encompass hands-on experiences including touch and interaction. Research demonstrating the benefits of the VARK model administered the assessment to medical students and found that 87% of the 100 participants were multimodal-having more than one learning preference (Prithishkumar & Michael, 2014).

Research has revealed that Millennials are predominately visual learners (Oblinger & Oblinger, 2005). These students try to make sense of presented material by constructing a coherent mental representation (Mayer, 2003). Addition of multimedia can improve the learning process as the students get a front row seat to the teaching modules—giving them a one-on-one instruction feel. A video alone may not be more effective than a textbook for a learning objective. A study conducted at Virginia Commonwealth University observed highly sustained learning in subjects who participated in the simulation-based videos on scenarios simulating clinical treatment and attribute the success to the application of Paivio's Dual Coder Theory (DCT). DCT explains an interconnection between verbal and nonverbal pathways of information processing. If equivalent emphasis is placed on nonverbal or imagery form (imagens) in conjunction

with verbal or written form (logogens), the use of visualization will enhance learning and recall (Hartland, Biddle, & Fallacaro, 2008).

Digressing back to dissecting the characteristics of specific generations, today's average college students are digital natives in that they have not had to adapt to technology. However, learning preferences differ drastically between the last three generations of student learners.

Generation X, ranging from 35 to 50 years of age, experienced small class sizes and introduction of new technologies during elementary and secondary education. The classroom was able to focus on the individual and more creative projects were developed. This generation tends to confuse cynicism with critical thinking and has a voracious appetite for information. Bored by theories, principles and foundations, Generation X-ers are focused on the outcome and prefer technology-aided learning. This generation faces factors that challenge their learning endeavors such as their cynical view of organizations and policies. Though they are willing to take on new responsibilities, they will often only commit to small projects while avoiding projects with long-term needs. Since rapid changing technology has always been a part of their lives, they are easily attracted to new gadgets (Robey-Graham, 2008).

The Millennials are true digital natives, and they have earned this label. The average person from this generation has not known life without computers, the Internet, or the ability to gain instant gratification from this instant knowledge. Being a digital native has influenced the way this generation processes information and is responsible for the detachment of their learning institutions. They are visual communicators as well as quick responders, and they expect a rapid response in return.

Access to technology is assumed by this generation. In conjunction with the evolution of instant gratification in search of knowledge, Millennials characteristically carry a sense of entitlement (Pew Research Center, 2014). This does not exclude their feelings of delivery and accessibility in their academic environment. A full third of older Millennials (ages 26-33) have a four-year college degree or more – making them the best-educated cohort of young adults in American history. To them, educational attainment is highly correlated with economic success (Pew Research Center, 2014). Interpreting how the millennial generation processes information is crucial to their success and will influence how motivated and engaged a student responds to the presented material.

Millennials need instant gratification and may become impatient when material is not always at their fingertips. This generation is more visually literate and more inclined to piece together information from multiple resources rather than have a linear track of learning (Oblinger & Oblinger, 2005). Comfort swarms these students in visual image environments more than with text formats (Twenge, 2009). These students are entertainment oriented; they will not want to learn if it is not entertaining (Sweeney, 2006). This is where interactive multimedia learning systems are expected.

The University of Pennsylvania, School of Medicine conducted a study to analyze the success of the introduction of an online, interactive learning module which would completely replace the dental morphology course for preclinical dental students. Traditional lectures were transferred into interactive media format with access to the *3D Interactive Tooth Atlas* program. This study found the independent interactive digital media group (treatment group) had a grade point average of 95.4 (with no failures on the final examination) versus an 88.1 average (with a 5% fail rate on the final examination)

for the group learning via lecture based course model. The results yielded that the interactive media module was student preferred and equally as effective as traditional lecture (Maggio, Hariton-Gross, & Gluch, 2012).

Previous generations accessed information and engaged with course material through textbooks, syllabi, lecture notes and printed articles paving a distinct linear learning process. Digital learners can access content and engage with lecture slides, narrated PowerPoint presentations, applications on electronic devices, and online through videos, electronic articles, blogs, *Google*, and e-books, with minimal use of textbooks or a course syllabus. This group's preferred learning process is categorized as random non-sequential (Saeed & Rodriguez, 2014).

Millennials focus on standardized test scores but feel they are entitled to good grades. They respect those who help them but expect authority figures to fix things for them, such as grades or conflicts with others. Information dissemination is often mistaken for learning. Millennials expect to control what, when and where they learn (Robey-Graham, 2008). This generation frequently skips steps in research and tends to stop after preliminary searches by skimming articles without reading thoroughly. They need interactive learning experiences where they can embrace technology in learning.

Faculty members may motivate their millennial students to learn by using group activities where they can apply course content and learn by doing; this provides students with relationship-building opportunities in the classroom or online that contribute to collaboration and teamwork. Achievement-oriented millennial students will also expect that faculty clearly specify educational goals and desired learning outcomes in the basic science and clinical curricula, and may express a strong need for feedback to monitor

their progress and accomplishment. If Millennials are less motivated to influence others, faculty members may need to pay attention to adding more classroom activities and online experiences that allow their students to engage in leadership skills development (Borges, Manuel, Elam, & Jones, 2010).

However, both Generation X and the millennial generation differ from Generation Z in that digital connections are essential with 90% of Generation Z students; they are unwilling to disconnect from the internet and further value this mobile technology more than money, materials, and real-world activities (Palley, 2012). Though vastly different in characteristics, all three generations have been enveloped by the digital age. Technology is giving instructors an opportunity for changing their approach to education. Active learning could be included in these opportunities.

### *Active Learning*

Active learning, a teaching method mentioned on numerous in this literature review, is defined as a combination of e-learning and instructor-led learning and sometimes referred to as blended learning. The basis of active learning is that learning should not be a passive activity done individually outside of the classroom. Interactivity within the class encourages engagement with the material. Reasons for active learning implementation are well defined by the famous quote from Benjamin Franklin, “Tell me and I forget. Teach me and I remember. Involve me and I learn.” Lectures are effective if used to synthesize information from multiple resources and disseminate common material as well as set the context or clarify complex concepts. Active learning allows faculty to become learning facilitators, not just distributors of course content and addresses the need for collaboration amongst classmates.

Multimedia can be used to facilitate a collaborative learning environment. Active learning can be influenced by the use of multimedia to promote discussion and reflection for active learning in the classroom. For healthcare school environments, active learning can include self-directed learning of evidence based patient care to increase critical thinking abilities. The intent of the implementation of active learning is critical thinking and decision-making skills that are necessary to provide effective and efficient dental hygiene treatment. Throughout the curriculum, the educational program should use teaching and learning methods that support the development of critical thinking and problem-solving skills (CODA, 2014). The Commission on Dental Accreditation (CODA) develops and evaluates the progress of the standards in which all dental and dental auxiliary fields must comply within the accredited program. Active learning is the solution to mastery of the CODA standards 2-20 and 2-22 for dental hygiene programs:

#### **ADA CODA Standard for Dental Hygiene**

**2-20** Graduates must be competent in the application of self-assessment skills to prepare them for life-long learning. Intent: Dental hygienists should possess self-assessment skills as a foundation for maintaining competency and quality assurance (CODA, 2014).

**2-22** Graduates must be competent in problem solving strategies related to comprehensive patient care and management of patients.

The American Dental Education Association (ADEA) also has developed “Core Competencies for the Entry into the Profession of Dental Hygiene” that are widely used by the majority of accredited programs in defining specific program competencies (American Dental Education Association, 2011). Active learning through collaboration also addresses the following ADEA core competencies:

## **ADEA Core Competencies (C) for Dental Hygiene**

**C.3** Use critical thinking skills and comprehensive problem solving to identify oral health care strategies that promote patient health and wellness.

**C.6** Continuously perform self-assessment for lifelong learning and professional growth.

There are, however, limitations of blended learning. Some research suggests that students performing at a higher level may already have appropriate learning techniques and be unaffected by accessory methods (Miller, 2014). Rebecca Cox, author of *The College Fear Factor: How Students and Professors Misunderstood One Another*, argues that the nontraditional student currently in college cannot be summed up with traditional-aged students. She suggests that these students are inherently intimidated by the idea of college. But most importantly regarding active learning, among expectations of tough classes and remote faculty, these students expect to be lectured to and view active learning activities as a waste of their time (Cox, 2011).

### *Digital Age*

Technology is the driving force of many aspects of daily living and has drastically changed lives within the past decade. There is a possibility that student learning methodologies have evolved due to the equally radical evolution of technological devices and ways of processing information. Cell phones and *Google* emerged into popularity in the late 1990's while *Facebook* was created in the year 2004, and the first *iPhone*, the leading device in smartphones, was launched in 2007 (Saeed & Rodriguez, 2014).

The Internet is now also referred to as *WEB 2.0*. This nickname, coined by Tim O'Reilly in 2004, describes the evolution of static pages that just allowed for retrieval of



information into the use of technology that allowed content to be easily generated by the user (O'Reilly, 2005). This new software encompasses digital applications, including social media tools, which enable interaction and collaboration amongst users, especially students. For example, *Twitter*, an online social networking service established in 2006, allows users to send short messages called “tweets”. The site enjoys global popularity as even national news media and professional organizations use *Twitter* feeds. Healthcare professionals use the site to receive quick responses to questions and communicate activities (Wink, 2009). Educators are now using *Twitter* as a vehicle for conversation and collaboration in their classrooms. Instructors can set up a *Twitter* account for a specific class, set usage rules, and promote guidelines for professional behavior during discussion while encouraging group reflection. The social network is also being used for informal quizzes and polls during lecture (Forgie, 2013).

The 21<sup>st</sup> century has made immeasurable amounts of information readily available to students. Today's learner demands to be involved and engaged anytime and place of their choosing. With the addition of technology in the classrooms, faculty can utilize multimedia resources to create opportunities for students to interact with a variety of educational content individually or with their peers.

### *Technology in the Collegiate Classroom*

Multimedia resources extend beyond a static PowerPoint presentation and into dynamic visual and audio content. These files are formatted content presented in multiple forms: text, audio, still images, animation, video, or interactivity content forms. A combination of multiple file formats can be dispensed to students simultaneously especially in a case where some students may respond more favorably to printed words

near corresponding graphics. Multimedia learning exists in several industries of the health care profession today including nursing, medical, and dental fields as well as non-medical sports training, and military organizations. Faculty members can structure lessons into learner-controlled segments that allow for the elimination of extraneous material giving more time to highlight essential material. A study surveying dental students found students had high expectations for digital learning formats as additional educational resources (Eynon, Perryer, & Walmsley, 2003). These resources provide asynchronous material that is readily available for a student to access at their own time discretion. Cognitivists believe that the addition of multimedia can help improve the learning process of students when they see concepts in action (Michelich, 2002).

Multimedia resources are best utilized as a classroom supplement to presented material.

As digital learners, computer-based instruction (CBI) or computer-aided instruction (CAI) increases interactivity and provides for anytime, anywhere learning (Oblinger & Oblinger, 2005). CBI is not limited to making lecture material available to the student, but also includes the use of online learning management systems such as *Blackboard* and *WebCT*. These programs run from internet based software that manages the delivery and tracking of e-learning for an institution (McCann, Schneiderman, & Hinton, 2010).

Popularity of digital learning even has the attention of major textbook publishers. These companies have quickly developed digital versions of their published material into what are referred to as e-books (electronic textbooks). Piles of heavy small print textbooks are being replaced with the use of a home personal computer, laptop, or a tablet that not only houses the text from the published book, but is updated with more images,

charts, and links to alternate online resources and interactive self-assessment quizzes that enhance visual learning.

Having e-books exclusively available to students is a growing trend in educational institutions. In theory, this could be driven by the overwhelming demand for digital learning material from current collegiate students; but, it might also be an avenue in choosing more affordable course materials. The Higher Education Opportunity Act (amendments to HEOA 1965), effective July 2008, enacted many authorizations to increase transparency of cost for students in higher education institutions. One of the provisions includes textbook information (cost) is mandated to be available to students more quickly (U.S. Department of Education, 2008). Most e-books can be found at a lower listed price than the published hard copy. In some instances, you can rent temporary rights to the text for a less than owning the digital rights. Multimedia resources have never been more readily accessible with the addition of electronic textbooks, and will be a trend that continues to grow in collegiate education.

With the availability of multimedia resources facilitated through online management systems, digital learners are growing comfortable with a mobile learning (m-learning) environment, or e-learning. This is the use of mobile technology through tablets, small computers, and smartphones to deliver multimedia resources such as online modules, podcasts, videocasts, and self-assessments. Though embarking in the direction of the learning preference of the current college student, there are distinct disadvantages to mobile learning. For instance, it may be difficult to deliver material when files are too large to stream and must therefore be downloaded to the mobile device prior to use. Students using Wi-Fi may have limitations to the amount of available data. A resource's

existing format must also be compatible with all types of devices and operating systems. Though research of e-learning at Michigan State University found no differences between e-learning and traditional learning, the experimental group of students agreed that the learning modules could serve as replacement for live lectures (Solomon, Ferenchick, Laiard-Flick, & Kavanaugh, 2004). The University of North Carolina, School of Dentistry found similar results involving 75 first-year dental students in a radiology course in three different test groups: interactive CD-only, interactive CD and lecture, and lecture only. Even though there were no differences in post-test scores of either group in measurement of knowledge gain, the combination group indicated a preference for the interactive CD (Howerton WB, 2004).

To complement lecture material with e-learning, instructors can create podcasts, a digital recording of a lecture that can be solely auditory or an audio-visual combination that is linked to classroom management sites and made available as a downloadable file for mobile listening. Some instructors may choose to record the live lecture and post after the lecture concludes. Instructors may also link an audio-only file to an existing slide presentation. Podcasts are best when used to complement course content instead of replacing it. One advantage of making a podcast available to students is the convenience for students that support both asynchronous access and delivery. These resources can be assigned as a requirement to access and allows easy tracking of participation. For faculty, podcasts are quick to develop alongside existing lecture material, they are relatively inexpensive to produce, and rarely require editing (Stiffler, 2011). A disadvantage to these types of resources is that students tend to multitask more while listening to a podcast than when reading material (Wood, 2010).

On-demand student self-assessment is on the rise in popularity for information retrieval with today's college students. Previous learning theories suggested that learning occurred during episodes of studying, and retrieval of information during testing does not accurately assess what was learned. Current research contradicts this view by demonstrating that information retrieval practice is actually a powerful mnemonic enhancer, often producing large gains in long-term retention relative to repeated studying. Retrieval practice is often effective even without feedback (i.e. giving the correct answer). In addition, retrieval practice promotes the acquisition of knowledge that can be flexibly retrieved and transferred to different contexts. The power of retrieval practice in consolidating memories has important implications for both the study of memory and its application to educational practice (Roediger & Butler, 2011). To aid in learning via retrieval practice, some institutions have integrated social media to allow students to create and exchange student-generated material. The offered theory is that in order to construct an assessment, the student must seek and then master content knowledge. *PeerWise*, a website with growing popularity in dental schools, is a platform that allows students to do just that. Students may author and edit multiple choice questions, (the site offers tutorials on the anatomy of a good multiple choice question), answer peer created questions, provide and receive feedback, comment on questions, and rate peer created questions.

A study conducted by the University of British Columbia School of Dentistry followed students' required participation using *PeerWise* as a course requirement. The students were required to create a minimum of seven questions and answer a minimum of 35 questions. Among their results, the researchers reported the class created an average of

8.73 questions (with 24 being the highest number of created questions) and answered an average of 86.64 questions (with 276 being the highest). Their findings concluded that the students overall enjoyed the experience by learning from their peers, answering questions to gain course knowledge, having a mix of topics, and having the freedom to use the website outside of class, on their own time. The students liked answering questions much more than creating them. A few comments of concern that accompanied using this online self-assessment program for a grade in the course included: tendency of difficulty in creating questions, spending more time than expected, and an overwhelming feeling to answer all available questions (Richardson, Bergmann, & Walker, 2014).

Educators now link many types of media games to follow posted podcasts or live, in-class lectures either for graded assignment or self-assessment reflection since there is documented value found in frequent questioning. Instructors can facilitate live audience participation through many online sites; *Poll Everywhere* is a no cost example. This site allows students to vote via texting to the online server during class. The instructor can gauge the class mastery as well as spark discussion over the current topic being presented. Another media game example is Jeopardy that can be created through many different platform sites; *SuperTeacherTools.com* is the most popular. This creates an interactive way to review information while engaging the students in reflection. With the overwhelming popular use of smartphones and tablets, many companies are creating study games for different specialties of healthcare through various applications. For example, most healthcare professions require the taking and passing of a licensure board examination. *PassIt! Dental Hygiene* is a for-cost application available to any dental hygiene student who wants extra practice before taking the National Board Dental

Hygiene Examination. It offers over 1200 multiple choice questions with answers and explanations. Students can easily download media games to refresh material and study while waiting during various daily activities.

The use of videos as a supplemental teaching method is a growing practice in education today. There have been studies that produce favorable findings in the effects of supplemental videos that simplify complex ideas using animation in student performance. Students can tap into their visual and auditory senses to learn complex concepts while being engaged with a concept in motion. Audial and visual senses direct an individual's learning styles and can enhance the learning experience for concepts that are unable to be seen with the naked eye and difficult to explain with just text. Videos can be essential supplemental learning modules to aid understanding while saving valuable class time.

Recent accessible software has allowed instructors to bring animation into the classroom and help bring a visual stimulus to a standalone lecture by creating an avatar; an avatar is a computer generated digital character that uses graphics technology to represent a human. This avatar can starkly resemble the creating instructor, or be a fictional character, that moves, walks, and adds nonverbal communication cues to the avatar creator's spoken word. For example, *Voki Classroom* allows an instructor to create a customized speaking animated character while facilitating classroom management software. Khan Academy, a nonprofit educational organization, also offers the software for instructors to create an avatar for teaching needs. Additionally with this site, students can create an avatar for their learning profiles. The advantages of creating an animated avatar are: it is new technology that is interesting and appealing to millennial learners, they can be faster to develop than video clips, and avatars have been found to increase

student participation. One disadvantage cited is the software expense. There are free versions of software on the Internet, but they often restrict the use of the avatar into downloadable files needed to disseminate information to the students. Once created, these files are very large (Wood, 2010).

During a presentation at the Closing Plenary Session of the Annual Session for the American Dental Education Association (ADEA), Desai, a medical educator for Khan Academy, explained why videos can be critical to the teaching of difficult objectives while giving examples of Khan Academy's motto that "repetition exemplifies retention" (Desai, 2014). Hartsell and Yuen (2006) describe video supplementation using the Joint Information Systems Committee report of 2002, relaying that video streaming can be analogized to the phrase "a picture is worth a thousand words" as moving images bring reality to presented material. Advances in technology have made creation and streaming of videos more user-friendly with faster downloads and universally compatible software.

Current research infers that technology can overcome many of the barriers to learning that Millennials may face in the classroom, but technology alone cannot deliver the vast amounts of necessary knowledge to student learners. Other university professors are convinced that technology is a mere distraction in the classroom, disguised as a helpful tool. Theodore Roszak, a retired professor from California State University, was quoted warning that, "what kids need to learn, and what teachers must commit themselves fiercely to defending, is the fact that the mind isn't any sort of machine... We should remind our children ... that more great literature and more great science were accomplished with the quill pen than by the fastest microchip that will ever be invented" (as quoted by Bugeja, 2007).



### *Video Media Supplementation*

Audiovisual resources can be a powerful communication tool in the classroom for student learning. Videos have been a viable solution for delivering instructional materials to students through technological advances including increasing bandwidth, user connection speeds, compatibility, and easy to use software - provided that the students have adequate training, comfort with computers, and online support (Hartsell & Yuen, 2006; Martindale, 2002). Audio narration and vivid animation can help students visualize a demonstration of a physical process or reveal relationships between two ideas (Denning, n.d.). As Siegel, Omer, and Agrawal investigated replacing written text of a case study to a brief video case, they hypothesized that adding the video component would lead to a greater increase in data exploration (searching for clues and determining differential diagnosis) and cognitive processes in problem-based learning for pediatric residents. Videos stimulating the cognitive process proved to be true in their results finding that the video group spent more time discussing the actions in the video and determining patient diagnosis (Siegel, Omer, & Agrawal, 1997).

Videos displaying animations may be advantageous by using visual cues to highlight specific components. Students can slow down or speed up various processes to emphasize concepts that are otherwise invisible to the naked eye (Miller, 2014). Specifically for dental hygiene curriculum, many of the taught dental hygiene assessments and clinical skills are performed subgingival (below the gingival tissue) blinding the clinician from visual evaluations. Animated videos can allow the student to visualize the internal process of patient care therapies. Many researchers advise that videos should be asynchronous, meaning they can be downloaded for later viewing and are done on an individual's independent time schedule outside of the classroom.

Advances in technology have made creation and streaming of videos more user-friendly with faster downloads and universally compatible software.

A few researchers argue that while videos may help promote learning in students with high visual orientation in their learning styles, a standalone video is unlikely to be more effective for teaching information than a book. They suggest that viewing context for the message within the text, i.e. using the media as supplementation to an instructional presentation is a critical factor in fostered learning (Denning, n.d.). What teachers and learners do with the media presentation and the accompanying message are much better predictors of educational effectiveness than whether the presentation is a video, lecture, reading of a textbook, or an alternate multimedia resource. Students may be motivated by the choice of media potentially influencing successful engagements in learning activities (Denning, n.d.).

Professors can use computer captured videos with programs like *Camtasia* (TechSmith), software that produces high-quality multimedia in various formats to project a particular process as lecture supplements to ensure the learners grasp and understand concepts. With a microphone to include audio narration and tools to draw attention on screen, one can take still images, even from a PowerPoint presentation, and converge into an interactive video lecture. This particular software also allows one to create interactive quiz questions to be administered during lecture and also provides the opportunity for students to test their knowledge during independent study. Incorrect answers return the student to the correct video segment for review and prevent continuing with the lecture until concept mastery is accomplished through the quiz. To use material that has already been created, there are open source programs available, meaning they are

available via a public web domain, and free to use. Multiple options exist for software use, many at no cost, allowing an educator to bring concepts to visual life. A few examples include *YouTube*, MedEd PORTAL, and Khan Academy (ADEA, 2014).

Khan Academy is an online platform that facilitates independent asynchronous learning by offering practice exercises and instructional videos (Khan Academy, 2015). This company's mission is to facilitate mastery-based learning through repetition resulting in retention. Registered students have access to videos created by credentialed professionals to refresh unused information prior to expanding upon a progressing concept. Interactive online games are also available and can be helpful tools in mastery-based learning. In one example, for health care, Khan Academy created a cardiopulmonary resuscitation (CPR) simulation game in which one must recall clinical skill in sequence to save the avatar. Instructors can set up a progress tracker through Khan Academy learning dashboard. This platform will monitor and verify use of different resources and facilitate instructor given assignments, giving the student and educator current reports of progress. With the use of multimedia resources similar to the ones housed within Khan Academy, educators can transition from traditional educational classroom lecture setting to being readily available to facilitate learning via multiple pathways of desired learning styles.

#### *Advantages of Video Media*

There are many advantages to using video media supplementation in collegiate academic curriculum, both in and outside of the classroom. With the use of multimedia, educators are creating content that is more appealing to today's learner by offering a more diverse and visually appealing form of instruction beyond the textbook (Hartsell &

Yuen, 2006). Educators can provide a synchronous lecture experience that generates interest and stimulates imagination with educational concepts through media resources, especially video media. Animation may help develop analytical skills relative to the topic.

Some may argue that more advantages exist for students outside of lecture time. With easily accessible media resources to aid understanding, students are not solely dependent on instructor's time to re-explain already covered objectives. Students can access the videos asynchronously, individually returning to material at their desired frequency, and in an independent location. They then have the authority of when to begin, pause, or replay at will any component of the video to ensure comprehension (Hartsell & Yuen, 2006). The information can be made interactive and include formative and summative assessments. This opportunity for visual repetition can allow student clarity of what is being viewed.

The learners can be expected to preview, receive or respond to the material as an assignment prior to further in class discussion or as a stand-alone assignment to facilitate active learning methodologies. For example, *Think-Pair-Share* is a method where instructors can ask a question about the viewed material then have students pair with a peer to discuss their responses and open to classmates for discussion. Use of multimedia outside of the classroom has created new opportunities for active learning explained later in this review.

#### *Limitations of Video Media*

There are some limitations to the utilization of audiovisual media. Unless the file is a streaming video, being viewed live via the Internet, these files may be quite large and

take a long time to download. This would result in the need for faster processing computers and high-speed internet capabilities to facilitate the information processing. Streaming allows the file to be downloaded into smaller buffered sections so media player software (i.e. Window Media Player) will play the sections into a stream, avoiding large cached files that require being downloaded to a personal computer (Hartsell & Yuen, 2006; Klass, 2003) . Once the streamed file has been viewed and the user closes the web-based application, the physical file does not remain on the individual's hard drive and can only be accessed by the web. If support is not readily available, it is difficult to sustain streaming video in academic institutions because of limited access to technology including bandwidth size and knowledgeable experts to help maintain media (Shepard, 2003; Hartsell & Yuen, 2006).

Even if qualifications exist for quick facilitation of the media files online, there may be conflicting qualifications for operating systems of device platforms. Historically, there have been issues between files created on a device using *Apple* technology being compatible with an *Android* operating system, and vice versa. Additionally, students must have access to some type of technology to be able to benefit from available resources. Though heavily popular with the millennial generation, not all students have access to mobile devices, such as smartphones and tablets, or home Internet that allows access to platforms to facilitate web-based material.

Lastly, one significant disadvantage of multimedia resources, from an educator's perspective, is simply the amount of time required for the creation of these resources. Though many files already exist and can be used for viewing immediately, information is always evolving and instructors have various alternative ideas and methods of explaining

different curriculum objectives. Emphasis, teaching style, and timeline are factors that would require an individual teacher to create their own media resources. Many instructors are already deficient in the resource of time to integrate vast amounts of knowledge and concepts into an already compact course load. Considering the time commitment in creating these files, the aforementioned Dr. Cynthia Miller, who has spearheaded video implementation in the lectures at the University of Kentucky, argues that while time invested in the creation of a video may require significant preparation time, the time invested may be advantageous to student success, particularly for at-risk students” (Miller, 2014).

#### *Online Teaching Modules: E-Learning, E-Curriculum*

The use of multimedia resources has not only made strides in increasing visual stimulation and student interest in learning, but it has also quickly evolved the presence of online learning, often referred to as e-learning, web-based learning (WBL), or distance learning. Distance instruction is characterized in multiple ways including by a division in place and/or time between the learner and the teacher or by the student and the learning resources (Mitchell, Gabbury-Amyot, Bray, & Simmer-Beck, 2007; National Center for Education Statistics, 2011). This option is also described as an active delivery of learning material via a form of electronic media that can include a combination of text, audio, visual, animation, and images (Wood, 2010).

Online learning can be beneficial for all collegiate students utilizing technological advances to reach the adult learner outside of a traditional classroom. 61% of two-year and four-year degree granting post-secondary institutions offer online or other distance education courses and account for 12.2 million enrollments (NCES, 2011). Individuals

seek to advance their education concurrently with their busy lifestyle or employment. This allows for the enrollment of more nontraditional students into universities providing increased access and individualized pace. A nontraditional student may have family or employment commitments coinciding with pursuing education, and self-paced access removes that roadblock. A report generated in 2001 by the American Association of University Women (AAUW) Educational Foundation found that women constituted the majority of distance learners in part because of the flexibility and minimal costs while saving on child care costs (Mitchell, Gabbury-Amyot, Bray, & Simmer-Beck, 2007). Universities have poured efforts into trying to create new avenues to deliver curricula to students in remote areas and to nontraditional students as well as appeal to the millennial learner (Grimes, 2002).

E-learning is now widely used in healthcare schools as either a supplement to in-person lectures or a standalone course in which one's physical presence in class is not required. The interactivity of online learning can help maintain a student's interest and motivation to continue with the material. Research indicates that web-based learning increases student preparation, confidence, retention of knowledge, problem solving, and (student) engagement. Similarly, research has also demonstrated that students have trouble progressing from basic rote memorization to conceptual reasoning and problem-solving (Miller, 2014). The opportunity for repetition allows for practice and reinforcement that may increase student learning where traditional class lectures may not afford time allowances. Two different avenues in which educators may utilize web-based learning are synchronous delivery and asynchronous delivery.

Synchronous computer based education involves the use of media such as video streaming, interactive discussion boards, even teleconferencing to enhance learning of curriculum objectives in the classroom. Computer-aided, self-instructional programs have been introduced into dental education as a means to combat the shortcomings of an overloaded curriculum and increasing shortage of faculty (Haden, Weaver, & Valachovic, 2002). An educator can include self-test to accompany in-class teaching modules to assist students' learning concurrently with the electronic lecture. Immediate feedback can be dispensed via text and graphics utilizing hyperlinks for cross-referencing other resources and can be seen by the student to further explain underlying concepts (McCann, Schneiderman, & Hinton, 2010 as quoted by Chumley-Jones, 2002).

Asynchronous computer based education involves the use of many multimedia resources, including videos, but the accessibility to these resources is increased with instant retrieval of information anywhere an internet connection exists. Students gain control over setting their own pace with course material (Grimes, 2002). This module gives the students greater freedom to use their available time and resources and subsequently requires less class time. Advantages for faculty to both types of WBL include the ease in updating course content as well as the ability to lay out a sequential learning path of objectives allowing faculty to standardize content and distribution.

Schools specializing in health care have been increasingly utilizing computer aided instruction (CAI) and web-based learning to combat limited instructional time with large curricula requirements, as both standalone instruction and as supplemental materials (Chao, Brett, Weicha, Norton, & Levine, 2012). A research study found web-based instructional delivery a viable alternative to face-to-face faculty instruction; third and



fourth year medical students presented significant pretest to posttest gains concerning women's health education as well as reported greater discussion of women's health with patients after using the CAI curricula (Zebrack, Mitchell, Davids, & Simpson, 2005).

The Boston University School of Medicine has transitioned to online, computer aided curriculum (CAI) for recognizing and treating delirium to fourth-year medical students as the sole method of instruction. The choice of using CAI followed a study that determined online components of their curriculum enhanced students' abilities to identify the problem and provide appropriate elements of a differential diagnosis, history, and physical examination, as well as increased the likelihood of a student suggesting options for patient management. This method of instruction was positively received by students and resulted in more efficient learning (Chao, Brett, Weicha, Norton, & Levine, 2012).

Faculty at Virginia Commonwealth University, Department of Nurse Anesthesia use short videos to simulate a variety of complex clinical situations that clinicians might encounter in delivering healthcare. They identify these modules as simulation-based video teaching interventions (SBVTIs), defined by focused video activity that employs realistic simulations to depict and explore essential information, serving as an alternative to real encounters. By using these interventions as a supplement to traditional teaching approaches, the faculty can improve the didactic and practical experiences by better engaging the students and meeting the diverse learning styles of the student audience (Hartland, Biddle, & Fallacaro, 2008). A study of the implementation and evaluation of web-based tutorials in medical education reported that WBL was necessary for learning problem-solving and implementation of evidence-based medicine. These videos were preferred over traditional lecture-based classes for accessibility, ease of use, freedom of

navigation, high image quality (medical radiographs), and the advantage of repeated practice (McCann, Schneiderman, & Hinton, 2010; Potomkova J, 2006).

Recently, e-learning has been strongly encouraged by the American Dental Education Association (ADEA, 2014). There are several examples of dental e-curriculum that include, but are not limited to, dental terminology, oral manifestations of systemic illness, tobacco cessation, and dental radiology (Maggio, Hariton-Gross, & Gluch, 2012). Research conducted by Dr. Ellen Grimes at the University of Vermont established that out of the 225 dental hygiene schools in 2002 (entry-level and bachelor's degree programs), 172 schools responded to a survey conducted on distance education (67% response rate). Distance education was offered by 22% (38 schools) and 13% had future plans to implement distance learning. Of the 22% currently offering e-learning courses, 81% were either satisfied or very satisfied with their distance education programs (Grimes, 2002). In a 2014 survey conducted by the American Dental Hygienists' Association, 97 of responding dental hygiene programs offer some type of distance learning, a large growth from the survey previously conducted by Grimes in 2002 (American Dental Hygienists' Association (ADHA), 2014). The most common textbooks used in dental hygiene education are currently available in electronic format with several publishers adding the rights to video access of various technical skills in the field of dental hygiene. However, most of the current videos available are restricted to clinical procedures and do not currently include digital media for conceptual objectives.

There have been mixed results on learner effectiveness when comparing stand-alone or adjunctive CAI or WBL with traditional instructional methods (Chao, Brett, Weicha, Norton, & Levine, 2012). Some current research shows that computer aided self-

instructional methods are as effective, if not more effective, than traditional lectures. Students also perceive these computer aided modalities as effective and an acceptable way to learn (Jackson, Hannum, Koroluck, & Proffit, 2011). New technologies, including video simulations, can enhance components of distance education or online learning and makes such learning a viable alternative. However, Jackson et. al. conducted a research study at the University of North Carolina at Chapel Hill (UNC) School of Dentistry, tracking the frequency that students access online teaching modules and use self-test assessments as course activities. Their results did not show statistical significance in the frequency of access to the online teaching modules; there was, however, a statistical relationship in the student use of the online self-assessment exams and the overall course grades (Jackson, Hannum, Koroluck, & Proffit, 2011). Bearden, Robinson, and Deis examined the difference in academic performances of 54 dental hygiene students enrolled in an online versus on-campus nutrition course. They concluded there was no difference in course average and performance on the National Board Dental Hygiene Exam between online and on-campus students (Bearden, Robinson, & Deis, 2002).

Computer based instruction, with the implementation of media resources, is widely used in graduate and undergraduate health care fields (Wood, 2010). An advantage to this method is the opportunity for webcasts or webinars, where students can tune in live, or download to experience at a later time. Presentations and lectures available via the Internet are widely improving student access to course information. Students are able to scan material and locate smaller refined content by available computer tools and applications. For students to be successful with e-learning, they must be motivated to access and master material, know when to contact an instructor for assistance, and

possess a willingness to learn and follow through (Mitchell, Gabbury-Amyot, Bray, & Simmer-Beck, 2007). At minimum, in order to participate, students must have entry-level computer skills plus access to a computer. Millennial learners are accustomed to not only computers but new technologies with software to facilitate optimal information exchange.

Other advantages of online learning include flexibility of access to content and quality of focus on materials, as a student must be internally motivated to access the resources. Students can attend to course materials while maintaining employment, giving an avenue to teach outside the classroom, providing convenient access for the students (Grimes, 2002). Delivery of e-curriculum with media resources opens avenues to promote creativity in learning. By facilitating enhanced critical thinking and simplicity, students can interact in a non-threatening environment, improve personal computer skills, exercise their ability to respond to a large range of learning styles, and monitor their own success, while increasing student responsibility and improving teacher-learner interactions (Grimes, 2002).

Arguably the most common disadvantage in the facilitation of online learning is incompatibility of various available software. Though the current generation of students is particularly identified by their use and demand for technology, not all students have consistent and reliable computer access. Other disadvantages to e-learning include some material, especially a stand-alone audio file without visual media, may be difficult to listen to by itself. For faculty, the resources may take longer to produce for the inception of the course. Creation demands require more upfront planning and are time-consuming, necessitating additional preparation time when producing a final product in comparison to traditional presentations (Wood, 2010).

Computer aided instruction can be effective in knowledge gains and is becoming a commonality to the delivery of collegiate curricula. The use of multimedia resources in both traditional and distance learning can save valuable class time making allowances for active learning activities.

### ***Summary***

Multimedia resources (MMR) give educators the opportunity to motivate student learning by bringing educational concepts to life. With more than 73% of the current collegiate student population belonging to the millennial generation, it is crucial that instructors discover and understand unique qualities of learning preferences and adapt instructional modalities to accommodate learning styles. MMR can be a way for instructors to entice the visual learning preference of current collegiate students. Educators have a vast selection of choices to incorporate MMR into their classroom environment including animated and real-time videos to explain difficult concepts, social media for student discussions, as well as creating podcasts or interactive games for on demand self-assessment. Each resource can be incorporated to facilitate e-learning or be used as a stand-alone resource. With the addition of technology in the classrooms, faculty can utilize multimedia resources to create opportunities for students to interact with a significant variety of educational content individually or with their peers. Using multimedia resources, educators can transition from the traditional educational classroom lecture setting to being readily available to facilitate learning via multiple pathways of desired learning styles.

## CHAPTER 3: METHODS & MATERIALS

### *Introduction to Research Design*

The research perspective of this study followed the formatting and styles for descriptive quantitative primary research by directly examining data collected from the research population participants. This study followed ethical conduct of participant selection. With approval from the University of New Mexico Human Research Protections Office (UNM HRPO) and the Institutional Review Board (IRB) as an exempt study, the research methods used the following design:

### *Sample Selection Defined*

**Non-random sample.** This study focused on the availability and frequency of the use of digital resources to supplement traditional lecture teaching modalities of dental hygiene programs. As of 2014, data collected by the largest national dental hygiene professional organization, American Dental Hygienists' Association (ADHA) grouped 335 entry-level dental hygiene programs (including Associate's, Bachelor's, and Certificate programs) with an accompanying 53 Degree Completion (Bachelor) Programs, and 21 Master's Degree Programs (ADHA, 2014). Out of a total of 409 accredited programs, the ADHA has an email listserv of 363 dental hygiene directors. The numbers differ as some professionals act as the director for multiple programs. All education levels were included in the study as programs may vary greatly in delivery methods even when housed in the same institution.

An electronic survey was sent to all the dental hygiene program directors included on the ADHA listserv. The researcher attempted to eliminate influences of non-response bias by the following factors: well-known and tested online survey software, *SurveyMonkey*,

was used. The sample was exclusive to dental hygiene program directors with the assumption that these individuals are well aware of the teaching methodologies, popular and infrequent, utilized by the faculty of their programs. The investigator informed the respondents that the results of the study will be shared with them once the research is complete.

#### *Site of Study and Research Participants*

To orchestrate this research study, The University of New Mexico School of Medicine, Principle Investigator Christine Nathe, RDH, MS and Co-Investigator Diana Graham, RDH, MS(c), distributed a survey to 363 emails (beginning with a total 372; two programs are no longer offered as of March 2016 and 7 programs had no contact listed) through online survey software *SurveyMonkey*. The survey was sent to the sample population including Program Directors of all the Dental Hygiene Programs, of all degree levels (Associate's, Bachelor's, Bachelor's Degree Completion, and Master's Degree levels), in the United States. Advantages of an electronic survey for participants include the convenience of participation from the subjects at a time and place of their choosing and anonymity preservation. The survey remained open and available for three weeks to allow flexibility in the sample population response rate. The researcher sent two survey reminders during the three week time period. Confidentiality was ensured through the online software.

#### *Means of Access (Instrumentation of Data Collection)*

The investigator sent a request inviting research participation via email using a listserv provided by the ADHA. The request email comprised of a letter describing the significance and content of the research study, notification of approval from the

Institutional Review Board (IRB), a link to participate in the research, and a statement informing the respondent that their participation is voluntary.

The chosen instrumentation for data collection was a survey facilitated through *SurveyMonkey*. A hyperlink to the survey was provided in the invitation email. The study contained 42 open and closed-ended questions and collected data covering the topic of the use of multimedia resources in the classroom throughout the dental hygiene program's curriculum. Anonymity was ensured by the survey engine software *SurveyMonkey* and no identifiers were collected. This self-reply format implied participant consent upon receipt of the survey and/or completion. Participants had a total of three weeks to complete the survey, with a reminder one week after the initial contact, and a second at the beginning of the third week. Online response data was collected through the month of March 2016. Possible limitations of an online survey may include the amount of quantitative and qualitative data obtained from subjects due to questionable internet services, length of the survey, or distrust of confidentiality being preserved sending personal data via the web (McPeake, Bateson, & Oneil, 2014).

### *Variables*

Each degree level of an institution's dental hygiene educational program was asked to compare teaching modalities and faculty preferences. Identification of media resources being utilized, in which courses, as well as availability of digital resources to students in the program, were asked in efforts to discuss the variable use of classroom multimedia resources (MMR). The questionnaire then focused on the faculty classroom facilitation: types of digital resources, frequency of use, and barriers faculty face in creating or directing access to multimedia resources. To assess faculty use of MMR as a standard



practice, the survey evaluated whether or not the use of digital resources in their classroom is required. Concluding the survey were questions to assess active learning teaching methodologies and program director opinions in the necessity and efficacy of digital resources in dental hygiene education.

### *Data Analysis*

The study's conclusions are based on the results of 78 surveys that were completed and submitted to the researcher via *SurveyMonkey*. Responses to the survey were evaluated to answer the research questions listed below in Table 1. Closed-ended question responses were grouped and charted by the online survey engine. Open-ended responses were exported into Microsoft Excel, grouped with similar topics, interpreted, and then charted to represent the sample data. All data was then reduced by grouping responses according to the research variables compared by the investigator. Statistical analysis included calculation of the confidence interval for the two main questions asked within the survey, MMRs supplementation as standard practice in dental hygiene education, and the proportion of dental hygiene programs that have MMR requirements for faculty. Results were reported in appropriate formats for the question including, but not limited to, raw data, percentages, and means, as well as displayed in narrative text, tables, and figures (charts). A list of these tables and charts is located in the front matter. Interpretation of the data is explained in the subsequent chapter.

### *Summary*

This chapter has explained the methods and instrumentation used in this descriptive quantitative research design of the standard practices of multimedia resources in the classrooms of dental hygiene programs across the nation. To summarize, it should be

emphasized that this research study examined data collected from an electronic survey disseminated to the population of dental hygiene program directors of all education levels in the United States.

**Table 1: Sub-Research Questions**

<b>Table 1 Sub-Research Questions to be Answered Through Survey Responses</b>	
1	Is there a relationship between geographical region and the use of MMR? Using a combination of the United States Census Bureau 4 regions and the most commonly referred 5 regions mapped by National Geographic, will evaluate responses by educational programs of the region (United States Census Bureau, 2015; National Geographic, 2015).
2	What percentages of dental hygiene directors are familiar with various types of available multimedia resources?
3	Is there a relationship in the level of degree earned by PDs and their confidence in their computer skills?
4	Is there an association between the level of degree offered in the program and the frequency of MMR use?
5	Is there a relationship in the age of the program and the frequency of MMR use?
6	What is the estimated percentage of students enrolled that would qualify under the definition of a millennial student?
7	Are there any dental hygiene programs that use learning styles of the students to dictate classroom delivery methods?
8	What percentage of respondents uses social media for classroom instruction?
9	What is the most common type of MMR that is currently being used?
10	What percentage of respondents uses <i>YouTube</i> in the classroom?
11	What percentage of respondents has created their own versions of MMR to use in the classroom?
12	Do dental hygiene program directors feel that student-faculty interactions will decrease with prolonged use of MMR outside of the classroom?

The sample participants were given a total of three weeks to complete the survey and responses remained confidential. The questionnaire evaluated relationships between the stated variables of teaching modalities and faculty preferences in dental hygiene education.

## **CHAPTER 4: RESULTS, DISCUSSION, & CONCLUSION**

### ***Introduction***

As stated in Chapter 1, this study examined in detail the changes in instructional modalities to include the use of technology, such as digital multimedia resources. Specifically, the research examined the use of supplemental multimedia resources in the dental hygiene education curriculum, surveying dental hygiene program directors across the country. This chapter is organized in terms of two specific research questions, with 12 subtopic questions. It first reports on the opinions and evidence provided by Dental Hygiene Program Directors on the use of supplemental multimedia resources and its status of use; secondarily, it examines whether dental hygiene faculty members are mandated to use various formats of multimedia as a supplement to classroom lecture. The 12 subtopic questions are located in Chapter 3-Table 1: Sub-Research Questions to be Answered through Survey Responses.

### ***Results***

#### ***Response Rate and Confidence Interval***

Using the electronic survey software of *SurveyMonkey*, data were equated, grouped and charted for interpretation. Questions that gathered open responses from participants were exported to Microsoft Excel and analyzed. For this study, 78 program directors (PDs) responded out of a sample population size of 316, resulting in a 25% response rate. The resulting response rate is explained in detail.

There are 407 accredited dental hygiene programs in the United States, which includes 335 entry level programs (Certificate, Associate's, and Bachelor's Degrees), 53 Degree Completion (Bachelor) Programs, and 21 Master's Degree Programs. As of 2014, The ADHA lists 409 operational programs; however, through research it was discovered

that two programs are no longer offered (ADHA, 2014). The ADHA maintains a list-serve of program directors for all education levels consisting of 363 names; the numbers differ for multiple reasons, including many professionals are administrators for multiple programs and some programs did not list individual program director contact information. In the process of sending the email invitation to participate in the research, a total of 47 emails were returned as undeliverable. Reasons for this might include an inaccurate listing of the contact information, or the current program director may be different at the time of contact for research participation. Another potential limitation may include directors of the Dental Hygiene Degree Completion Programs may not have acknowledged their eligibility to participate in the study. This leaves the final sample population total to reach 316 emails successfully sent to program directors of dental hygiene education programs.

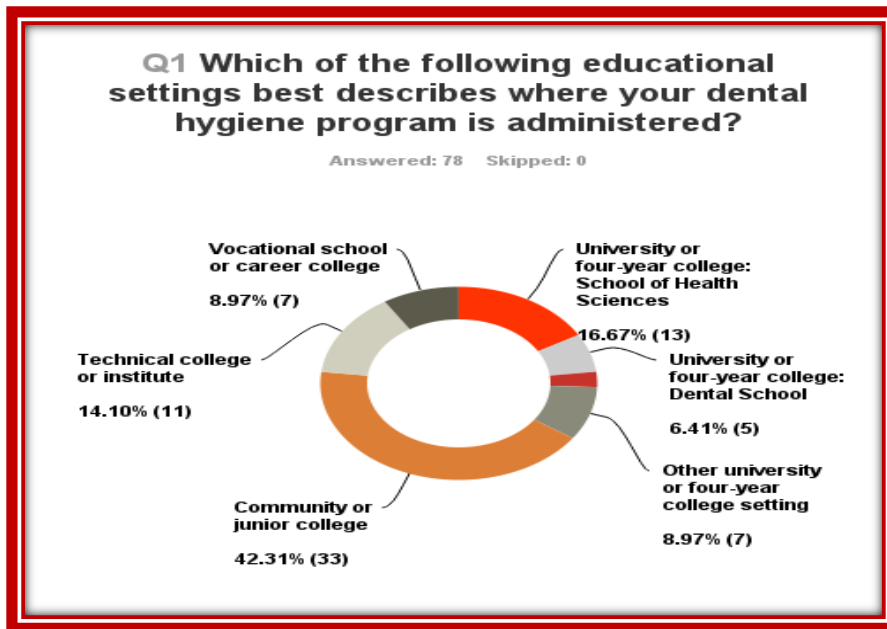
### *Demographic Reports*

There were no identifiers collected in this research; however, some demographic information was gathered to establish a baseline in order to draw relationships between the variables. School categories were derived from the classifications given by the Commission on Dental Accreditation when schools complete an annual report (CODA, 2014). It was assumed that program directors would be most familiar with these categories. Community or Junior College was the educational setting with the highest response rate of 42.31% (33 respondents). University or four-year colleges, though split into 4 specific groups, constituted secondary majority with 34.6%. Figure 1 describes the educational settings of the respondents. Not labeled in Figure 1 is the smallest

percentage, 2.6%, responded with University or four-year college: separate dental department (2 respondents).

Question 2 asked the participants to report the highest level of dental hygiene education offered within their institution. Responses were as follows: Certificate of Completion – 0, Associate of Occupational Science in Dental Hygiene – 0, Associate of Applied Science in Dental Hygiene – 36 (46.15%), Associate of Science in Dental Hygiene – 17 (21.79%), Bachelor of Science in Dental Hygiene – 19 (24.36%), Master of Science in Dental Hygiene - 6 (7.69%).

Figure 1: Educational Settings of Respondents

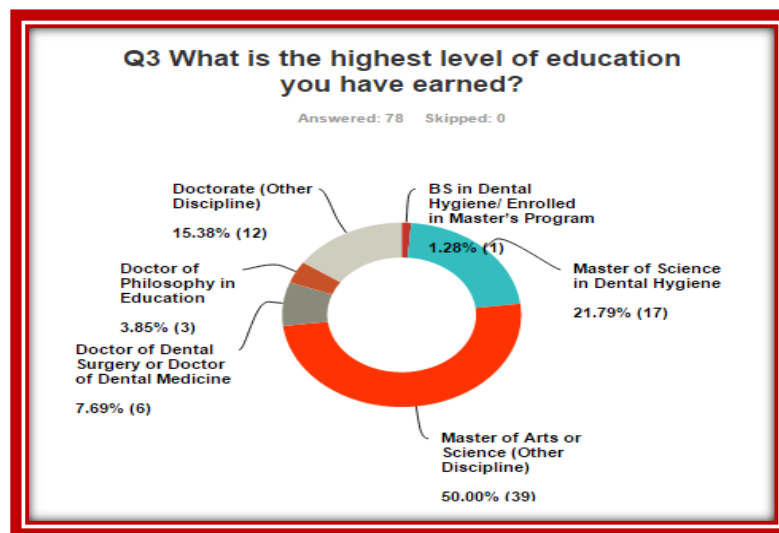


This question is solid in content validity as it includes all possible levels of dental hygiene education, but fails to be successful in face validity. The intention of this question was to identify the educational level of the dental hygiene (DH) program of which the survey participant was the administrator. Since the possibility of the responding program director holding multiple chairs in differing levels of dental hygiene education exists, attempts to limit respondents to answering the survey appropriately for

the each level were successful in all questions except this one. If an individual did hold multiple DH chair positions, asking the respondent to identify which level of DH education they are director of would have left the rest of the survey open to conflicting answers and the researcher would not have been able to identify at what level of education the participant was answering questions.

Question 3 was specific to the individual respondent to take inventory of the level of education the PD had achieved. The highest fraction of respondents (50%; 39) possesses a Masters of Arts or Science in a discipline outside of dental hygiene. Only 1 PD reported having a Bachelor of Science Degree while currently enrolled in a Master's Program; details can be seen in Figure 2.

**Figure 2: PD Level of Education**



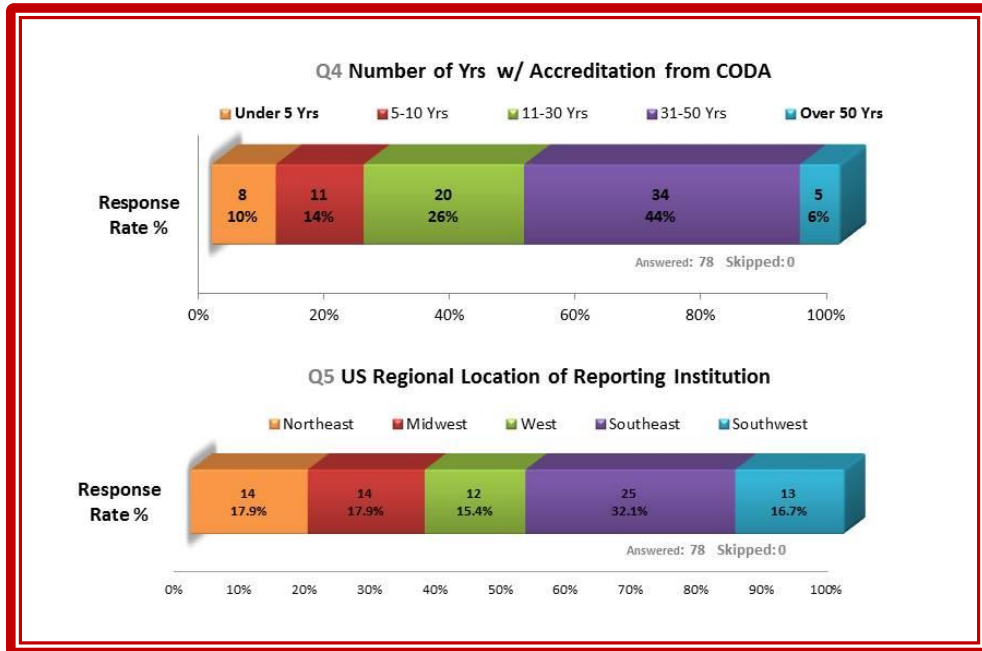
The Principle Investigator conducted a comparison report utilizing the results of Question 3 to determine possible relationships between the level of education earned by the PD and several different variables researched within the study. While specific details of the relationships are reported in the discussion of the results, the researcher was not able to identify a relationship between level of education and the PD's computer literacy, efforts

in seeking MMRs, or the prevalence of encouragement/requirement of their faculty to supplement course objectives with MMRs. The research did however identify differences in the prevalence of DH programs in the creation and use of recorded lectures (both audio and audio-visual formats). While 70% of programs in which the PD holds a doctoral degree (of any discipline) uploads audio-visual recordings of live lectures online, and 60% upload audio-only lecture recordings, there is a significantly lower incidence of this format use in programs in which the PD holds a Master's Degree (37% develop both audio-only and audio-visual lecture recording). Results also yielded a significant difference when exploring the implementation of student participation in individual learning style assessments. While 65% of PDs with a Master's Degree have encouraged or required their actively enrolled students to take some type of learning style questionnaire during their DH education, only 35% of PDs with a doctoral degree have done the same.

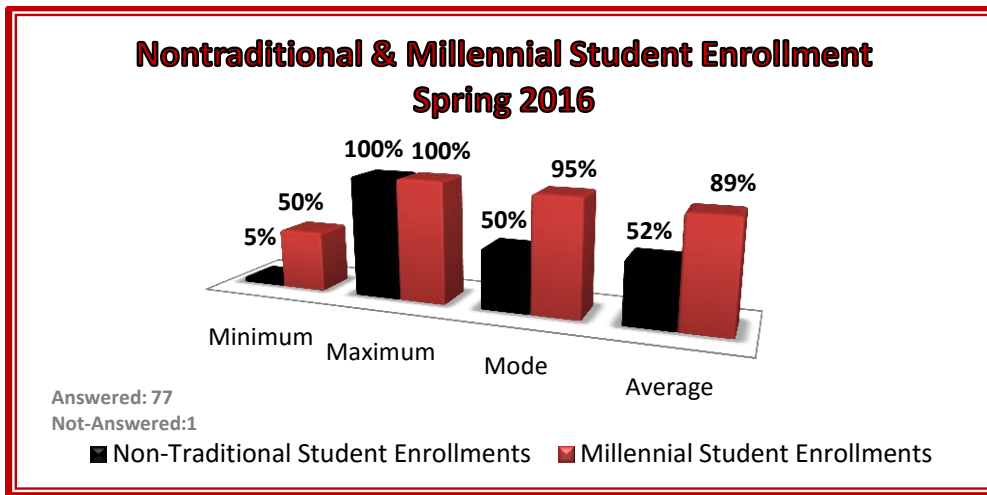
Question 4 and 5 also collected demographic data asking the age of the program as well as the regional location of the reporting institution. Ten percent (8) programs are under 5 years old, 44% (34) are well established between 31 and 50 years old, and 6% (5) are over 50 years old. The sample population was also assembled by geographical location. Using the five United States Regions of Education, respondents were given a chart with the state in which they reside, and the corresponding region (Appendix 4A). The 78 responses collected were almost equally distributed within all regions (15-18%), with the exception of southeast region reporting with 32%. The charted values for Question 4 and 5 can be seen in Figure 3.

Lastly, the PD was asked to report, to the best of their knowledge, the percentage of actively enrolled students who would qualify for nontraditional and/or millennial student classifications. Figure 4 depicts the sample responses for this data. Responses settled within a wide range with the lowest nontraditional student enrollment percentage reported being 5% and the highest equally 100%. The average reported nontraditional

**Figure 3: Years with Accreditation & US Regional Location of Reporting Institution**



**Figure 4: Nontraditional & Millennial Student Enrollments**





student enrollment was 52% with the mode being 50%. With identifying the percentage of students who belong to the millennial generation (ages 19-36), the average reported enrollment was 89% with the mode being 95%; the range contained a minimum of 50% and a maximum of 100%. More accurately, 49 of the 78 respondents (63%) reported the estimated enrollment of millennial students is between 90-100% for the 2016 spring term.

*Thesis Question: Has the Use of MMR Become Standard Practice?*

The overall thesis question of this study intended to evaluate if the use of multimedia resources (MMRs) has become a standard practice in dental hygiene education. To investigate the overall thesis question, the investigator began with analysis of educational methodologies being adapted to match digital information demands.

In response to Question 8, only 4% (3) of the responding sample reported being unfamiliar with the variable options of MMRs to be used as instructional aids, leaving an overwhelming 96% stating familiarity with these resources, including resources available through textbook publishers. Sixty-four percent of PDs reported that the availability of e-resources affects their textbook choice during curriculum review. When asked for their opinion if a MMR would enhance objective comprehension with visualization of the subject matter, 95% of respondents agreed. Ninety-six percent (percentages differ as 1 respondent skipped this question) reported seeking out MMRs to supplement their own instructional strategies. In reporting formats of MMRs used by the participants, only 1 survey indicated there were none of the listed media formats used in their program. The rest of the population reported using multiple formats synchronously, either personally or knowledge of another faculty member's use, within their curriculum. A high majority reported using some form of videos in the classroom: 59 (76%) PDs reported using

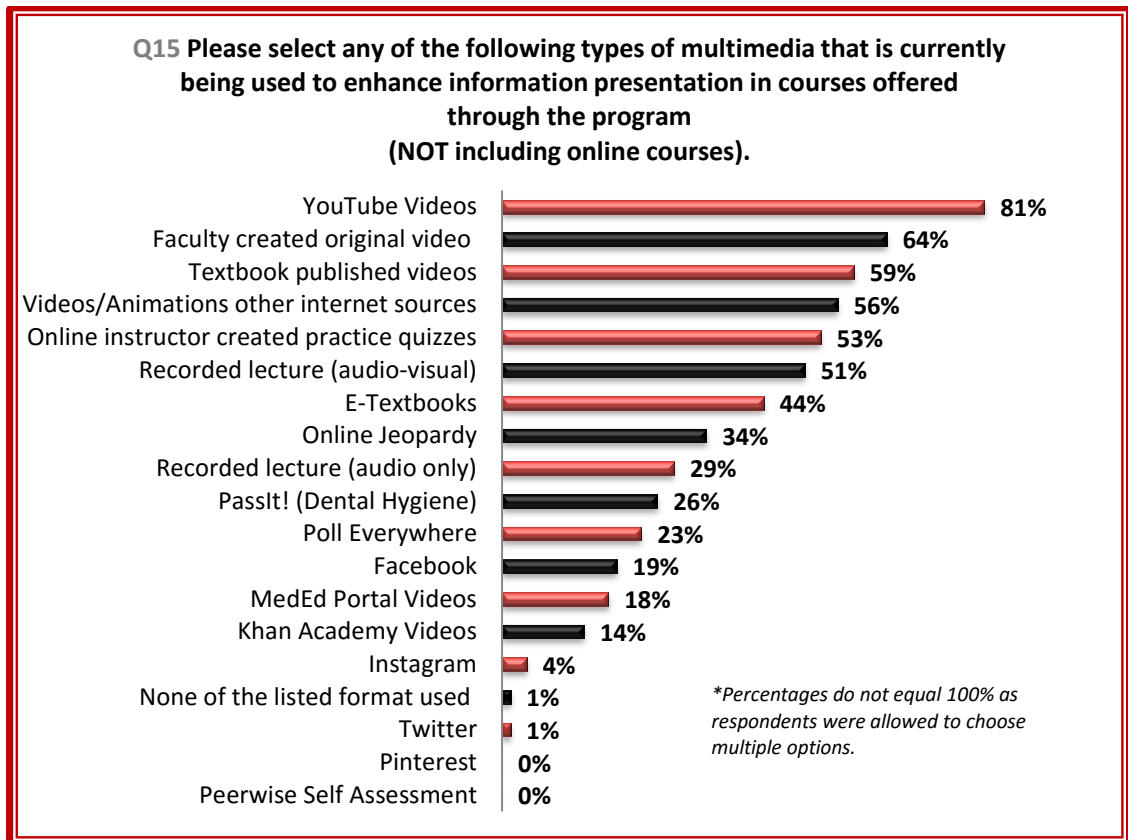
*YouTube* videos, 47 (60%) reported using original, faculty created videos, and 43 (55%) reported using videos from textbook publishers. Fifty-one percent of faculty posts an audio-visual recording of lectures, and 44% of programs are using e-textbooks. Social media use was present but not significant. Sites with inquiry included *Facebook*, *Twitter*, *Pinterest*, and *Instagram*. Though 19% of programs testified to using *Facebook* as a supplement to instruction, only 4% reported utilizing *Instagram*, and 1 DH program uses *Twitter* while none of the programs reported using *Pinterest*. Figure 5 shows these results in detail as well as other MMR format options. PDs were also asked to select the top 3 resources used in the curriculum at their individual institutions and the response rate showed the same data as above with various video formats reaching the top. Charting of this information is shown in Appendix 4B. PDs were given a chance to report any other MMR commonly used in the DH program that was not listed as an option in this research study. Table 6 (Appendix 4E) summarizes those responses.

Table 2 depicts the most common courses included in dental hygiene curriculum that reported utilizing MMRs. The courses with the highest incidence of MMR use were interpreted as follows: 53 PDs (73.6%) reported using MMRs in Clinic Theory courses, 48 (66.7%) conveyed using MMRs in Dental Anatomy/Histology, and 44 (61.1%) reported use in Head and Neck Anatomy. Unpredictably, only 9 (12.5%) reported MMRs use in Anatomy and Physiology courses. Six PDs (8%) indicated MMR use in Cariology; however, this low number could be due to the number of programs that offer this specific class, as it is not required by CODA standards to be a separate course. In evaluating the timeframe that programs have been utilizing digital resources, data collected showed that

33.8% (24) have been using MMRs for under 5 years. The majority, 53.5% (38) recounted using technology in the classroom between 5 to 10 years (see Figure 6).

Research also attempted to assess certain specifics of the use of media formats in these dental hygiene education courses. A total of 85% of respondents indicated their program utilizes computer-based course exams with intent to familiarize students with the computer-based National Dental Hygiene Board Exam (NBDHE) and 78% of the overall participants stated they encourage an online review program to their dental hygiene students in preparation for the NBDHE. Overall, 53% (39) PDs reported using online practice quizzes created by faculty. Some of those are facilitated through the school’s online course management system.

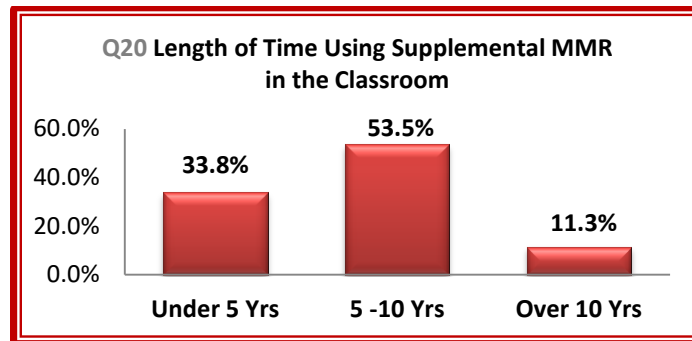
**Figure 5: Format of MMRs Used By Responding Institutions**



**Table 2: Courses in DH Curriculum Reporting use of MMRs**

Courses Reporting MMR Use	Response %	Response Count	Courses Reporting MMR Use	Response %	Response Count
			Additional Courses Listed by PD (Not by Original Study Question)		
Clinic Theory <sup>1</sup>	73.6%	53	DH Board Review	4.2%	3
Dental Anatomy/Histology	66.7%	48	Infection Control	4.2%	3
Head & Neck Anatomy	61.1%	44	Medical/ Dental Emergencies	4.2%	3
Local Anesthesia	58.3%	42	Principles of DH Practice/Ethics	2.8%	2
Periodontology	56.9%	41	Clinical Dental Technology	1.4%	1
Radiology	55.6%	40	Intro to Dentistry/Dental Hygiene	1.4%	1
Community Public Health	54.2%	39	DC - Educational Methodology <sup>2</sup>	1.4%	1
General/Oral Pathology	52.8%	38	DC - Technology in Oral Health <sup>2</sup>	1.4%	1
Special Needs/Medically Compromised	45.8%	33	Master's Level Courses	1.4%	1
Dental/Biomaterials	41.7%	30	Preventative Dentistry	1.4%	1
Nutrition	40.3%	29	Dental/Medical Terminology	1.4%	1
Pharmacology	33.3%	24	<sup>1</sup> Clinic Theory includes responses of Dental Health Education <sup>2</sup> DC = Degree Completion		
Research	16.7%	12			
General Anatomy & Physiology	12.5%	9			
Cariology	8.3%	6			

**Figure 6: Length of Time Using MMRs**



Almost all, 96%, reported their program currently utilizes an online course management system, *BlackBoard Learning* being the most common, leaving only 4% not utilizing any type of online course management system. A full list of course management systems and percentage of program reported use can be seen in Appendix 4C.

This research study also attempted to draw relationships in the frequency of multimedia resource use with the learning styles of the today’s collegiate student. To understand any relationships, PDs were asked about encouraging their actively enrolled students to take learning style assessments. Results were nearly equal as survey responses

revealed that 56% of DH programs either encouraged or required students to take a learning style assessment within the duration of the program. Only 1 institution reported using the Honey and Mumford SQ, 10% testified to using the Kolb's Model, 15% stated the VARK assessment is administered, and 5% of PDs reported their academic institution has created their own learning style assessment for the students to take. A significant amount, 29% of PDs, reported the program does use a learning assessment, however not one of the given choices in the survey.

In assessing the use of multimedia resources and the evolution of teaching modalities in the collegiate classroom, this study also collected data on the availability of online courses, also referred to as distance learning, or web-based learning (WBL). Distance education is defined in dental hygiene (DH) courses where 90% of the course material is delivered to the learner at a distance from the presenting institution. Data confirmed 59% of the respondents reported their program does not offer distance education courses via online delivery. Of the programs that do offer this type of course delivery, the most commonly reported courses included Ethics and Jurisprudence, followed by Research, Dental Hygiene Education, and Nutrition courses. Two institutions reported facilitating Radiology through web-based learning. Seven respondents indicated that 100% of the Bachelor's Degree Completion program courses are offered online, and 4 PDs stated that 100% of their Master's Degree program was offered online.

There were two unique responses in this question. One institution stated that "all of the dental hygiene core courses offer hybrid courses with an online component" while another reported, "all DH courses were facilitated online except for lab components and clinicals".

**Table 3: Courses Offered as Distance Education (Online)**

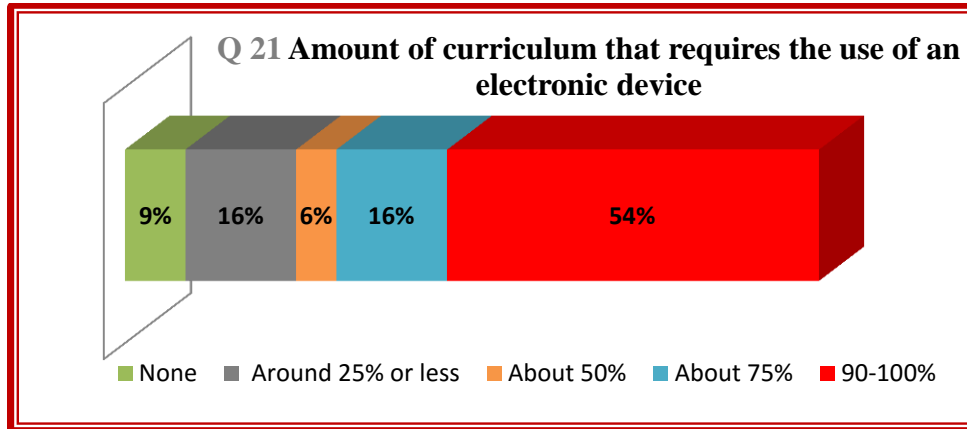
Response Text of Course Titles Offering Distance Education Learning in DH Educational Programs		
<b>Top Courses Reported</b>		<i>*The Number in ( ) depicts the amount of times the course was reported</i>
Ethics and Jurisprudence (5)	Dental Hygiene Education (4)	Research (4) <i>(1 reported as a hybrid course)</i>
Nutrition (4)	Periodontology (3)	Community Oral Health (3) <i>(1 reporting as a hybrid course)</i>
Teaching in Oral Health (3)	Cariology (3)	Medically Compromised Patients or Medical Emergencies (2)
Current Issues in DH (2)	Tooth Morphology (2)	
<b>Other Courses Reported</b>		
Radiology	Oral Pathology	Public Speaking
Advanced Radiology	Professional Development	Psychology
Process of Care	Advanced Instrumentation	Technology in Oral Health
Sociology	Dental Materials	Oral Health Promotion/ Oral Health Practice
Local Anesthesia	Infection Control	
<b>Other Responses Recorded</b>		
Bachelor of Science Degree Completion in Dental Hygiene 100% online (7)		
Master of Science Curriculum 100% online (4)		
"Almost all of the DH core courses offer hybrid courses with an online component."		
"All ... but labs and clinicals."		

To assist with the development of the online course structure and media formats, 68% of the reporting institutions that utilize online learning offer professional instructional designers that work with faculty to best provide online education. Of the reported online courses, 50% of institutions have been utilizing web-based learning for between 5 and 10 years and 23% have been offering online classes for 10 years or longer.

In anticipation of the high frequency in technology use to explain DH course objectives, this study also assessed the need for electronic devices to access available resources. PDs were asked to report the percentage of their curriculum that fit these criteria. As seen in Figure 7, 54% of respondents indicated that 90-100% of the material presented in all dental hygiene courses within their program would require an electronic device of some variety in order to access course content. Specific responses included

statements such as, “100% ... must view PowerPoint slides outside of class,” and “100%-we are an all e-book/iPad program.” The majority of PDs (77.8%) felt that a personal computer/laptop was necessary to access digital material for course resources while 15.3% felt no electronic devices were necessary.

**Figure 7: Percent of DH Curriculum that Requires Electronic Devices to Access**



And while 86% (61) of programs do not issue electronic devices to their enrolled students, 4% (3) positively reported issuance of a computer/laptop, and 11% (8) indicated providing a tablet or notebook for student use. Lastly, since a high majority of the resources reported by the programs are facilitated via the Internet, PDs were asked to identify any barriers students experience in accessing MMRs either on or off-campus. While 51% indicated there were no barriers experienced, 43% cited slow internet connections were a problem, 28% experience bandwidth problems (possibly creating a slow connection), and on 21% reported software compatibility as a barrier to accessing resources with ease.

In addition to the above results, PDs were asked their opinions on several statements provided in the survey.

**Table 4: Necessary Electronic Devices for Curricular Resource Access**

<b>Q 22 Which of the following electronic multimedia devices are necessary or required to facilitate all delivery methods presented in any given course for the program? (Please select all that apply.)</b>	
<b>Answer Options</b>	<b>Response Percent</b>
<b>Personal Computer/Laptop</b>	<b>77.8%</b>
<b>Personal Tablet/Notebook</b>	41.7%
<b>Personal Smartphone</b>	43.1%
<b>None of the above</b>	15.3%

In regard to active learning activities, 85% of PDs agreed that active learning can be facilitated via online delivery equally as effective as active learning that happens in the classroom. However, 94% of respondents believe that the use of MMRs outside of the classroom will provide more time to facilitate active learning within the classroom during lecture. Conversely, almost half (49%) of PDs did not feel that with consistent use of MMR availability outside of the classroom, the amount face-face interaction between students and faculty would decrease. PDs were also asked about their agreement with the following statement: “The use of multimedia resources will become standard for dental hygiene education in the future.” The vast majority, 79% (57 respondents) agreed, while 7% (5) disagreed, and surprising 14% (10) had no opinion (6 participants skipped this question). Statistical analysis revealed confidence interval values of  $.713 \leq p \leq .871$  for .90 levels. Interpretation of these values validates that using the sample response data, it can be concluded with 90% confidence that the proportion of all DH PDs in accredited programs throughout the United States that would agree with the statement that the use of MMR will become standard practice in DH education is between 71% and 87%.

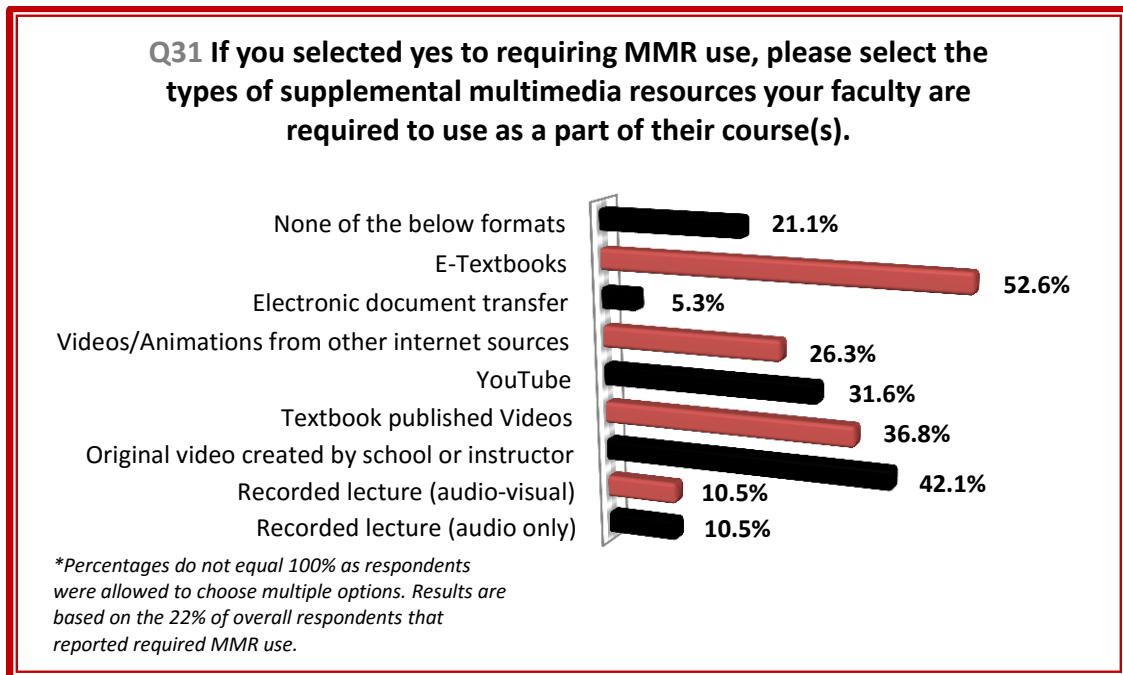
*Thesis Question: Mandating Faculty to Utilize MMRs*

The second thesis question involved investigation in the frequency that dental hygiene faculty are mandated to use MMRs in the classroom. When asked, 88% of PDs



reported encouraging faculty members to seek MMRs on their own. Conversely, a majority 78% of PDs stated they do not require faculty members to use MMRs in their respective courses. Confidence levels for statistical analysis revealed a margin of error equating .081, yielding confidence interval values of  $.697 \leq p \leq .858$  for a .90 confidence level. Alternatively, the given results indicate with 90% confidence that the percentage of DH programs across the country that do not hold or enforce multimedia requirements for faculty are between 70% and 86%. Figure 8 shows the breakdown of media resource formats for the 22% (16 of the 78 respondents) of programs that do require MMR use.

**Figure 8: Reported Formats of MMRs that Faculty are Required to Use**



In effort to ensure the program's faculty are complying with media requirements, of the 22% of programs that require MMR use, five PDs testified to previewing and preapproving syllabi that must list all delivery methods, two listed faculty annual reviews to ensure requirement compliance, and two other programs reported that the use of e-textbooks is required. Interestingly, one respondent replied that all lectures for the

program are recorded (distinction of audio-only or audio-visual was not provided).

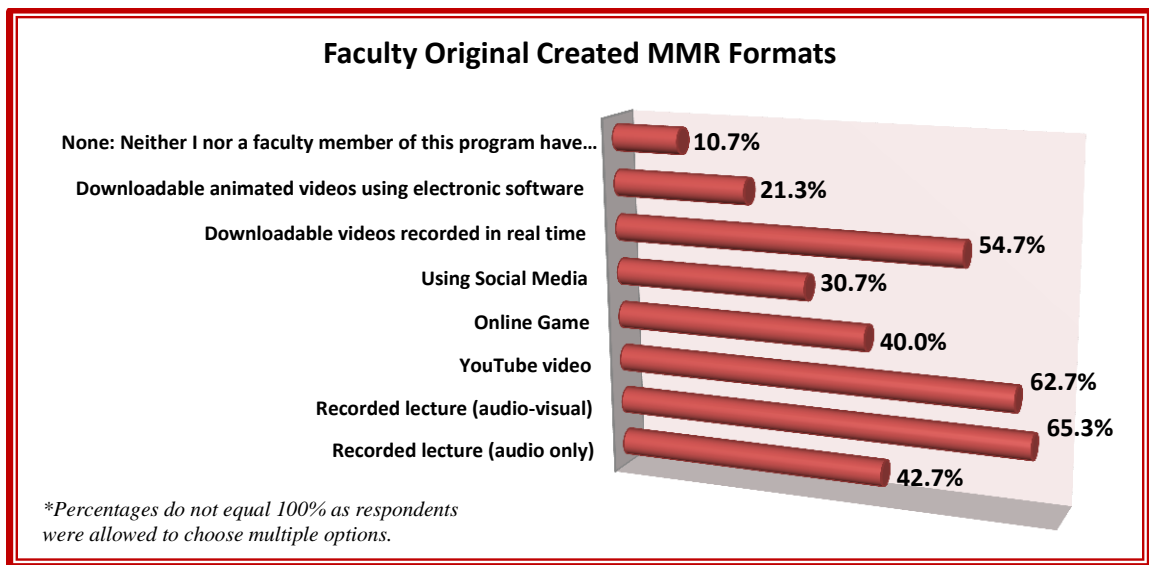
Results were divided almost evenly in reporting if the program had any faculty with an aversion to using forms of technology, with 60% (44) informing they have at least one faculty member with this description, leaving 40% (30) denying any faculty aversions (4 participants skipped this question).

Faculty continuing education is converting to electronic delivery. Sixty percent of PDs stated that faculty development exercises are available online for their program. Of that fraction, 44% (19) have courses and training available online to be completed at the faculty member's discretion.

In evaluating confidence of personal computer skills, 96% were secure with their computer familiarity and only 4% (3) respondents reported being insecure in their computer literacy skills. Similarly, 85% (62) were confident in their own ability to link online multimedia resources to other documents for student access. A smaller group, 60%, reported being confident in their own ability to create formatted versions of multimedia resources. These results help explain the findings in mandatory use of media in the classroom. Confidence aside, 71% of responding PDs conveyed they have created some format of multimedia to supplement instruction. A larger portion, 82%, have faculty in their administration that has created some format of MMR for their course material. Of the top three formats of originally created media resources, the highest percentage reported accompanied audio-visual recordings of lecture with 65%. Closely related, 43% of either PDs or their faculty has created audio-only recordings of lectures. Of the sample population, 63% have created a video and posted to *YouTube*, and 55% testified to creating a downloadable video that was recorded in real-time. A full

description of self-created MMRs can be seen in Figure 9. The types of software utilized to create the reported formats of MMRs were also analyzed. Predictably, 84% of PDs stated either themselves or their faculty utilize Microsoft PowerPoint. Twenty-seven percent of respondents have used *TechSmith Camtasia* to create animation videos, and 30% have used Windows Movie Maker.

**Figure 9: Format of Faculty Original Created MMR**



Lastly, the responding population was asked to describe barriers they or their faculty members face when creating their own formatted versions of media resources.

Table 5 shows the barrier options the PDs were given in detail. A comprehensive visual summation of the results from Table 5 can be seen in Appendix 4D. A total of 71% of respondents testified to having created an original version of a formatted MMR to supplement instructional strategies.

**Table 5: Faculty Barriers to Creating Media Resources**

<b>Q35 Which of the following barriers does your faculty currently experience in the use of supplemental multimedia resources? (Please select all that apply.)</b>		
<b>Answer Options</b>	<b>Response Percent</b>	<b>Response Count</b>
Lack of time to create media resources	75.4%	52
Lack of knowledge in ways to create resources	47.8%	33
Lack of faculty training in ways to use various types of media resources	46.4%	32
Lack of faculty training in the various media types available	39.1%	27
Lack of resource availability	18.8%	13
We do not experience any of the above barriers	15.9%	11
We do not use supplemental multimedia resources	0.0%	0
<i>*Response percentage does not equal 100 as respondents were allowed to select multiple answers.</i>	<i>Answered question</i>	<b>69</b>
	<i>Skipped question</i>	<b>9</b>

### ***Discussion of Results***

The new generation of student learners identifies with the evolving digital era and demands the use of technology in the classroom. The results of this research study allow inferences to be made about the frequency of multimedia learning facilitated in dental hygiene (DH) programs across the United States. Multimedia learning is explained as information processing through words and pictures and holds high relevance in healthcare education. By defining the qualities of specific generational learning preferences, availability of multimedia resources, and online learning, the objective of this research was to identify the incidence of faculty adapting current teaching modalities to include the use of multimedia resources as an adjunct to the classroom and the relationships these media delivery methods have with several observed factors.

The investigator first evaluated relationships regarding some of the non-identifying demographic information collected. Researchers conducted a comparison report to determine possible relationships between the level of education earned by the PD and several different variables including computer literacy, the prevalence of MMR use, and prevalence of faculty mandates to supplement course objectives with MMRs.

All (100%) PDs who hold a doctorate degree (including Doctorate of Dental Surgery or Dental Medicine, Doctorate of Philosophy in Education, or other Doctorate degree) testified to being confident in their computer skills, but only 79% affirmed confidence in their ability to link online MMRs to other documents. PDs holding a Master's Degree in Dental Hygiene or another discipline were 98% confident in overall computer skills and 82% were also confident in linking MMRs online. As a result, there is not a conclusive relationship between program director education level and computer literacy.

Specifically regarding MMRs, all (100%) PDs with doctoral degrees testified to being familiar with MMRs and the different formats that are available, while 6% of PDs with a master's degree reported unfamiliarity with what MMRs are and how they are delivered. 94% of both degree types reported seeking out MMRs to supplement course material and 70% of both degree types testified to having created some format of MMR in the past. While there is no difference in the incidence of *YouTube* use in the classroom (70% of both degree types reported use), there is a significant difference in the creation of audio-only and audio-visual recordings of live lectures. Seventy percent of PDs with doctoral degrees reported creating and uploading audio-visual lecture recordings, formally named podcasts, while only 37% of programs with a director holding a master's degree create podcasts. The cause of this gap is unknown.

Conversely, 65% of DH PDs with a master's degree have encouraged or required students to partake in some type of learning style assessment while enrolled in the program. Compared to only 35% of DH programs whose director holds a doctoral degree encourage using a learning style questionnaire in the program, a difference is evident. Doctoral and master's degree PDs were near equivalent regarding the following opinion

questions asked in the survey: PDs agreed that MMRs allow for active learning opportunities in the classroom and 81% of master's degree PDs believe that MMR use will become the standard for dental hygiene education (compared to 74% of doctoral PDs). A slight difference exists with faculty requirements as 30% of doctoral PDs have specific MMR formats that are mandated for program use and only 20% of master's degree PDs hold the same delegation for MMRs.

With the above variables, there can be no relationships drawn from the level of education and the use of MMRs with the exception of a notable difference in the incidence of podcast creation in programs with a PD who holds a doctoral degree and a higher incidence of learning style assessment use in PDs who hold a master's degree.

This study also aimed to evaluate the existence of a relationship between the age of the dental hygiene program and the use of certain media delivery formats. Figure 10 depicts the responses given for each program in two separate categories, programs 5 years old and newer compared to programs 50 years old and above. The types of media listed in the chart include all of the responses given by the participants. Newer programs reported a higher usage percentage with 8 of the 14 listed media formats utilized. As illustrated, programs developed within the last 5 years have higher frequency media usage in the following formats: Online Jeopardy, PassIt! (a dental hygiene board review application), e-textbooks (with a significantly higher usage rate of 67% compared with 25%), and videos from internet sources or faculty created original videos, with special significance in *YouTube* ( 89%, in comparison to 63% of older programs) and Khan Academy (44%, compared with 13%) usage. In light of the following data, no concrete

inferences can be made regarding the age of a dental hygiene program affecting the use of multimedia resources as supplement to course material.

There is however a strong relationship between the age of the dental hygiene program and the incidence of sustaining faculty requirements to utilize multimedia resources in the classroom. Figure 11 shows that in the responding programs that are 5 years old or less, 67% hold requirements for faculty to use some format of MMR. Conversely, of the longest standing programs that are 50 years old and beyond, only 13% hold the same requirements.

**Figure 10: Age of DH Program Vs Use of MMR**

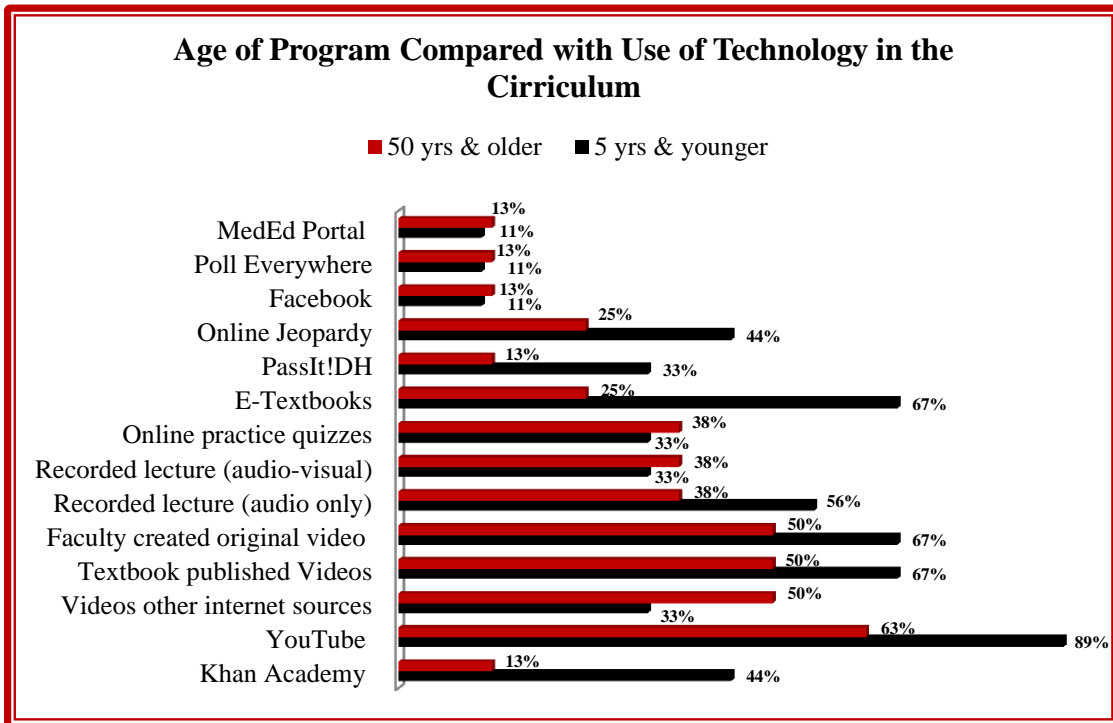
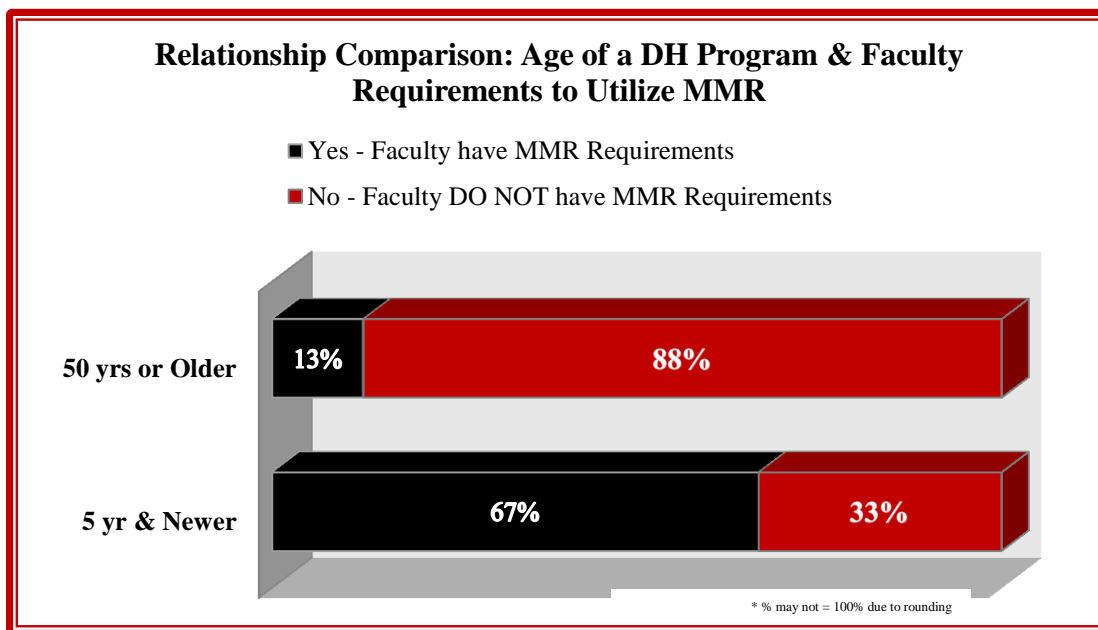


Figure 11: Age of DH Program and Faculty Requirements to Use MMR



In addressing the subtopic research questions proposed in Chapter 3, the study also evaluated the question of an existing relationship between geographic region and the use of technological resources to supplement lecture. A relationship can be seen in the western region and the use of technological resources in the classroom with the high percentage reporting using videos in the classroom as well as being the region with the highest incidence of faculty requirements in the use of multimedia resources as supplement to lecture material. Upon analysis, the use of videos (either published from textbooks, streamed videos from *YouTube* and other internet sources, or original videos created by faculty) was the media format used at the highest frequency among all 5 regions comprised of the northeastern (NE), midwestern (MW), western (W), southeastern (SE), and southwestern (SW) divisions. *YouTube.com* was reported in the top three for each region ranging from 70-92% of the respondents reporting the site's use. The MW region showed the highest incidence of supplying audio-visual recordings of



lectures as their second most utilized format at 69%. The W region showed that 82% of programs have faculty creating original videos to supplement lecture, the highest recorded. The SW region testified to the highest incidence (69%) of using e-textbooks in the dental hygiene curriculum. Conversely, 54% of PDs from the MW stated that availability of e-resources does not affect their options for textbooks during curriculum review. Regarding course management systems, *BlackBoard Learning* was reported most commonly through all five regions, though *Canvas* tied in the W division.

In the analysis of social media use between regions, though not frequently (between 7-30%), the NE, MW, and W regions testified *Facebook* is the sole social media platform used in their programs. In the SE region, 30% use *Facebook*, and a mere 4% use *Twitter* and *Instagram* in conjunction. The SW did not report use of any social media platforms for courses in their curriculum. Lastly, faculty mandated technology usage was analyzed for each region of the nation. All five regions were near equal with a low occurrence of 13-23% requiring faculty to use some type of media delivery method in their courses, with the exception of the W region which reported 36% requiring MMR use.

Examining the science of learning is crucial to understanding the need for evolution in the science of instruction, including evidence-based principles in the design of effective instruction, and how it applies to healthcare professors. Working memory process has limited capacity; therefore, information must be grouped together in order to effectively learn and retain material. The cognitive theory of multimedia learning explains that information dissemination via a multimedia resource (MMR) is received first by the eyes and ears and stored in sensory memory. If the learner starts *selecting words or images* important to the task, then it is moved to working memory as sounds

and images. The learner then *organizes words* by rearranging words into a cognitive model and *organizing images* by rearranging for optimal memory retention. Lastly, the learner begins to *integrate* both verbal and pictorial models of the multimedia source with prior knowledge for maximum learning for long-term memory (Mayer, 2003; Mayer, 2010).

Creating MMRs for instructional objectives will also eliminate extraneous process in learning, where cognitive processing not pertaining to the learning objective occurs as a result of poor instructional design. An example of extraneous processing is when the text explanation of an objective is on one page, and the illustration is on another. Cognitive processing is wasted by alternating between the pages. If too much extraneous processing is allowed, there is not enough remaining capacity for productive cognitive processes. An essential quality of the use of MMRs is they activate the generative cognitive process which aims to make sense of the presented material, and its commitment to long-term memory is regulated by the student's motivation to learn the material. Understanding the cognitive theory of multimedia learning offers insight to effective instructional design in the use of MMRs in the classroom (Mayer, 2010).

If DH faculty members understand student learning styles, it is possible to reduce the amount of student frustration with material while improving instructional delivery methods (Murphy, Gray, Straja, & Bogert, 2004). This research study asked PDs to identify learning style assessments available to their currently enrolled students. The VARK, introduced by Fleming, identifies a learner into one of the following four preferred learning modes: visual (V), Aural (A), read/write (R), and kinesthetic (K) to describe how a student uses their senses in information gathering. Previous research

presents the VARK as one of the most common collegiate utilized learning assessments; however, occurrence of use was low in this study, 15%. Another limitation of the survey encompassed failure to ask the 29% of PDs that reported using a learning style questionnaire for their students, but did not select any of the options in the survey, to identify the learning assessment utilized in their program. In addition, extended knowledge is desired in those programs who have implemented some type of learning style assessment and if efforts exist to adapt teaching methodologies to be compatible with the assessment findings. Further study of the validity of learning style assessments and typical dental hygiene student learning styles would be critical in fully understanding educational delivery methods optimal for full objective comprehension.

The average college-aged students are digital natives in that they have not had to adapt to technology. In 2012, over 73% of the population of collegiate student enrollment were identified as belonging to the millennial generation (ages 19-36), representing distinct learning preferences that are changing the environment of the collegiate classroom (NCES, 2013). Specifically in dental hygiene education, the average reported enrollment of millennial students by the respondents was 89% with the mode being 95%; the range contained a minimum of 50% and maximum of 100%. More accurately, 49 of the 78 respondents (63%) reported estimated enrollment of millennial students is between 90 – 100% for the 2016 spring term. In other words, on average, a dental hygiene program is comprised of three-fourths to full enrollment of millennial students, making multimedia learning a current issue. The average person from this generation has not known life without computers or the Internet, gaining instant gratification of instant knowledge. Being a digital native has influenced the way this generation processes

information and is responsible for the detachment of their learning institutions. They are visual communicators as well as quick responders, and they expect a rapid response in return.

Research has revealed that Millennials are predominately visual learners (Oblinger & Oblinger, 2005). Visual learning is identified when students try to construct a coherent mental representation of a concept (Mayer, 2003). Millennials need instant gratification and may become impatient when the material is not always at their fingertips. This generation is more visually literate and more inclined to piece together information from multiple resources rather than have a linear track of learning (Oblinger & Oblinger, 2005). These digital learners access content and engage with lecture slides, narrated PowerPoint presentations, applications on electronic devices, and largely online through videos, electronic articles, blogs, *Google*, e-books, etc. Given that today's learner demands the ability to be involved and engaged anytime and place of their choosing, dental hygiene education is making great strides in adapting with multimedia learning and the delivery options available.

Research also coins Millennials as linked to social media. For example, educators are now using *Twitter* as a vehicle for conversation and collaboration for their classrooms to adapt to student interest and access to information. The social network, including *Facebook* and *Instagram*, is also being used for informal quizzes and polls during lecture (Forgie, 2013). If digital multimedia resources can significantly increase student interest by enabling visual learning, academic institutions must be ready to facilitate the evolution of curriculum delivery away from standalone traditional lecture format.

Nontraditional students are not to be overshadowed in the demographics of current dental hygiene enrollments. The National Center for Education Statistics defines nontraditional (NT) students as meeting one of seven characteristics: delayed enrollment into postsecondary education; attends college part-time; works full time; is financially independent for financial aid purposes; has dependents other than a spouse or is a single parent (National Center for Education Statistics, 2012). This definition does not take NT out of the classification of Millennial as many still belong to the millennial generation. For this study, responses settled within a wide range with the lowest nontraditional student enrollment percentage reported being 5% and the highest equally 100%. The average reported nontraditional student enrollment was 52% with the mode being 50%. Fitting into the definition of a NT student does mean they may have different learning styles and educational delivery needs. Some may have an aversion to technology. In regard to active learning, among expectations of tough classes and remote faculty, these students expect to be lectured to and may view active learning activities as a waste of their time (Cox, 2011). In order to facilitate effective learning, educators must take all preferences and learning needs into account.

Research regarding dental hygiene student learning includes findings of students lacking ownership of their education and relying predominantly on faculty feedback (Gadbury-Amyot, 2016). The basis of active learning is that learning should not be a passive activity done individually outside of the classroom and can be utilized to remedy student engagement to course material. Active learning is defined as a combination of e-learning with instructor-led learning and sometimes is referred to as blended learning. Interactivity within the class encourages engagement with the material. Multimedia can

be used to facilitate a collaborative learning environment. Active learning can be influenced by the use of multimedia to promote discussion and reflection for active learning in the classroom. Patient assessment can involve countless variables including physiological, developmental, environmental, and behavioral factors. The intent of active learning implementation is to develop critical thinking and decision-making skills necessary to provide effective and efficient dental hygiene services. In addition, active learning can facilitate a crucial competency skill that the Commission on Dental Accreditation (CODA) requires of programs, demonstrating self-assessment strategies to identify one's strengths and weakness for self-improvement (Gadbury-Amyot, 2016). These skills combined can guide professional continuing education in order to deliver optimal dental hygiene care. Active learning also allows the faculty to become learning facilitators, not merely distributors of course content, and acts as a catalyst for collaboration amongst classmates. Educators can train on the upper level of the concept rather than the introductory level by using critical thinking and problem solving in the classroom instead of just the fundamentals of the objective.

Specifically, Millennials have greater needs to belong to social groups and to share with others, stronger team instincts, tighter peer bonds, and greater needs to achieve and succeed (Lancaster & Stillman, 2003). A strong argument exists that multimedia learning can facilitate this desired format of active learning that evidence links to academic success of the millennial student.

Detailed analysis of the use of supplemental MMRs to complement traditional educational modalities revealed many factors that are currently circulating through dental hygiene educational curriculum. These files are formatted content utilizing multiple

arrangements of text, audio, still images, animation, video, or interactivity content. When using supplemental MMRs, faculty members can break lessons into learner-controlled segments allowing for the elimination of extraneous material and giving time to highlight essential material and active learning. A recent study published in the Journal of Dental Hygiene from Old Dominion University found this evident while evaluating the effectiveness of simulated mouth models to improve identification and recording of dental restorations compared to traditional didactic instruction. At the conclusion of the study, results yielded a mean average of 86.73 on graded dental charts from the experimental group using the simulated models compared to an average graded score of 74.43 with the control dental hygiene students using two-dimensional pictures (Lemaster, Flores, & Blacketer, 2016). Cognitivists believe that the addition of multimedia can help improve the learning process of students when they see concepts in action (Michelich, 2002). These resources provide asynchronous material that is readily available for a student to access at their own discretion.

With the prevalence of technology in everyday lives, it seems natural to progress into the classroom. At the forefront of this discussion, is the use of electronic textbooks within DH programs. Publishers have quickly developed digital versions of their published material into what are referred to as e-books. Piles of heavy, small print textbooks are being replaced with the use of a home personal computer, laptop, or a tablet that not only houses the text from the published book, but is updated with more images, charts, and links to alternate online resources and interactive self-assessment quizzes to enhance visual learning. Having e-books exclusively available to students is a growing trend in educational institutions. Results from this study demonstrated that just under half, 44% of

reporting programs, utilize e-books, some institutions exclusively. In theory, this could be driven by the overwhelming demand for digital learning material from current collegiate students.

To complement lecture material with e-learning, instructors can create podcasts, a digital recording of a lecture that can be solely auditory or an audio-visual combination that is linked on classroom management sites and made available as a downloadable file for mobile listening. The advantage of making a podcast available to students includes convenience for students that prefer both asynchronous access and delivery. Resource access can be assigned as a requirement and participation is easy to track online. For faculty, podcasts are quick to develop alongside existing lecture material, are relatively inexpensive to produce, and rarely require editing (Stiffler, 2011). Other programs are using 3D imaging software such as *eHuman* and *3DToad* to enhance visual details and demonstrations of anatomy and physiological processes. Audio narration and vivid animation can help students visualize a demonstration of a physical process or reveal relationships between two ideas (Denning, n.d.).

Audiovisual resources can be a powerful communication tool in the classroom for student learning. Videos are a viable solution for delivering instructional materials to students due to technological advances, including, increased bandwidth, user connection speeds, compatibility, and easy to use software provided that the students have adequate training, comfort with computers, and online support (Hartsell & Yuen, 2006; Martindale, 2002). Videos displaying animations may be advantageous by using visual cues to highlight specific components. Some of the most popular textbooks used in DH education, including Darby and Walsh's *Dental Hygiene: Theory and Practice* as well as



Nield's *Fundamentals of Dental Hygiene Instrumentation*, include online section videos over select learning skills in addition to electronic textbook format. Students can slow down or speed up various processes to emphasize concepts that are otherwise invisible to the naked eye (Miller, 2014). With easily accessible media resources to aid understanding, students are not solely dependent on instructor's time to re-explain already covered objectives. Addition of multimedia can improve the learning process as the students get a front row seat to the teaching modules providing a one-on-one instruction feel. A video alone may not be more effective than a textbook for learning an objective. Students can access videos asynchronously, individually at their desired frequency of returning to the material, and in an independent location. They have the authority to determine when to begin, pause, or replay any component of the video to ensure comprehension (Hartsell & Yuen, 2006). This opportunity for visual repetition can allow student clarity of what is being viewed. Table 6 (seen in Appendix 4E) shows PD responses of other alternate formats of MMRs that were not mentioned in the survey.

Faculty in higher education institutions still fall into the perception of teaching with a sole lecture-style method. Lecture can be described as a passive learning method that encourages rote memorization and note-taking as a means to assimilate knowledge. Even in 2004, Murphy, Gray, Straja, and Bogert suggested student frustrations in learning included the disparity between learning and the delivery of instruction (Murphy, Gray, Straja, & Bogert, 2004). Millennial students crave a more collaborative learning environment and peer research states that students today seek visual resources for explanation. Results of this study illustrate that dental hygiene programs are meeting this demand. A high majority of programs reported using some type of videos in the

classroom: 59 PDs reported using *YouTube* videos, 47 reported using original faculty-created videos, and 43 reported using videos from textbook publishers. Limitations discussed in the literature review such as download speed due to bandwidth availability or limited access to technology, though present, did not reveal significant issues within the results.

The use of multimedia resources has not only made strides in increasing visual stimulation and student learning interest, but it has also quickly evolved the presence of online learning, often referred to as e-learning, web-based learning (WBL), or distance learning. Distance instruction is characterized in multiple ways, including, by a division in place and/or time between the learner and the teacher, or by the student and the learning resources (Mitchell, Gabbury-Amyot, Bray, & Simmer-Beck, 2007; National Center for Education Statistics, 2011). This option is also described as an active delivery of learning material via electronic media that can include a combination of text, audio, visual, animation, and images (Wood, 2010). E-learning is now widely used in many healthcare schools as either a supplement to live lectures or as a standalone course where physical presence is not required. The interactivity of online learning can help maintain a student's interest and motivation to continue with the material. Research indicates that web-based learning increases student preparation, confidence, retention of knowledge, problem-solving, and (student) engagement.

Similarly, research has also demonstrated that students have trouble progressing from basic rote memorization to conceptual reasoning and problem-solving (Miller, 2014). Educators can develop videos demonstrating relevance of material to actual practice that can be used outside the classroom saving valuable class time. This allows for active

learning and peer collaboration, discussion, and practice. Continued access to these videos while in the program of study will be an easily accessible way to refresh earlier concepts and objectives. The opportunity for repetition allows for practice and reinforcement that may increase student learning where traditional class lectures may not have time allowances.

In this study, 69% of programs that offer online courses reported to having a professional course designer that work with the faculty to best deliver necessary course information. Providing this support can alleviate potential barriers to MMR availability or faculty aversion to spending the time necessary to create effective resources. Of the institutions offering e-learning, many programs offer core online dental hygiene courses early in the academic sequence. One reporting institution claimed all DH courses were “offered online with the exception of lab and clinicals.” Another testified that all core DH courses consisted of a hybrid delivery, partial online access, and partial real-time lecture. It is typical, as shown by survey results, that Bachelor of Science Degree Completion Programs are almost 100% online. Several PDs reported the same for Master’s Degree Programs.

Even if a course is not restricted to online delivery, many resources can be made accessible. One of the most beneficial resources to students can be practice quizzes from lecture material. Current research demonstrates that retrieval practice is actually a powerful mnemonic enhancer, often producing large gains in long-term retention relative to repeated studying. Retrieval practice is often effective even without feedback (i.e. giving the correct answer). In addition, self-assessment practice promotes the acquisition of knowledge that can be flexibly retrieved and transferred to different contexts. Study

results recounted that on-demand self-assessments are also available in various online gaming formats to enhance student interest and participation. For example, several PDs reported using an online site called *Kahoot!* in which instructors can create fun and interactive learning games by adding videos, diagrams, and images to engage students. Students answer on their own electronic device while the game is played on a shared screen while in the same room or playing offsite on their own time (Kahoot!, 2016). *EDpuzzle* is another site PDs cited using that claims to save time by uploading preexisting videos from other online servers like *YouTube* or *Khan Academy*, or allows personal video uploads. Instructors can engage students with self-paced, interactive lessons and reinforce accountability by tracking the student's views and quiz scores (EDpuzzle, 2016). A significant number of dental hygiene programs are using Audience Response System Classroom Clickers. Many options do not require separate hardware but can operate with responses from student devices including smartphones or tablets. Not only can educators poll students' understanding and quiz for comprehension, but using a response system can allow time for active learning opportunities. In dental hygiene education, facilitating exams either for course assessment, or practice quizzes, is used in efforts to prepare students with familiarity of taking the National Board Dental Hygiene Examination that is exclusively offered as a computer-based examination. Retrieval practice can be an integral component of building self-assessment skills, including self-directed learning, that dental hygiene students are required to master by CODA before entering the professional environment.

Dental hygiene learning often requires pictorial (static or dynamic) and verbal instruction. When asked for their opinion if MMRs would enhance objective

comprehension with visualization of the subject matter, 95% of PDs agreed. Ninety-six percent (percentages differ as 1 respondent skipped this question) reported seeking out MMRs to supplement their personal instructional strategies. In addition to the information above, the study demonstrates evidence that DH programs are complying with digital demands as 85% of responding administrators indicating that at least one type of electronic device is necessary to view available resources posted for student use.

Dental hygiene faculty must understand how to use media content to create new teaching methodologies and active learning activities using new technologies. Media learning is not a question of textbook versus video instruction; learning effectiveness depends on how the instructor is using the material and what the student is doing with this new information. Eighty-eight PDs testified to actively seeking new MMRs to supplement classroom instruction, an overwhelming percentage. This testifies to the comprehension of educators in the science of learning and the necessary means to digitally engage students. When creating an original format of MMR, educators can control information content. The most significant barrier administrators reported for using or creating MMR was lack of time to create resources (31%). Creating digital media resources can be consuming by requiring significant preparation time, but the benefits to the students are numerous. The key to effective MMR creation is instructor preparation and the time commitment is negligible once the video is complete and may be used repeatedly. Universal transition to formats of MMRs by all faculties could possibly be limited by instructor confidence in computer skills or abilities to create original formats of MMRs. Limitations can also include a general aversion to technology.

## ***Conclusion***

Today's traditional college students are digital learners in part because they are digital natives. Technology has drastically changed the delivery of collegiate education as educators attempt to improve student learning and satisfaction with the academic environment. Education methodology research is discovering that college students' learning styles require audile and visual modalities to be included with or replace the traditional classroom lecture. Specifically concerning dental hygiene education, many students may struggle in progressing from rote memorization to satisfy learning in introductory courses to critical thinking and application of clinical concepts. Since mastery of these concepts is crucial for successful completion of dental hygiene education, adding multimedia resources to facilitate multimedia learning can improve the cognitive learning process for these students as the today's collegiate student is likely to be visually literate. By creating multimedia resources, faculty can augment material from the text and stimulate learning of difficult subject matter.

With the demand of media usage in collegiate educational delivery methods, this research study aimed to identify the technological presence in dental hygiene educational modalities to allow allied dental education insight into the most common curricular instructional strategies pertaining to multimedia resources. This study was able to quantify the use of specific multimedia resources in dental hygiene curriculum. The thesis question inquired if the use of multimedia resources in the dental hygiene classroom is standard practice across all programs in the nation in order to comply with the audio-visual learning styles of today's college student.

To answer the thesis question, this research study evaluated survey responses of dental hygiene program directors across the United States regarding the use of

multimedia resources to supplement lecture information throughout the curriculum. Successfully achieving the aim of this study, with the results it can be inferred that the use of multimedia resources is standard practice for most dental hygiene programs as they adapt to the digital demands of current college students. And though the majority of program directors reported being confident in both seeking and creating original media resources, it is not a common practice for DH programs to mandate specific types of multimedia resource use at this time. The results validate pre-existing views of media formats being a common practice to enhance student learning and offers insight into the frequency of programs mandating the use of specific media-learning formats or delivery methods.

Types of media used in the classroom include videos, audio-recorded lectures, online games, and social media. Videos specifically can be a powerful teaching instrument when used in conjunction with other delivery methods in modern education. These videos can bring life with animation to many complex educational concepts by demonstrating abstract ideas. Frequency of watching a short video can support the theory that repetition sustains concept retention. With various options of media available in the classroom, instructors must ultimately decide on the most effective media teaching module for their classroom.

The response rate could also be a limitation as the confidence of overall population inference for dental hygiene program directors would be higher with more survey responses. Further study is recommended to explore the option of covering certain course objectives solely outside live lectures to save valuable class time. Supplementary investigation of the use of learning style questionnaires to determine the most effective

media delivery methods for students would also be beneficial to dental hygiene educators.

These findings are significant to dental hygiene education due to the increasing faculty awareness of the evolving learning style preferences for current college students that includes multimedia resources, especially video formats for curricular supplementation. Media formats may eventually be a standard requirement complement to information presented in traditional classroom lectures or published text. Study implications may include exploration of options for media delivery methods for dental hygiene programs by comparison of existing resources being utilized to the testimony of other dental hygiene programs across the nation. For example, programs may discuss transitioning to e-books for education material, or programs may investigate creating an original narrated instructional video for concept comprehension.

With emphasis on educational delivery involving the use of multimedia resources, students are no longer bound to the traditional classroom as material is constantly available through a continuous digital connection. Students are already utilizing these technologies and it is time for educational institutions and instructors to embrace this educational movement. For those institutions not currently using multimedia resources on a large scale, change in curricular delivery must begin with the educators. It is also evident that although faculty requirements to utilize MMRs exist, most are not significant enough to be generalized to the entire population of dental hygiene education programs. With high significance in the study results, it is evident that use of MMRs is frequent in current dental hygiene curriculums and implies utilization of supplemental multimedia



resources presents as standard practice in dental hygiene education to improve student learning.

## APPENDICES

### APPENDIX A: UNM HRRC/HRPO Approval Letter



Human Research Review Committee  
Human Research Protections Office

March 9, 2016

Christine Nathe, RDH, MS University of New Mexico MSC09 5020  
Albuquerque, NM 87131 (505) 272-8147  
Fax: (505) 272-5584  
CNathe@salud.unm.edu

Dear Ms. Nathe:

On 3/8/2016, the HRRC reviewed the following submission: Type of Review: Initial Study

Title of Study: THE USE OF SUPPLEMENTAL MULTIMEDIA RESOURCES TO COMPLIMENT DENTAL HYGIENE STUDENT LEARNING

Investigator: Christine Nathe, RDH, MS  
Study ID: 16-040  
Submission ID: 16-040

IND, IDE, or HDE: None

Submission Summary: Initial Study - Multimedia Use in Dental Hygiene Student Learning

Documents Approved: HRP-581 - MMR Use Protocol 1/26/16  
Participant Survey  
Consent Form Final 1/26/16

Review Category: Exemption: Categories (2) Tests, surveys, interviews, or observation

Determinations/Waivers: Requires written statement about research  
HIPAA Authorization Addendum Not Applicable

Submission Approval  
Date: 3/8/2016  
Approval End Date: None  
Effective Date: 3/8/2016

The HRRC approved the study from 3/8/2016. If modifications were required to secure approval, the effective date will be later than the approval date. The “Effective Date” 3/8/2016 is the date the HRRC approved your modifications and, in all cases, represents the date study activities may begin.

Because it has been granted exemption, this research is not subject to continuing review.

Please use the consent documents that were approved and stamped by the HRRC. The stamped and approved consents are available for your retrieval in the “Documents” tab of the parent study.

This determination applies only to the activities described in this submission and does not apply should you make any changes to these documents. If changes are being considered and there are questions about whether HRRC review is needed, please submit a study modification to the HRRC for a determination. A change in the research may disqualify this research from the current review category. You can create a modification by clicking Create Modification / CR within the study.

In conducting this study, you are required to follow the Investigator Manual dated April 1, 2015 (HRP-103), which can be found by navigating to the IRB Library.

Sincerely,

Thomas F. Byrd, MD  
HRRC Chair

## **APPENDIX B: Informed Consent – Invitation to Participate in Research**

### **The University of New Mexico Health Sciences Center**

#### **Informed Consent Letter for Anonymous Surveys**

##### **The Use of Supplemental Multimedia Resources to Compliment Dental Hygiene Student Learning**

Dear Program Directors:

You are invited to participate in a research study by Christine Nathe RDH, MS and Co-Investigator Diana Graham, RDH MS(c) from the Department of Dental Medicine. We are conducting this study due to the peaked interest in evolving education modalities to match the demand for digital information.

#### **Purpose**

The purpose of this study is to examine the use of supplemental multimedia resources in the dental hygiene education curriculum while surveying dental hygiene program directors across the country.

#### **Procedure**

You are being asked to participate in this study because you are a dental hygiene program director. Your involvement in the study is voluntary, and you may choose not to participate. Your participation will involve taking a brief survey that will take about 10 minutes to complete. The survey includes questions such as the types of multimedia resources that are utilized by faculties in the didactic classroom. There is no compensation for participating and you may decline to answer any of the questions at any time.

#### **Benefit and Risk**

Benefits from taking part in this research will assist in the progression of gathering answers to student learning in the science of education. Results will allow comparison of present methods and resources being utilized in your curriculum with the rest of the dental hygiene educational programs in the country.

There are no known risks in this study, but some individuals may experience discomfort when answering questions.

#### **Confidentiality**

There are no names or identifying information associated with this survey. All data will be kept for 1 year in a locked file in Christine Nathe's office and then destroyed.

The findings from this project will provide information on the types and frequency of use in multimedia resources in the didactic classroom for dental hygiene students. If published, results will be presented to you in summary form.

**Questions**

If you have any questions about this research project, please feel free to call Christine Nathe RDH, MS at (505) 272-4513 or Diana Chapman RDH, MS(c) at (575) 302-9539. If you have questions regarding your legal rights as a research subject, you may call the UNM Office of the IRB (OIRB) at (505) 277-2644.

**Electronic Consent**

*By clicking the survey link below you are consenting to participate in the study.*

Follow this link to take the survey: <https://www.surveymonkey.com/r/Z5VGHQP>

Your time and participation is greatly valued.

Sincerely,

Principle Investigator: Christine Nathe RDH, MS  
Vice Chair, Department of Dental Medicine

Co-Investigator: Diana E. Graham RDH, MS(c)  
Master Degree Candidate

## APPENDIX C: *SurveyMonkey* Research Survey

### 1. Welcome

**Thank you for participating in our survey. Your feedback is important.**

## 2. Demographics

1. Which of the following educational settings best describes where your dental hygiene program is administered?

- University or four-year college: School of Health Sciences
- University or four-year college: Dental School
- University or four-year college: Separate dental department
- Other university or four-year college setting
- Community or junior college
- Technical college or institute
- Vocational school or career college

2. What is the highest level of degree in dental hygiene your institution offers?

- Certificate of Completion
- Associate of Occupational Science in Dental Hygiene
- Associate of Applied Science in Dental Hygiene
- Associate of Science in Dental Hygiene
- Bachelor of Science in Dental Hygiene
- Master of Science in Dental Hygiene

3. What is the highest level of education you have earned?

- Bachelor of Science in Dental Hygiene and currently enrolled in a Master's Program
- Master of Science in Dental Hygiene
- Master of Arts or Science (Other Discipline)
- Doctor of Dental Surgery or Doctor of Dental Medicine
- Doctor of Philosophy in Education
- Doctorate (Other Discipline)

4. How many years has your dental hygiene program been operating with full accreditation from CODA?

5. Using the below table as a guide, please select the region of the United States that your Dental Hygiene Program resides.

(United States Census Bureau, 2015; National Geographic, 2015)

\*The National Center for Education Statistics defines **nontraditional students** as meeting one of seven characteristics: delayed enrollment into postsecondary education; attends college part-time; works full time; is financially independent for financial aid purposes; has dependents other than a spouse; is a single parent" (National Center for Education Statistics, 2012).

6. To the best of your knowledge, what percentage of your actively enrolled students are classified as non-traditional students?

7. To the best of your knowledge, what percentage of your actively enrolled students are between the ages of 19 and 36 (belonging to the millennial generation)?



### 3. Use of Multimedia Resources

Multimedia Resources (MMR) involve digitally formatted content that uses multiple types of formatting: text, audio, still images, animation, video, or interactivity content forms. Examples include:

o **Mass published or self-created downloadable videos**

- Animated Videos
- Real Time Videos

o **Streaming Videos from an internet site. For Example:**

- YouTube
- KhanAcadamy

o **E-Textbooks**

o **Lecture Podcasts**

- Recorded lecture (audio only)
- Recorded lecture (audio-visual)

8. Are you familiar with the variable options of multimedia resources(MMR) that are available to use as instructional aids in education?

Yes

No

#### 4. The Use of Multimedia Resources

9. Please answer Yes or No to the following questions.

	Yes	No
Do you think that some courses have difficult objectives where the use of a MMR (i.e. a video) would enhance objective comprehension by the enhancing visualization of the subject matter?	<input type="radio"/>	<input type="radio"/>
Do you seek out multimedia resources to supplement instructional strategies for a course, either on ground or online course?	<input type="radio"/>	<input type="radio"/>
Have you ever created your own multimedia resource to use as a supplement to instruction?	<input type="radio"/>	<input type="radio"/>
Do you have other faculty who create their own MMR for their course material?	<input type="radio"/>	<input type="radio"/>

10. What formats of multimedia resources(MMR) have either you created in the past, or that you have knowledge of another faculty member creating? *(Please select all that apply.)*

<input type="checkbox"/> Recorded lecture (audio only)	<input type="checkbox"/> Using Social Media
<input type="checkbox"/> Recorded lecture (audio-visual)	<input type="checkbox"/> Downloadable videos recorded in real time
<input type="checkbox"/> YouTube video	<input type="checkbox"/> Downloadable animated videos using electronic software
<input type="checkbox"/> Online Game	<input type="checkbox"/> None: Neither I nor a faculty member of this program have ever created a multimedia resource

11. Have you ever used any of the following programs to create multimedia resources? *(Please select all that apply.)*

<input type="checkbox"/> TechSmith: Camtasia	<input type="checkbox"/> Windows Movie Maker
<input type="checkbox"/> Voki Classroom	<input type="checkbox"/> None of the above
<input type="checkbox"/> Microsoft PowerPoint	

12. Do you encourage faculty to seek supplemental MMR on their own?

Yes  
 No

13. Do you have any faculty members that have an aversion to using forms of technology (including online course management systems, online resources, etc)?

Yes  
 No

14. What online course management systems does your program utilize? (If multiple, please select the primary system.)

- |   |  |
|---|--|
| <input type="radio"/> WebCT               | <input type="radio"/> Pearson Learning Studio                                |
| <input type="radio"/> Blackboard Learning | <input type="radio"/> Evolve (Elsevier) Course Management                    |
| <input type="radio"/> Desire2Learn        | <input type="radio"/> None of the above listed                               |
| <input type="radio"/> Canvas              | <input type="radio"/> None, we do not use an online course management system |
| <input type="radio"/> Moodle              |  |

## 5. The Use of Multimedia Resources

The following are examples of common types of multimedia resources (MMR) that are used in education:

### Electronic Text

- o E-Textbooks

### Podcasts

- o Recorded lecture (audio only)
- o Recorded lecture (audio-visual)

### Videos

- o Original video created by your school or faculty member
- o Textbook published Videos
- o YouTube Videos
- o Khan Academy Videos
- o MedEd Portal Videos
- o Videos/Animations from other internet sources

### Online Games

- o Jeopardy
- o PassIt!

### On-Demand

#### Self-Assessments

- o Peerwise
- o Online instructor-created practice quizzes
- o Poll Everywhere

### Social Media

- o Facebook
- o Twitter
- o Instagram
- o Pinterest

15. Please select any of the following types of multimedia that is currently being used to enhance information presentation in courses offered through the program (NOT including online courses). *(Please select all that apply.)*

- |  |  |   |
|--|--|---|
| <input type="checkbox"/> E-Textbooks   | <input type="checkbox"/> MedEd Portal Videos                           | <input type="checkbox"/> Facebook   |
| <input type="checkbox"/> Recorded lecture (audio only)                           | <input type="checkbox"/> Videos/Animations from other internet sources | <input type="checkbox"/> Twitter  |
| <input type="checkbox"/> Recorded lecture (audio-visual)                         | <input type="checkbox"/> Online Jeopardy                               | <input type="checkbox"/> Instagram  |
| <input type="checkbox"/> Original video created by your school or faculty member | <input type="checkbox"/> PassIt! (Dental Hygiene)                      | <input type="checkbox"/> Pinterest  |
| <input type="checkbox"/> Textbook published Videos                               | <input type="checkbox"/> Peerwise Self Assessment                      | <input type="checkbox"/> None of the above formats are used in this program |
| <input type="checkbox"/> YouTube Videos  | <input type="checkbox"/> Online instructor created practice quizzes    |   |
| <input type="checkbox"/> Khan Academy Videos                                     | <input type="checkbox"/> Poll Everywhere                               |   |

16. Please list any format of multimedia that is currently being used to enhance information presentation in courses offered through your program that was not listed above.

17. Please select the courses that currently use the above selected type of multimedia resource as a supplemental delivery method for course material. (Select all that apply.)

- |   |  |  |
|---|--|--|
| <input type="checkbox"/> Dental Anatomy/Histology     | <input type="checkbox"/> Dental/Biomaterials | <input type="checkbox"/> Clinic Theory                       |
| <input type="checkbox"/> Head & Neck Anatomy          | <input type="checkbox"/> Local Anesthesia    | <input type="checkbox"/> Special Needs/Medically Compromised |
| <input type="checkbox"/> General Anatomy & Physiology | <input type="checkbox"/> Pharmacology        | <input type="checkbox"/> Oral Pathology                      |
| <input type="checkbox"/> Nutrition                    | <input type="checkbox"/> Research            | <input type="checkbox"/> Community Public Health             |
| <input type="checkbox"/> Radiology                    | <input type="checkbox"/> Periodontology      | <input type="checkbox"/> Cariology                           |

18. Please list any courses that currently use the above selected types of multimedia resources as a supplemental delivery method for course material that was not listed above.

19. Please rate the top 3 types of multimedia used in the curriculum most often to enhance material presentation?

- Recorded lecture (audio only)
- Recorded lecture (audio-visual)
- Original video created by school or instructor
- Videos from textbook
- Videos/Animations from other internet sources
- Electronic document transfer
- E-Textbooks
- None of the above

20. How many years would you estimate these courses have been using supplemental multimedia resources to present to the students?

21. NOT including online courses, what is the percentage of courses in your curriculum that present material in which the students need an electronic device to view course material?

22. Which of the following electronic multimedia devices are necessary or required to facilitate all delivery methods presented in any given course for the program? *(Please select all that apply.)*

- Personal Computer/Laptop
- Personal Tablet/Notebook
- Personal Smartphone
- None of the above

23. Does your dental hygiene program issue any of the following electronic devices for student use (either for the student to keep or to return after completion of the program)?

- Computer/Laptop
- Tablet/Notebook
- Smartphone
- No, we do not issue any type of electronic devices

24. Do your students experience any of the following barriers in using MMR either on or off campus? *(Please select all that apply.)*

- Slow internet connection
- Bandwidth problems
- Software compatibility
- None of the above

25. Does your program offer computer-based course exams (in any course of the curriculum) to familiarize students with computer-based National Board Dental Hygiene Examination?

- Yes
- No

26. Do you encourage an online review program to your students in preparing for the National Board of Dental Hygiene Exam?

- Yes
- No

*Learning Style Questionnaire*

27. Have you ever encouraged or required your students to take a learning assessment questionnaire while actively enrolled in the program?

Yes

No

28. Does your program encourage or require students to take any of the following learning style questionnaires?

VARK

Kolb's Model

Honey and Mumford LSQ

National Association of Secondary School Principals (NASSP)

Our Academic institution has created a learning style assessment that the students take

Yes, but none of the above

We do not use or encourage a learning style questionnaire

29. Please answer Yes or No to the following questions.

	YES	NO
Are you confident in your computer skills?	<input type="radio"/>	<input type="radio"/>
Are you confident in your ability to link online multimedia resources to other documents?	<input type="radio"/>	<input type="radio"/>
Are you confident in your ability to create your own multimedia resource?	<input type="radio"/>	<input type="radio"/>
Are you familiar with any multimedia resources through the content of your textbook publishers?	<input type="radio"/>	<input type="radio"/>

30. During curriculum review, does the availability of e-resources affect your textbook choice for a course?

- Yes  
 No

31. Do you require your faculty members to use media delivery methods in their courses?

- Yes  
 No

32. If you selected yes, please select the types of supplemental multimedia resources your faculty are required to use as a part of their course(s).

- |   |  |
|---|--|
| <input type="checkbox"/> Recorded lecture (audio only)                  | <input type="checkbox"/> Videos/Animations from other internet sources |
| <input type="checkbox"/> Recorded lecture (audio-visual)                | <input type="checkbox"/> Electronic document transfer                  |
| <input type="checkbox"/> Original video created by school or instructor | <input type="checkbox"/> E-Textbooks                                   |
| <input type="checkbox"/> Textbook published Videos                      | <input type="checkbox"/> None of the above                             |
| <input type="checkbox"/> YouTube  |  |



35. Which of the following barriers does your faculty currently experience in the use of supplemental multimedia resources? *(Please select all that apply.)*

- Lack of resource availability
- Lack of time to create media resources
- Lack of faculty training in the various media types available
- We do not experience any of the above barriers
- Lack of faculty training in ways to use various types of media resources
- We do not use supplemental multimedia resources
- Lack of knowledge in ways to create resources

36. Do you offer general faculty development exercises through online modalities?

- Yes
- No

37. If yes, how often do you require completion of online faculty development?

- N/A
- Weekly
- Monthly
- Biannually
- Annually
- Courses are available to be completed at the pace of the faculty member

38. Distance education is defined as any dental hygiene course where 90% of the material is delivered to the learners at a distance from the presenting institution (Grimes, 2002).

Does your Dental Hygiene Program offer distance education courses via online delivery?

- Yes
- No

39. Please provide the names of the distance education courses via online delivery.

40. How long has your program has been utilizing distance education?

41. Does your institution offer any professional instructional designers for the online courses included in your curriculum that work with faculty to best provide online education (not including IT support)?

- Yes
- No

42. Please note if you agree or disagree with the following statements:

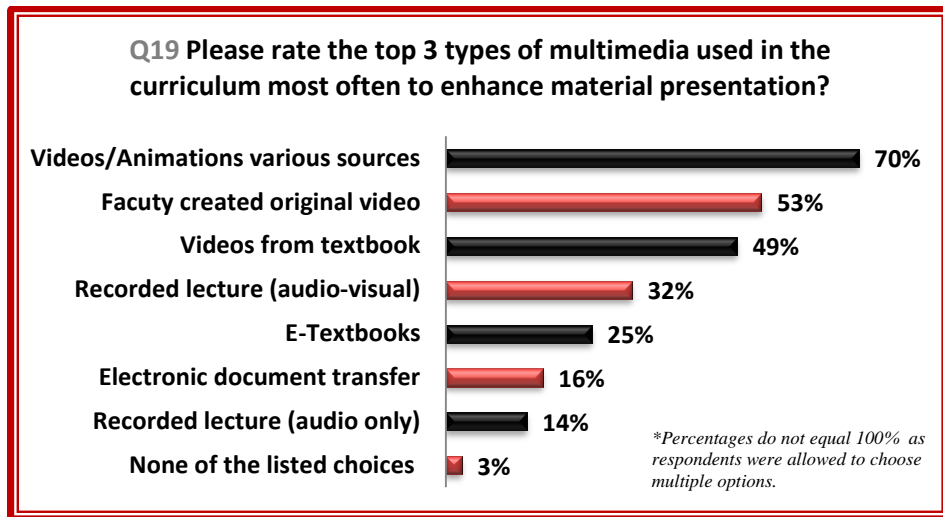
	Agree	Disagree	No Opinion
I believe that active learning can be facilitated through online learning comparable to active learning that happens in the classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe the use of multimedia resources outside of the classroom will provide the time to facilitate active learning in the classroom setting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The use of multimedia resources will become the standard for dental hygiene education in the future.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I expect the amount of face-to-face interaction between students and faculty will be less with consistent use of MMR <u>outside</u> the classroom.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**APPENDIX D: Supplementary Data Figures/Tables Not Included in Body of Text**

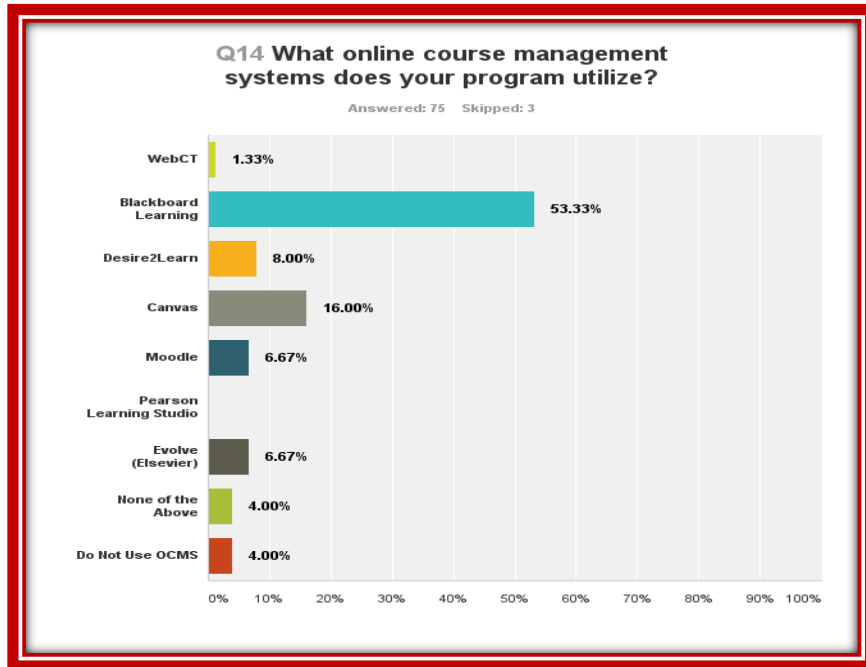
**D.1: Chart of US Regions from National Geographic** (National Geographic, 2015)

NORTHEAST	MIDWEST	WEST	SOUTHEAST	SOUTHWEST
Connecticut	Illinois	Colorado	Delaware	Arizona
Maine	Indiana	Idaho	District of Columbia	Texas
Massachusetts	Michigan	Montana	Florida	Oklahoma
New Hampshire	Ohio	Nevada	Georgia	New Mexico
Rhode Island	Wisconsin	Utah	Maryland	
Vermont	Iowa	Wyoming	North Carolina	
New Jersey	Kansas	Alaska	South Carolina	
New York	Minnesota	California	Virginia	
Pennsylvania	Missouri	Hawaii	West Virginia	
	Nebraska	Oregon	Alabama	
	North Dakota	Washington	Kentucky	
	South Dakota		Mississippi	
			Tennessee	
			Arkansas	
			Louisiana	

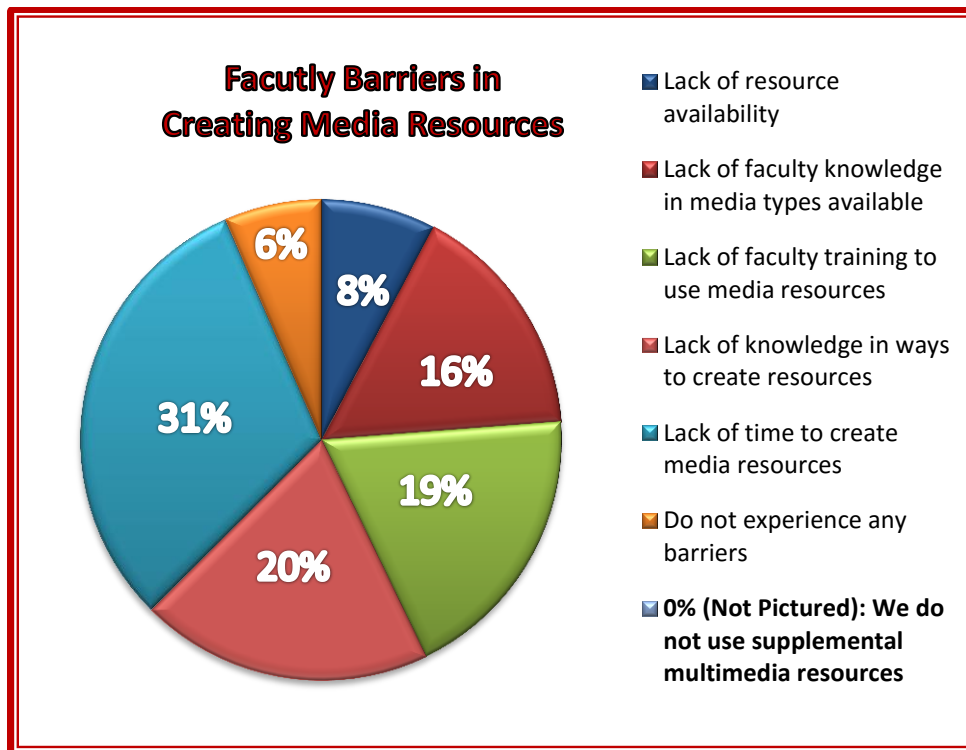
**D.2: Top 3 Rated MMR Used by DH Programs**



### D.3: Options for Course Management System Use



### D.4: Faculty Barriers in Creating Media Resources



## D.5: Formats of Multimedia Used in the DH Classroom

<b>Table 6: Formats of Multimedia Used in the DH Classroom (Not Listed in Q15)</b>	
<b>Online Interactive Quizzes, Games &amp; Tutorials</b>	
Kahoot! (4)	
Elsevier Online DH NB board testing	
Edpuzzle (2)	
Web Conferencing Classrooms	
<b>Video Capture Software</b>	
AdobeConnect	
Panopto (Lecture Capture Video Software) (2)	
Doceri (Interactive Whiteboard for iPad)	
iTunesU	ScreenCast
iBook (2)	Socrative
Prezi	E-Human
<b>Interactive Audience Response - Clickers</b>	
Audience Response System Classroom Clickers (Turningtech or Others) (8)	
<b>3D Imaging Tutorials</b>	
3D Toad (2)	
E-Human	
<b>Other Responses</b>	
Online/Digital Flashcards (like Quizlet) (2)	
Interview Stream	
Engrade McGraw-Hill (Course and Learning Management)	
Blue Spot Web Design	
<i>*The number in ( ) is the amount of times the response were recorded.</i>	

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