Use Authorization

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Idaho State University, I agree that the Library shall make it freely available for inspection. I further state that permission to download and/or print my thesis for scholarly purposes may be granted by the Dean of the Graduate School, Dean of my academic division, or by the University Librarian. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature _____

Date _____

EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

By

Carri Shamburger

A thesis

Submitted in partial fulfillment

Of the requirements for the degree of

Master of Science in the Department of Dental Hygiene

Idaho State University

Summer 2014

COMMITTEE APPROVAL

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of CARRI SHAMBURGER find it satisfactory and recommend that it be accepted.

_____

JoAnn Gurenlian, RDH, PhD

Major Advisor

_____

Kandis Garland, RDH, MS

Committee Member

_____

Chris Sanford, PhD, CCC-A

Graduate Faculty Representative

Idaho State
UNIVERSITY

Office for Research Integrity

921 South 8th Avenue, Stop 8046 • Pocatello, Idaho 83209-8046

April 21, 2014

Carri Shamburger 13802
Arboretum St. Anchorage, AK
99516

RE: Your application dated 4/17/2014 regarding study number 4080: Evaluating the Effect of Multimedia Learning on the Teaching of Extraoral Fulcrum Use to Dental Hygiene Students

Dear Ms. Shamburger:

Thank you for your response to requests from a prior review of your application for the new study listed above. Your study is eligible for expedited review under FDA and DHHS (OHRP) 7. Individual or group behavior designation.

This is to confirm that your application is now fully approved. The protocol is approved through 4/21/2015.

You are granted permission to conduct your study as most recently described effective immediately. The study is subject to continuing review on or before 4/21/2015, unless closed before that date.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Thomas Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Research& Graduate Studies

UNIVERSITY of ALASKA ANCHORAGE 3211 Providence Dr.
Anchorage, Alaska 99508-4614
T 907·786·1099,
F 907·786·1791
www·uaa·alaska·edu/research/ric

DATE: April 25, 2014

TO: Carri Shamburger, AA, BS, MS
FROM: University of Alaska Anchorage IRB

PROJECT TITLE: [601971-1] EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON THE TEACHING OF EXTRAORAL FULCRUM USE TO DENTAL HYGIENE STUDENTS
SUBMISSION TYPE: New Project

ACTION: APPROVED
DECISION DATE: April 25, 2014
REVIEW TYPE: Expedited Review

Your proposal received an expedited review and was granted approval. In keeping with the usual policies and procedures of the UAA Institutional Review Board, your proposal is judged as fully satisfying the U.S. Department of Health and Human Services requirements for the protection of human research subjects (45 CFR 46 as amended/revised). This constitutes approval for you to conduct the study.

This approval is in effect for one year. If the study extends beyond a year from the date of this submission, you are required to submit a progress report and to request continuing approval of your project from the Board. At the conclusion of your research, submit the required final report to the IRB. These report forms are available on IRBNet.

Please report promptly proposed changes in the research protocol for IRB review and approval. Also, report to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

On behalf of the Board, I wish to extend my best wishes for success in accomplishing your objectives

Lance Howe, Ph.D.

Co-Chair, Institutional Review Board

ACKNOWLEDGMENTS

The author thanks thesis committee members JoAnn Gurenlian RDH, PhD, Kandis Garland RDH, MS and Chris Sanford, PhD, CCC-A of Idaho State University for their support and guidance. The author also thanks Program Director Sandra Pence RDH, MS, and faculty members Sue Gregg, RDH, BS and Elizabeth Barnett, RDH, BS from the Department of Dental Hygiene at the University of Alaska, Anchorage for their assistance and support of the study. A special thank you to Sarah Shimer, MPH, Research Associate from the Institute for Circumpolar Health Studies at the University of Alaska, Anchorage for her statistical analysis.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

1. MMI – Multimedia Information

GLOSSARY

The following terms and definitions were used throughout the study and explain the conceptual and operational terms for this study. For the commonality of definitions used in dental hygiene, textbooks are used as reference.

Control – actions taken to maintain proper stability and manipulation of the dental hygiene instrument (Neild-Gehrig, 2013a). Control was measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Critical thinking – Higher-level of thinking and reasoning

Didactic – a teacher-centered instructive pedagogy used for presenting information.

Effectiveness – capacity of producing desire results or effect. For the purpose of this study, effectiveness was measured by the removal of eight simulated pieces of calculus on the maxillary root surfaces of a dentaform. An evaluation of the complete removal of each simulated calculus deposit using an extraoral fulcrum was used to assess for effectiveness. The goal was to determine if the effectiveness of one group of students was statistically different than the other.

Extraoral fulcrum - stabilization of the clinician's hand outside the patient's mouth, against the cheek, jaws and chin. An extraoral fulcrum may be used with a mirror (Neild-Gehrig, 2013b).

Fulcrum – a finger rest used to stabilize the clinician's hand during periodontal debridement. An effective, well established finger rest is essential for stability, unit control, prevention of injury, control of stroke length and comfort to the patient (Neild-Gehrig, 2013b).

Intraoral fulcrum – stabilization of the clinician's dominant hand by placing the pad of the ring finger on a tooth near the tooth being instrumented (Neild-Gehrig, 2013a).

Multimedia Instruction (MMI) – the use of more than one type of media and integrating the use of text, graphics, sound, or video

Observation – the act of viewing or noticing an occurrence. Observation was used to assess the student's ability for control. For the purpose of this study, control, skill and safety were observed and evaluated using a task analysis rubric. (Appendix A).

Safety – the freedom from injury, danger or harm. Safety was measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Skill – competent in performance due to knowledge and experience. Skill will be measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Task Analysis - the analysis of how a task is accomplished and discovers if a person has or has not mastered it, as well as analyzes the information processing of the task and whether it is easy or problematic. For the purpose of this study, task analysis was performed to access the effect of MMI on the education of extraoral fulcrums.

Traditional Educational Methodology – for the purpose of this study, traditional education methodology was defined as the transmission of skills, facts, and standards in the classroom setting and involves lecture, or demonstration, and memorization.

ABSTRACT

EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

Purpose: The aim of the study was to evaluate the effect of Multimedia Information (MMI) to teach the skill of using an extraoral fulcrum as compared to a traditional lecture-based teaching experience.

Methods: Fourteen first year dental hygiene students were randomly placed in a treatment group or control group. A MMI video was used as an adjunct to teaching extraoral fulcrum skills and measured through a practical skills exam.

Results: There were no significant differences between the groups in mean age, sex and dental knowledge. A multinomial repeated measure regression was used to assess differences between the two groups. Assessment of the skill acquisition of an extraoral fulcrum appeared higher for the treatment group exposed to MMI ($p = .05$) compared with the control group.

Conclusion: Further research is warranted for learning environments with larger samples. Additional studies should examine multimedia use in dental hygiene curriculum for instruction and training.

SECTION I

CHAPTER 1

Introduction

In the first textbook for dental hygiene, *Mouth Hygiene, A Course of Instruction for Dental Hygienists* (Fones, 1921), the dental prophylaxis is defined as "that scientific effort, either operative or therapeutic, which tends to prevent diseases of the teeth and their surrounding tissues"(p.234). Even though this text was written almost 100 years ago, many of the principles covered on the dental prophylaxis are still relevant today. Fones stated that the dental hygienist's responsibilities are to include the removal of the heavy tartar deposits, large accretions, and accumulations of stain and plaques (Fones, 1921). Fones (1921) presents detailed instructions of hand instrumentation with scalers to remove "tartar" deposits from "above" and "below" the periodontium of surrounding teeth (p.239). Those instructions still stand today; however, techniques in dental hygiene practice have significantly changed and advanced since the profession began in the early 1900s. New techniques and advancements include the progression of dental hygiene instruments and their purpose. Advancements in instrument design have improved access to deep periodontal pockets, furcations, posterior deposits, and have improved ergonomics for the clinician.

Dental hygiene instrumentation and scaling involves the effective removal of deposits and biofilm from the tooth crown and root surfaces safely without patient or clinician injury. In order for this to occur, the clinician must use the appropriate techniques and instruments for thorough debridement. These appropriate techniques include the use of safe, stable and secure fulcrums. Fulcrums are finger rests that are used to stabilize the clinician's hand during instrumentation (Hui, D., Barr, A., Loomer, P., & Rempel, D., 2005). The fulcrum functions

to support the hand during instrumentation procedures, and allows the hand and instrument to move as a unit with precise control during instrumentation. A well-established fulcrum or finger rest is needed to control the hand/instrument unit, reduce the stress on the muscles of the clinician's hand during instrumentation, increase patient comfort and provide control of instrument stroke (Hui, D., Barr, A., Loomer, P., & Rempel, D., 2005). The standard intraoral fulcrum is a necessary requirement for any dental hygienist to master; however, the addition of extraoral fulcrum techniques are needed for a clinician to properly instrument more involved periodontal cases.

Intraoral fulcrums are adequate for supragingival or shallow subgingival instrumentation, but there are limitations in accessing deep periodontal pockets with the proper working angulation of the instrument (Pattison, Matsuda, & & Pattison, 2004). For instrument access into a deeper periodontal pocket with an intraoral fulcrum, the clinician must start finger flexing, making the movement ergonomically unsound. Finger flexing strokes tend to exert more lateral pressure at the beginning of the stroke and to taper off as the stroke moves in a coronal direction, making long root planing strokes with even lateral pressure difficult to achieve (Pattison, Matsuda, & & Pattison, 2004). In a study conducted by Lanning, Best and Hunt (2007), the removal of subgingival calculus consists of nearly 60% of all procedures performed by a dental hygienist. What makes extraoral fulcrums more challenging is that they require stabilization of the dental hygienist's dominant hand outside the patient's mouth against the cheeks, jaws or chin (Millar, 2009). With the development of control, the clinician is able to accurately apply stroke pressure against the tooth surface and maximize the power of hand instrumentation (Pattison, Matsuda, & & Pattison, 2004). The purpose of this special type of fulcrum is to secure entry and correct angulation in deep periodontal pockets. Although considered an advanced fulcrum that requires stability and

control, the addition of extraoral fulcrums expands one's ability to address challenging instrumentation cases (Pattison, Matsuda, & Pattison, 2004).

Traditional educational methodology for teaching an extraoral fulcrum with instrumentation involves the students memorizing the anatomy and physiology of the tooth with no real critical thought to how to solve instrumentation problems (Ray, Gray, & Spoonts, 2011). Instrumentation instruction has the educator verbally explaining and/or demonstrating proper hand placement and techniques for instrumentation and the student is expected to copy the instruction repeatedly (Ray, Gray, & Spoonts, 2011). Competency-based education, as required for accreditation, expects the student to integrate critical thinking into the learning process. Critical thinking requires the use of self-correction and the ability to step back and reflect on the quality of that thinking (American Dental Education Association, 2013). Simpson and Courtney (2002) point out that critical thinking processes require active discussion, initiative, and reasoning, envisioning and analyzing alternatives, and making value judgments. The Commission on Dental Accreditation (CODA) supports the implementation of critical thinking as an essential component in both dental and dental hygiene curricula (American Dental Association, 2013). Today's dental hygienist must use evidence-based decision making to provide effective care (National Dental Hygiene Research Agenda, 2007).

Patients are presenting with advanced periodontal diseases and, according to the Center for Disease Control and Prevention (CDC, 2011) advanced periodontal diseases affect 4-12% of all U.S. adults and is more prevalent in those that smoke. Albandar (2005) stated that 48% of all adults in the United States have chronic periodontitis. Periodontal health cannot be maintained without the removal of both supragingival and subgingival calculus (Pattison, Matsuda, & & Pattison, 2004). Research conducted by Lanning, Best and Hunt (2007) states that greater than 90% of scaling and root planing therapy and periodontal

maintenance cases are performed by dental hygienists. The adult population is presenting with complex periodontal problems and the dental hygiene student must have exposure and practice with patients with complex periodontal conditions to gain competence. Today's dental hygienist needs to be equipped to treat patients that present with involved medical and periodontal issues.

Extraoral fulcrums or external finger rests are needed for advanced instrumentation and play an important role for obtaining access into deep periodontal pockets. Cosaboom-Fitz Simons et al. (2008) stated that "dental hygienists should use alternative fulcrums to improve ergonomic instrumentation based on the clinician's individual needs and preferences" (p.8, 9). Learning how to use extraoral fulcrums while in a dental hygiene program with an instructor's guidance will develop a well-rounded, knowledgeable clinician with the skills needed to enter into the work force. The Commission on Dental Accreditation for Dental Hygiene Education Programs (2013), established a standard that states, "Dental hygiene sciences provide the knowledge base for dental hygiene and prepares the student to assess, plan, implement and evaluate dental hygiene services as an integral member of the health team" (p. 20). Additional research indicates that the knowledge gained while in a formal education program is more likely to be incorporated into practice than information gained in any other setting, as with professional continuing education courses or workshops (Fried, Reid, & DeVore, 2004). Including the knowledge and practice of extraoral finger rests or fulcrums into formal education is essential.

Statement of the Problem

Health care educators are aware of the challenge students have with applying information from the classroom to the clinical procedure (Aragon & Zibrowski, 2008; Bauer

& Huynh, 1998; Boynton et al., 2007; Hudson, 2004). One education methodology to improve the transfer of information from the didactic classroom to preclinical and clinical settings is the use of expert designed multimedia instruction (MMI) (Issa et.al, 2013). According to Mayer (2005), learning takes place in a person's cognitive system and is the acquisition of knowledge or skill by systematic study and the change or modification in the learner through practice, training or experience. "Learning is personal and involves a change in what the learner knows" (p. 60). Multimedia learning involves making connections between words and images. When words and pictures are both presented to the learner, there is the opportunity to construct mental images and build connections between the two (Mayer, 2005). A report in the Association of American Medical Colleges Institute for Improving Medical Education entitled *Effective Use of Educational Technology in Medical Education* (2007), recommended using principles that have been shown to improve retention and transfer in undergraduate college students.

Visualization of how and where to use extraoral fulcrums would greatly increase the dental hygiene student's knowledge base and provide the student with the skills needed to access involved periodontal cases with their dental hygiene instruments. There is evidence that supports using an extraoral finger rest and that it has some advantages for clinicians and their ability to effectively debride advanced periodontal conditions (Pattison, Matsuda, & & Pattison, 2004). Hauser and Bowen (2009) stated that requiring students to view expert performance or product before learning the skill is an effective instructional technique. Visualization of extra oral fulcrum techniques allows the dental hygiene student the ability to critically think about how to reproduce the results and adapt the dental hygiene instrument to the varying anatomy of the tooth surface and periodontal pocket.

A review of the literature revealed a lack of research conducted on the use of multimedia instruction in dental hygiene education in the area of extraoral fulcrum use for instrumentation instruction. Very few studies assessed the retention of dental hygiene instrumentation knowledge and the application of that knowledge once the dental hygiene student was in the clinical setting following the exposure to MMI. Most researchers in the literature reviewed did show that MMI had value in health care education and cited the need for further research before universal implementation of MMI into curriculum. The aim of this study was to assess the effect MMI has as an educational strategy for extraoral fulcrums instruction.

Purpose of the Study

The purpose of this research was to compare the effect of using MMI in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based experience. Information gathered allowed for a further analysis of the benefit of incorporating visualization tools in dental hygiene educational methodology.

Professional Significance of Study

Information gained through this study will support current dental hygiene curricula which prepares dental hygienists to meet the complex periodontal needs of the public. This research addresses the National Dental Hygiene Association Research Agenda for Professional Education and Development (Topic C), and the subtopics of evaluating the extent to which current dental hygiene curricula prepare dental hygienists to meet the increasingly complex oral health needs of the public (subtopic 1), as well as provide information that

assesses continued clinical competency (subtopic 9) (American Dental Hygienists' Association, 2007).

Complexity of decision-making in a dental hygienist's practice demands critical thinking finesse. There is a demand for elevated professional skills, including critical thinking skills that are needed for more involved periodontal cases (Hodges, 2005). Extraoral fulcrums become a necessity when intraoral fulcrums are ineffective. Using critical thinking and decision making along with correct instrumentation skills will advance a dental hygiene student's clinical skills and ability to be an effective clinician. Educating students on the use of extraoral fulcrums will prepare them for successful completion of their accredited program with advanced techniques and the ability to safely incorporate them in clinical practice. The use of multimedia information to assist with teaching extraoral fulcrums may facilitate clinical instrumentation and critical thinking by providing visual imaging that assists dental hygiene students in understanding effective instrumentation.

Research Question:

What is the effect of MMI in the form of interactive videos on dental hygiene students learning to use extraoral fulcrums compared to traditional didactic based learning with clinical demonstration?

Hypothesis

There is no difference in reproducibility of skill level of using extraoral fulcrum techniques in first year dental hygiene students when comparing a traditional lecture-based format with a multimedia instruction approach.

Definition of Terms:

The following terms and definitions were used throughout the study and explain the conceptual and operational terms for this study. For the commonality of definitions used in dental hygiene, textbooks are used as reference.

Control – actions taken to maintain proper stability and manipulation of the dental hygiene instrument (Neild-Gehrig, 2013a). Control was measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Didactic – a teacher-centered instructive pedagogy used for presenting information.

Effectiveness – capacity of producing desire results or effect. For the purpose of this study, effectiveness was measured by the removal of eight simulated pieces of calculus on the maxillary root surfaces of a dentaform. An evaluation of the complete removal of each simulated calculus deposit using an extraoral fulcrum was used to assess for effectiveness. The goal was to determine if the effectiveness of one group of students was statistically different than the other.

Extraoral fulcrum - stabilization of the clinician's hand outside the patient's mouth, against the cheek, jaws and chin. An extraoral fulcrum may be used with a mirror (Neild-Gehrig, 2013b).

Fulcrum – a finger rest used to stabilize the clinician's hand during periodontal debridement. An effective, well established finger rest is essential for stability, unit control, prevention of injury, control of stroke length and comfort to the patient (Neild-Gehrig, 2013b).

Intraoral fulcrum – stabilization of the clinician's dominant hand by placing the pad of the ring finger on a tooth near the tooth being instrumented (Neild-Gehrig, 2013a).

Multimedia Instruction (MMI) – the use of more than one type of media and integrating the use of text, graphics, sound, or video

Observation – the act of viewing or noticing an occurrence. Observation was used to assess the student's ability for control. For the purpose of this study, control, skill and safety were observed and evaluated using a task analysis rubric. (Appendix A).

Safety – the freedom from injury, danger or harm. Safety was measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Skill – competent in performance due to knowledge and experience. Skill will be measured by evaluating instrumentation technique using a task analysis rubric (Appendix A).

Task Analysis - the analysis of how a task is accomplished and discovers if a person has or has not mastered it, as well as analyzes the information processing of the task and whether it is easy or problematic. For the purpose of this study, task analysis was performed to access the effect of MMI on the education of extraoral fulcrums.

Traditional Educational Methodology – for the purpose of this study, traditional education methodology was defined as the transmission of skills, facts, and standards in the classroom setting and involves lecture, or demonstration, and memorization.

CHAPTER 2

Review of the Literature

Teaching makes acquisition of knowledge and skills possible through systematic interaction between teachers and learners (Akerele & Afolabi, 2012). It happens daily and involves teacher, learner, methodology, and materials interaction. Part of these materials are known as instructional resources. Multimedia is an instructional resource.

Multimedia is defined as the combination of video, animation, audio, graphics, and computer hardware and software that allows for multiple sensory levels of learning integrated into an educational tool for diversity in curricula presentation. Multimedia Information or MMI uses computer technology for supplementing the distribution of course content with that of traditional methods (Mayer, 2002). MMI bring experts to the learner demonstrating skills that range from clinical reasoning to carrying out the procedure. MMI can enable the recognition of words, terms and demonstrate tasks and movement through space (Gilakjani, 2012). "The design of effective multimedia educational materials should enhance the innate cognitive processes involved in how humans learn and retain information" (Issa, et.al, 2013, p. 389). Chapter 2 reviews the literature on the concepts of adult learning, competency based education, multimedia instruction (MMI), the use of MMI in health care education and dental hygiene instruction on extraoral fulcrums.

PubMed and Google Scholar were used to search *keywords:* clinical competence, clinical evaluation, competence-based education, dental education, dental hygiene education, extraoral fulcrum, manikin, multimedia instruction in dental educational, and typodont.

Adult Learning

Knowles, a pioneer in adult learning, stated that the theory of andragogy, the study of adult teaching and learning, is focused on student learning and considers previous learning as a foundation to build upon new knowledge (Knowles, 1990). Mayer (2003) stated learning takes place in a person's cognitive system and is acquisition of knowledge or skill by systematic study and the change or modification in the learner through practice, training or experience. Merriam (2008) noted that adult learning is more than just cognitive processing; it is multidimensional and takes place in various contexts. The realization of these concepts has enhanced the understanding of how adults learn and expanded instructional strategies to foster adult learning (Merriam, 2008). One of the central concepts of adult education is that of autonomy. The adult learner is empowered to be self-directed, self-paced and interact with learning experiences (Knowles, 1990). Adult learning is also based on the principle that the student takes ownership of their learning, and is motivated in topics that are personal to them, and have an understanding of why it is important to learn (Knowles, 1990). The development of a skill can involve the transfer of knowledge from the classroom into a practical situation that can be customized and expanded for similar situations (Peters, 2000). When the student applies this knowledge in a clinical situation, such as in dental hygiene, they can be better prepared for the different contexts in which incidences occur. The instructor's role is to serve as a facilitator to guide or promote student learning and examination. The outcome is that learning is more meaningful and relevant to the student (Stegeman & Zydney, 2010).

Competency Based Education

The Commission on Dental Accreditation (2013) defines competent as the level of knowledge, skill and values required by the new graduate to begin independent, unsupervised

dental practice (p.9). The primary mission of dental hygiene school is to produce entry level practitioners who have the capacity to function independently without supervision. (Commission on Dental Accreditation, 2013). An individual in training for a professional role evolves from a novice level through a series of stages where the individual capacities are gradually and progressively enhanced by trial and error. The process of educating dental hygiene students begins with the development of the novice or beginning clinician evolving to a clinician who has expert thought and skillfully performs the clinical task. Learning is successive and is supported by timely and corrective coaching. Table 1 depicts the stages of development of motor learning and competence.

Gadbury-Amyot et.al (2013) stated competence is the ability to accurately self-assess. In order for students to accurately self-assess, they must possess a good understanding of what the desired performance and outcome should be. A study by Gadbury-Amyot et.al (2013) examined how iPad technology with instructional videos could be used in a preclinical dental laboratory setting to enhance the teaching and learning environment as well as identify strategies for teaching novice learners psychomotor skill acquisition that add to ideal clinical procedures. The study findings indicated that the use of video combined with visual and verbal instruction in the acquisition of motor skills resulted in greater accuracy and retention of learning into long-term memory. As this was a pilot study, results are early indicating further research needed for enhancing the teaching and learning environment in preclinical laboratory courses with technologies such as the iPad with instructional videos.

Figure 1. Stages of motor learning and competence

Stages of Motor Learning Associated With Motor Performance	Stages of Competence	Attributes
Cognitive (trial and error)	Novice	Requires explicit directions, small steps, standardized or ideal circumstances, slow, stiff or rigid, hesitant extrinsic feedback, rules, dependence on faculty, isolated skills to provide foundation for later performance.
	Beginner	Application of what has been learned, some judgment and recognition of need to adjust to rules, guided performance, shows some initiative, extrinsically rewarded, semiconscious.
Associative (targeted)	Competent	Ready to begin independent practice, has a range of judgment and procedures, capacity to accurately self-assess, understand what they are doing, conscious.
	Proficient	Flawless, fluid, easily modified, conforms to context, intrinsically rewarded, appropriate values are internalized.
Autonomous (automatic)	Expert	Has internalized standards, is self-managed, performance is accurate and integrated, semiconscious (automatic), intrinsically rewarded.

Source: Chambers, D.W. (1993) A competency-based curriculum. *Journal of Dental Education, 57 (11); 790-793.*

Multimedia Learning

Multimedia leaning involves making connections between words and images. Mayer (2002) defined multimedia instruction as presentations that use words (such as spoken or printed text) and pictures (such as animation, video, illustrations, and photographs) with the goal to promote learning.

When words and pictures are both presented to the learner, there is the opportunity to construct mental images and build connections between the two (Mayer & Sims, 1994). Well-conceived MMI conveys information in a manner designed to help the student learn new material and/or improve knowledge of materials previously studied (Stegeman & Zydney, 2010).

The pedagogical strength of multimedia is that it uses the natural information processing ability that humans possess (Mayer, 2005). According to Mayer and Sims' (1994) cognitive theory of multimedia learning, adults process information through two different channels, visual and auditory. Multimedia learning incorporates both channels allowing the learner to build verbal and pictorial representations that enhance deeper understanding of the material. Eyes and ears, in conjunction with the brain, accomplish the challenging task of transforming data into information (Mayer & Sims, 1994). Advantages of using multimedia over text-based data is that it uses multiple senses. An important principle of didactic teaching is the use of several different types of sensory information. With the incorporation of multiple sensory learning, new information is acquired quicker and retained compared to the use of just one type of data presentation (Willis, 2006).

The principle behind multimedia learning was described by Mayer (2005), "People learn better from words and pictures than from words alone" (p. 3). A review of the literature by Gadbury-Amyot et.al (2013) indicates that:

> "the use of video combined with visual and verbal cues when used as a mechanism in the facilitation of motor skill acquisition, results in positive outcomes in terms of less error, more accuracy and greater retention compared to verbal or video instruction alone" (p.252).

Multimedia instruction is able to deliver information and foster learning to assist students to retain the material studied (Stegeman & Zydney, 2010). Visual material can be presented when visualization is an important concept, as in learning to manipulate and use intraoral instruments in the education of dental hygiene instrumentation.

Information presented using the visualization capabilities of video can be immediate and powerful (Mayer, 2005). The ability to view, and interact with the content of video provides increased understanding with the material. Particular concepts, and scenarios that may seem complicated when presented in text form, or by the use of diagrams and images, may be easier to understand when presented in visual form (Stegeman & Zydney, 2010). A video showing the information or a concept can demonstrate and emphasize the key points, and in these situations, the presentation of video may help explain or illustrate a concept (Asthana, 2012).

Figure 1 depicts the theory of multimedia learning which incorporates visualization as a part of the learning process.

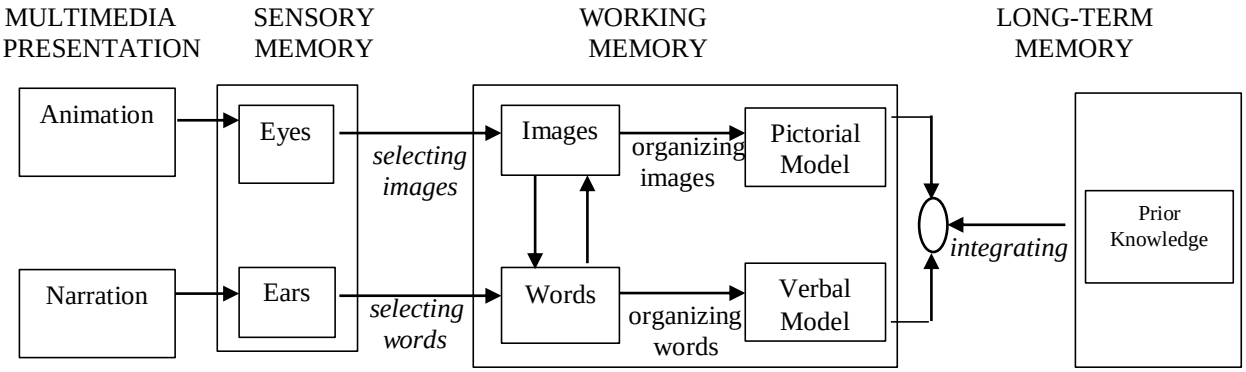

Fig. 2. A cognitive theory of multimedia learning.

Source: Mayer, R. E. & Moreno, R. (2002). Animation as an aid to multimedia learning. *Educational Psychology Review, 14(1)*.

The Use of MMI in Health Care Education

Learning in health care involves the ability to transfer knowledge from didactic courses to pre-clinical laboratory classes or clinical settings for optimal professional practice and patient care (Hudson, 2004). Health profession educators seek teaching strategies that foster critical and independent thinking, enhance efficiency of learning, transfer of learning, problem-solving in clinical situations, retention of material, and improve manipulative and clinical skills at a faster rate (Barzak, Ball, & Ledger, 2001). Health care educators and researchers have been taking advantage of technology to meet the changing demands and challenges of health care as well as attempting to meet the student's learning needs (Stegeman & Zydney, 2010).

MMI in health care education relates to the rapid expansion of pertinent information in all disciplines in health care. The amount of information presented today is much greater than that present even a decade ago. Yet to graduate from an accredited program, the length of the program remains the same (Stegeman & Zydney, 2010). There is a need to learn more

information in the same period of time which presents a challenge to educators. MMI may provide an alternative to these challenges. MMI programs designed to educate health care students can be used as a supplement or replacement to traditional teaching strategies (Stegeman & Zydney, 2010). Designing quality learning activities are to engage the learner to critically think about the meaning and relevance of the material, its application, and the various contexts to which it can be applied (Fouad & Burleson, 1997).

A study performed by Fouad and Burleson (1997) found case-based MMI to be effective when used as an adjunct or as an additional resource to lecture. The study evaluated the effectiveness of MMI for the diagnosis of endodontic issues. Ninety third-year dental students were given a pre-survey to measure knowledge along with ten lectures. The participants were then divided into three groups. Group one was exposed to lecture and MMI containing a case situation for 1hour, group two was given a lecture and participated in a seminar group that contained the identical case situation as the first group for the same amount of time, and group three received lecture only on the same case. A post-survey was given to evaluate knowledge of the presented case. The three groups then took a post-test to evaluate their diagnostic knowledge in endodontics. The improvement of scores from pre- to post-test in the three groups were statistically different ($p = 0.018$). The simulation group students improved significantly more than the seminar group ($p = 0.05$) and the control group ($p = 0.0024$). The students in group one, who received MMI and lecture scored significantly higher in knowledge than the other two groups (Fouad and Burleson, 1997).

The evidence is inconsistent as to whether multimedia information fosters an increase in knowledge in health care education. Fouad and Burleson (1997), found a significant increase in knowledge in health care students with the use of MMI. Aly, Elen and Willems

(2004) conducted a study to compare the effectiveness of interactive multimedia course work versus standard lectures in the transfer of knowledge, understanding and problem solving skills in orthodontics. Pre- and post-test assessments of final-year dental students (n = 26), who either used an interactive multimedia courseware package (n = 15) or attended standard lectures (n = 11) on equivalent material of the undergraduate orthodontic curriculum were carried out. Both groups were tested by written and multiple-choice questions covering knowledge, understanding, and application areas in the curriculum. Both groups improved their scores after the course. In one question investigating the extent of understanding the instructional content of the multidisciplinary orthodontic treatment, the multimedia courseware package group scored significantly better. When MMI was combined with didactic teaching, researchers found that the experimental group that combined MMI with didactic teaching had a higher level of skill that that of the didactic only group (Issa et. al, 2013).

MMI may prove to be beneficial for the achievement of a skill which includes performance of a task, application of knowledge in a clinical setting, interpretation of a clinical situation, and the diagnosis of a clinical situation or disease (Stegeman & Zydney, 2010). The ability for students to review the MMI as many times as necessary and having the ability to start and stop the program to evaluate procedure or technique gives the student an advantage to learn. When a procedure is demonstrated in front of a class, some students do not have the same viewing ability as others. MMI gives each student the same observation ability as the next student and offers an opportunity to visualize a process or procedure before it is actually encountered (Stegeman & Zydney, 2010). This learning experience has the potential to increase cognitive knowledge.

Health care educators know that there is a challenge of students applying information from the traditional classroom setting to the clinical procedure (Aragon & Zibrowski, 2008; Bauer & Huynh, 1998; Boynton et al., 2007; Hudson, 2004). Aragon and Zibrowski (2008) studied the use of videos in teaching pre-clinical dental students fixed prosthodontics. The video was detailed instruction of a crown preparation and placement followed by a group demonstration and independent practice on a mannequin. Students viewed the video as many times as they needed and the outcome was compared to the class of the previous year. Findings showed that the group that used the videos had a better performance with pre-clinical crown preparation and placement. Boynton, et. al (2007), noted a significant increase in the application of knowledge in a clinical setting when using MMI to complement traditional lecture in educating pediatric dental students on child management behavior.

Rystedt et al (2013) conducted research at the University of Gothenburg in Sweden in preclinical endodontics with students in their third year of a five year dental undergraduate training program. The aim of the study was to bridge the gap between preclinical lecture-based classes and clinical experiences. In a course that teaches how to negotiate root canals, traditional clinical demonstrations were replaced with guided video-based root canal treatments visualized through a surgical microscope. Students were expected to perform an uncomplicated root canal treatment in an extracted tooth mounted in a mannequin. Students reported that the video-based demonstrations made it easier to apply the theoretical instructions in skills training. According to Al-Haliq, M. A., Oudt, M.A. & Abu Al-Taieb, M. (2013), video instruction can be used to provide real experiences in almost all fields of learning. It can be made to repeat information and demonstration as many times as possible; thereby, learning is made easier, realistic and concrete for learners. Video instruction allows for self-instruction and a way of disseminating educational information and practical skills.

Dental Hygiene Education

Review of current literature showed no information on techniques and methodology to educate dental hygiene students about the use of extraoral fulcrums. Instrumentation textbooks contain units within them on how to use extraoral fulcrums. Without evidence to indicate which education medium is used to teach extraoral fulcrums, educators use textbooks that require didactic instruction from the educator with a possible demonstration of its use, requiring the student to reproduce the technique until proficient or competent. No literature exists describing whether or not extraoral fulcrums are being taught in formal dental hygiene education settings. If this skill is not being taught, students must use self-study to learn and incorporate extraoral fulcrums into instrumentation procedures. Therefore, research is needed regarding the use of multimedia forms to teach the clinical or preclinical techniques on extraoral fulcrums.

Summary

Dental hygiene instrumentation skills require that the student master a high level of fine motor control as well as understand how to manipulate dental hygiene tools to provide efficient and successful therapy. The principles of instrumentation such as adaptation, angulation, and stroke activation are vital to effectiveness of hand instrumentation. Properly applied, the principles form the basis for efficiency and effectiveness in nonsurgical periodontal therapy and treatment (Pattison & Pattison, 2003).

Motor skill learning refers to increasing spatial and temporal movements with accuracy through practice. Fine motor skill involves the use of small muscles such as those in the fingers and enables functions such as grasping small objects, writing, and fastening

clothing; all usually in coordination with the eyes (Hauser & Bowen, 2009). A literature review by Hauser & Bowen (2009) found that fine motor skills are required for dental and dental hygiene students learning to instrument and successfully perform intraoral procedures that depend on a high level of fine motor control. The correct use of dental hygiene instruments through visual instruction paired with the practice of fine motor skills increases the probability of dental hygiene instrumentation instruction being successful. Repetition and continued practice is required to improve performance (Hauser & Bowen, 2009). Hauser and Bowen (2009) indicated that the use of visual technology in the curriculum of dental hygiene instrumentation instruction can be highly beneficial to developing the correct fine motor skills and instrumentation skills necessary to become a successful clinician and meet the complex oral health care needs of the public, which includes the development and use of extraoral fulcrums. Through multimedia use, the learner can pair and connect the written and oral instruction to what is visually seen to recreate successful instrumentation skills. Messer, Kan, Cameron and Robinson (2002) conducted research that created and installed five pediatric dental cases in a multimedia presentation tool and evaluated dental student responses to the learning methodology over a three-year period which showed that computer-assisted teaching of case management was received enthusiastically by the majority of dental students.

A standard established by the Commission on Dental Accreditation for Dental Hygiene Education Programs (2013), states "Dental hygiene sciences provide the knowledge base for dental hygiene and prepare the student to assess, plan, implement and evaluate dental hygiene services as an integral member of the health team" (p. 20). Incorporating teaching that promotes student awareness and obligation to optimal patient care while in dental hygiene programs that continues into clinical practice as a health care professional support this standard.

There is limited research on the topic of teaching methodologies in dental hygiene education for instrumentation using extraoral fulcrum providing justification for further research in the area of teaching methods for enhancing clinical instrumentation. The goal of this study is to compare the effect of using MMI in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based experience. Information gathered will allow for a further analysis of the benefit of incorporating visualization tools in dental hygiene educational methodology.

CHAPTER 3

Methodology

The purpose of this study was designed to evaluate the effect of the pedagogical strategy of Multimedia Information (MMI) incorporated into a dental hygiene curriculum. The study measured the effect of using MMI in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based teaching experience. Information gathered will allow for a further analysis of the benefit of incorporating visualization tools in dental hygiene educational methodology. This chapter provides a description of the study design.

Research Design

The research design for this study was a randomized experiment with a treatment and control group. Measurement of learning was conducted using a competency based examination (Appendix A) evaluated through clinical observation.

Research Setting

First year dental hygiene students took part in the study. The class consisted of fourteen students. All fourteen students participated in the study that took place in the second semester of the students' first year within the program (spring 2014) in an accredited dental hygiene program in the northwest United States. The research was conducted and assessed on a mannequin-mounted typodont in the classroom and clinic.

Research Participants

The sample for this study included two groups of first-year students. The two groups were similar in standard characteristics, with the students having successfully completed all

prerequisite dental hygiene courses and enrolled into the dental hygiene professional program. The descriptive statistics from demographic information was reported separately by group. A survey was used to gather demographic information (Appendix D) prior to the start of the study.

Minimal risk was anticipated in the research and were not greater than that ordinarily encountered in daily life or during the performance of routine dental hygiene examinations or tests. Research description and risks were explained to the students prior to the start of the project. Students were given the freedom to decline participation without any recourse. Care was taken to reduce any identifiable variables to the student identity. A sample of the consent form for Human Subject research can be viewed in Appendix B and the Human Subjects Protection form can be viewed in Appendix C.

A review of the dental literature revealed that there is an established pattern of sample sizes in similar research for pilot studies. A meta-analysis by Rosenberg, Grad, and Matear (2003) found that research in MMI in dental education generally have sample sizes ranging from 20 to 105 participants. The smaller sample sizes support the 14 participants that were used in the proposed study. The reviewed studies also used convenience samples from their respective learning institutions, supporting the use of this type of sample for this study.

Procedure

First year dental hygiene students practice dental hygiene skills on each other for the first semester. In order for the student to proceed from preclinical classes to the clinical setting, an instrumentation competency examination is taken to assess the student's ability to instrument safely and effectively. In a study conducted by Licari and Chambers (2007) "competencies are the skills that are essential to begin the practice of dentistry and allied

dental practice" (p.8). The accreditation standards for dental education define competent as the level of knowledge, skills, and values required to begin independent, unsupervised, dental practice (Commission on Dental Accreditation, 2012). Students work with patients for the first time in the second semester. During the initial clinical experiences with patients, students are expected to use fundamental sound intraoral fulcrums as instructed in the previous semester. Clinical faculty are available to assist the student if the student experiences difficulty. As the semester progresses, the student treats patients that present with increased periodontal challenges.

First-year students (n=14) received lecture-based classroom instruction and were taught using traditional lecture-based classroom instruction including a PowerPoint presentation, lecture, and clinical demonstration of extraoral fulcrum use. Each dental hygiene student was then assigned a number (one through fourteen). Numbers were placed in a pool and students were randomly selected for either the control or treatment group. The first seven students drawn from the pool were placed in the control group (didactic teaching only) group, the following seven in the treatment group (MMI group, n=7). The independent variable was the treatment of using MMI in the form of video instruction to facilitate extraoral fulcrums learning. The objective measure was the level of skill obtained using area specific curets.

The video showed extra-oral fulcrum techniques to address clinical situations where the patient has advanced periodontal pocketing as well as how to use an extra-oral fulcrums with area specific curets. The video was shown to the treatment group in the latter half of their second semester. Each student in the treatment group viewed the video independently on laptops in the classroom and were allowed to start, stop, rewind and review the video at any point. The treatment group also was given the opportunity to view the video outside of the

classroom to work and practice on their own. Both groups were given the opportunity to ask questions and get clarification prior to the clinical competency examination. All students were given the same clinical competency based examination post instruction.

A faculty member facilitated the group instruction and received training and materials from the principle investigator. Two other faculty members received training on evaluating the skill level of extraoral fulcrums use by using the Instrument Competency with Extraoral Fulcrum Rubric (Appendix A). All three faculty members had no other involvement with the study. Each learning environment required the same length of time (60 minutes) to complete. Outcomes were measured by comparing the clinical competency based examinations (treatment group n=7; lecture-based classroom instruction: n=14).

The videos in the study were created by Anna Pattison, RDH, M.S., of the Pattison Institute. Anna Pattison is an instrumentation expert in the dental hygiene field having worked as a professor in dental hygiene from 1970-2011 (Dimension of Dental Hygiene, 2014). She has co-authored the textbook, *Periodontal Instrumentation* and contributed to the last five editions of *Carranza's Clinical Periodontology* (Pattison Institute, 2012). Ms. Pattison has been a featured speaker for annual sessions of the American Academy of Periodontology, American Dental Hygienists' Association, American Dental Association, and the Canadian Dental Hygienists' Association. The videos used in this study are part of a series of videos teaching periodontal instrumentation. The setting of the videos is a dental hygiene classroom with Ms. Pattison demonstrating instrumentation on a manikin-mounted typodont. Ms. Pattison had no affiliation with this study.

Data Collection

The instrument that was used to assess the dependent measures of extraoral fulcrum skill in this project was a competency based skill examination (Appendix A). Five teeth were used to evaluate skill level and an average of the scores were reported. Research conducted on the integration of MMI in health care education was assessed learning using pre and post evaluation tools such as tests or surveys (Aly et al., 2004; Bauer & Huynh, 1998; Howerton et al., 2002; Wannan & York, 2005; Williams et al., 2001).

On the skill observation competency examination, the student was evaluated using ten criteria scores. Definitions of those criteria can be seen in Appendix A. A point value was given to each of the criteria: 2 = Excellent; 1 = Acceptable; 0 = Unacceptable. 100 points were possible. Students were familiar with the clinical competency assessment tool as it is used in preclinical evaluations. Each student was given the identical clinical skill examination two weeks following the intervention. Clinical faculty were trained and served as evaluators and administrators.

Limitations

This researcher used a convenience sample. The two study groups were similar in almost all respects except for the treatment in question. The sampling technique and size of the sample limited the generalizability of the study. However, this study was exploratory in nature.

Data Analysis

Outcomes compared clinical competency-based examinations between the two groups of students, treatment group (n=7) and the control group (n=7). The competency based exam

is a hands-on clinical examination. The students have completed similar exams in their preclinical course early in the fall of their first year. The design of the competency-based examination instrument is based on published evaluation tools to assess basic instrumentation skill (Nield-Gehrig, 2013). The instrument tool used in this study had been slightly modified to include extraoral fulcrums. The instrument consisted of ten instrumentation criteria to test performance of instrumenting on a manikin-mounted typodont using an extraoral fulcrum. Five teeth were used as part of the competency assessment and an average of the scores was reported. Performance was observed by three clinical faculty members according to established criteria known to the student. The examination was evaluated and scored as either excellent (2 points), acceptable (1 point), or unacceptable (0 points).

To ensure similarities between the groups, a Fisher Exact Test was performed to compare the treatment group and control group on gender, race, and dental experience. An independent two sample t-test was used to compare age and GPA between the treatment and control group. The level of significance was set at $\alpha=0.05$.

Reliability between coders was used to demonstrate trustworthiness of data. Intercoder reliability measured the likelihood that the different coders who received the same training, assigned the same value or score to the same piece of content. Intercoder reliability coefficients range from 0 (complete disagreement) to 1 (complete agreement). In general, coefficients .90 or greater are considered highly reliable, and .80 or greater is acceptable in most situations, and .70 may be appropriate in some exploratory studies for some indices (Neuendorf, K. A., 2002). Intercoder reliability for this study was calculated between the three coders by counting differences in coding and calculating the percentage agreement

between all three coders. Intracoder reliability could not be assessed due to lack of repeated evaluation on the same student.

Multinomial repeated measures regression was used to assess differences between students in the control group and treatment group. A repeated measures test was used to compensate for any correlation possible within each student's performance.

Summary

A dental hygienist must be prepared to advance the profession and meet the needs of a variety of patient populations. The complexity of oral disease and needs of the population are changing, and a dental hygienist has a responsibility to effectively meet those public health care needs. The main goal of a dental hygienist is the maintenance of oral health and the prevention of oral diseases. To be prepared to meet changing oral health care needs, the dental hygiene student must be equipped with techniques to perform the duties adequately.

> "The increasing emphasis on the skills of the dental hygienist has placed a greater emphasis on the education system to ensure that the students of the profession are receiving adequate levels of training. Dental hygiene graduates are expected to be capable of carrying out their roles as clinicians, educators and promoters of oral health." (Reitz & Jadeja, 2004, p. 38).

The Journal of Dental Education is a peer-reviewed journal that publishes original scholarly work that advances the understanding and development of dentistry both as a profession and as an academic discipline. The journal focuses on research that promotes the education of dental professionals with a sound scientific base.

The finished manuscript of this project will be submitted to the Journal of Dental Education with the aim to provide information to enhance and/or improve dental hygiene education by evaluating the effect of the pedagogical strategy of using multimedia information (MMI) in dental hygiene curriculum and to prepare dental hygienists to meet the increasingly complex oral health needs of the public. Manuscript submission guidelines for the Journal of Dental Education can be viewed in Appendix E.

References

Albandar, J. (2005). Epidemiology and risk factors of periodontal disease. *Dental Clinics of North America, (49)*, 517-532.

Akerele, J. A., & Afolabi, A. F. (2012). *Effects of video on the teaching of library studies amoung undergraduates in adeyemi college of education, ondo*. Retrieved from Digital Commons at University of Nebraska Lincoln: http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1754&context=libphilprac.

Al-Haliq, M. A., Oudt, M.A. & Abu Al-Taieb, M. (2013). The effect of using video on developing physical fitness of physical education students at the hashemite university. *Asian Social Science, 10 (1),* 21-27.

Aly, M., Elen, J., & Willems, G. (2004). Instructional multimedia program versus standard lecture: A comparison of two methods for teaching the undergraduate orthodontic curriculum. *European Journal of Dental Education, 8 (1)*, 43-46.

American Dental Association; Commission on Dental Accreditation. (2013). *Accreditation standards for dental hygiene education programs.* Chicago, Il: American Dental Association.

American Dental Education Association. (2013). *Critical thinking*. Retrieved from: http://www.adea.org/adeacci/Resources/Critical-Thinking-Skills-Toolkit/Pages/Introduction.aspx

American Dental Hygienists' Association. (2007). *National dental hygiene research agenda*. Retrieved from: https://www.adha.org/resources-docs/7111_National_Dental_Hygiene_Research_Agenda.pdf

Aragon, C., & Zibrowski, E. (2008). Does exposure to a procedural video enhance preclinical dental student performance in fixed prosthodontics? *Journal of Dental Education; 72(1)*, 67-71.

Association of American Medical Colleges (2007). Effective use of educational technology in medical education. In *Institute for imporving Medial Education.* Washington, DC. Retrieved from: https://members.aamc.org/eweb/upload/Effective%20Use%20of%20Educational.pdf

Asthana, A. (2012). *Multimedia in education*. Retrieved from: http://encyclopedia.jrank.org/articles/pages/6821/Multimedia-in-Education.html

Bauer, M.D. & Huynh, M.V. (1998). Nursing students 'blood pressure measurement following CD-ROM and conventional classroom instruction: A pilot study. *International Journal of Medical informatics, 50, 103-109.*

Barzak M.Y., Ball, P.A., & Ledger, R. (2001). The rationale and efficacy of problem-based learning and comuter assisted learning in pharmaceutical education. *Pharmacy Education, 1*, 105-113.

Boynton, J.R., Green, T. G., Johnson, L. A., Nainar, H., & Straffon, L. H. (2007). The virtual child: Evaluation of an internet-based pediatric behavior management simulation. *Journal of Dental Education, 71(9), 1187-1193*.

Chambers, D.W. (1993). A competency-based curriculum. Journal of Dental Education, 57(11), 790-793.

Centers for Disease Control and Prevention (CDC). (2011). *Oral health; Preventing cavities, gum disease, tooth loss, and oral cancers 2011*. Retrieved from: http://www.cdc.gov/oralhealth/

Commission on Dental Accreditation (2012). *Self-study guide for dental education programs*. Retrieved from http://gsa.ada.org/search?q=self+guide+for+dental+education+programs&x=0&y=0&site=ADAorg_Collection&client=ADAFrontEnd&proxystylesheet=ADAFrontEnd&output=xml_no_dtd

Cosaboom-FitzSimons, M. E., Tolle, S. L., Darby, M. L., & Walker, M. L. (2008). Effects of 5 different finger rest postitions on arm muscle activtity during scaling by dental hygiene students. *Journal of Dental Hygiene, 82 (4)*, 1-10.

Darby, M. L., & Walsh, M. M. (2010). Hand activated instruments. In M. L. Darby, & M. M. Walsh, *Dental Hygiene Theory and Practice, 3rd ed.* (pp. 432-480). St. Louis, Missouri: Saunders; Elsevier Inc.

Dimension of Dental Hygiene. (2014). *Anna Pattison, RDH, MS*. Retrieved from Dimensions of Dental Hygiene: http://www.dimensionsofdentalhygiene.com/ddhright.aspx?id=35

Fones, A.C. (1921). *Mouth hygiene: a text-book for dental hygienists*. Philadelphia and New York; Lea & Febiger.

Fouad, A. F., & Burleson, J. A. (1997). Effectiveness of an endodontic diagnosis computer-

simulation program. *Journal of Dental Education, 61 (3), 289-295*.

Fried, J. L., Reid, B. C., & DeVore, L. E. (2004). A comparison of health professions student attitudes regarding tobacco curricula and interventionist roles. *Journal of Dental Education, 68 (3), 370-377*.

Gadbury-Amyot, C., Purk, J. H., Williams, B. J., & Van Ness, C. J. (2013). Using tablet technology and instructional videos to enhance preclinical dental laboratory learning. *Journal of Dental Education, 78(2),* 250-258.

Gilakjani, A. P. (2012). The significant role of multimedia in motivating efl learners' interest in english language learning. *International Journal of Modern Education and Computer Science; 4*, 57-66; DOI: 10.5815/ijmecs.2012.04.08.

Hauser, A. M., & Bowen, D. M. (2009). Primer on preclinical instruction and evaluation. *Journal of Dental Education, 73(3),* 390-398.

Hodges, K. (2005). Reconsidering the explorer. *Dimensions of Dental Hygiene, 3(4),* 26-28.

Howerton, W. B., Platin, E., Ludlow, J., & Tyndall, D. A. (2002). The influence of computer assisted instruction on acquiring early skills in intraoral radiography. *Journal of Dental Education, 66*(10); 1154-1158.

Hudson, J.N. (2004). Computer-aided learning in the real world of medical education: Does the quality of interaction with the computer affect student learning? *Medical Education, 38, 887-895.*

Hui, D., Barr, A., Loomer, P., & Rempel, D. (2005) The effects of finger rest positions on hand muscle load and pinch force in simulated dental hygiene work. *Journal of Dental Education, 69*(4); 453-460.

Issa, N., Mayer, R.E., Schuller, M., Wang, E., Shapiro, M., & DaRosa, D. A. (2013). Teaching for understanding in medical classrooms using multimedia design principles. *Medical Education*, 47, 338-396.

Journal of Dental Education (2014). *Information for authors.* Retrieved from: http://mc.manuscriptcentral.com/societyimages/jdentaled/Information%20for%20Authors.pdf.

Knowles, M. (1990). *The adult learner: A neglected species* (4th ed.). Houston, TX: Gulf Publishing Company.

Lanning, S. K., Best, A. M., & Hunt, R. J. (2007). Periodontal services rendered by general practitioners. *Journal of Periodontology, 78 (5),* 823-832.

Licari, F. W. & Chambers, D. W. (2007). Some paradoxes in competency-based dental education. J*ournal of Dental Education* 72(1), 8-18.

Mayer, R. E., & Sims, V. K. (1994). For whom is a picture worth a thousand words: Extensions of a dual coding theory of multimedia learning. *Journal of Educational Psychology, 86*, 389-401.

Mayer, R. E. (2002). Cognitive theory and the design of multimedia instruction: An example of the two-way street between cognition and instruction. *New Directions for Teaching and Learning, 89*, 55-71.

Mayer, R. E. (2005). Introduction to multimedia learning. In R. E. Mayer, *The Cambridge Handbook of Multimedia Learning.* (pp. 1-18). New York, NY: Cambridge University Press.

Mayer, R. E. & Moreno, R. (2002). Animation as an aid to multimedia learning. *Educational Psychology Review, 14(1)*.

Merriam, S. B. (2008). Adult learning theory for the twenty-first century. *New Directions for Adult and Continuing Education*, 93-98: doi 10.1002/ace.309a

Messser, L.B., Kan, K., Cameron, A., & Robinson, R. (2002). Teaching pediatric dentistry by multimedia: A three-year report. *European Journal of Dental Education., 6,* 128-138.

Millar, D. (2009). Reinforced periodontal instrumentation and ergonomics: The best practice to ensure optimal performance & career longevity. *CDHA Journal*, *24*(3), 8-16.

Neuendorf, K. A. (2002). *The content analysis guidebook.* Thousand Oaks, California: Sage Publications.

Nield-Gehrig, J. S. (2013). Module 4: Mirror and finger rests in anterior sextants. In J. S. Nield-Gehrig, *Fundamentals of Periodontal Instrumentation & Advanced Root Instrumentation, 7th ed.* (pp. 87-130). Baltimore, MD: Lippincott Williams & Wilkins.

Pattison, A., Matsuda, S., & Pattison, G. (2004). Extraoral fulcrums: The essentials of using extraoral fulcrums for periodontal instrumentation. *Dimensions of Dental Hygiene, 2(10),* 20, 21-23.

Pattison, A., & Pattison, G. (2003). Periodontal instrumentation transformed. *Dimensions of*

Dental Hygiene, *1*(2), 18-20. doi:10.1097/01.don.0000145035.85272.7c.

Pattison Institute. (2012). *About pattison institute*. Retrieved from Pattison Institute: https://www.pattisoninstitute.com/periodontal-videos/about

Peters, M. (2000). Does constructivist epistemology have a place in nurse education? *Journal of Nursing Education; 39(4), 166-172.*

Ray, C., Gray, J., & Spoonts, L. (2011). *The diagnosis of clinical remediation: Teaching dental hygiene clinicial instructors how to teach.* Retrieved from www.adea.org/publications/library/Documents/clinicalRemed.pdf

Reitz, M., & Jadeja, R. (2004). The collaborative practice of dental hygiene. *International Journal of Dent Hygiene, 2*, 36-39.

Rosenberg, H., Grad, H.A., & Matear, D.W. (2003). The effectiveness of computer aided, self-instructional programs in dental education: A systemic review of the literature. *Journal of Dental Education, 67*(5), 524-532.

Rystedt, H., Reit, C., Ondont, Dr., Johansson, E., & Lindwall, O. (2013). Seeing through the dentist's eyes: Video based clinical demonstrations in preclinical dental training. *Journal of Dental Education, 77(12)*, 1629-1638.

Simpson, E., Courtney, M. (2002). Critical thinking in nursing education. *International Journal of Nursing Practice*, 8, 89-98.

Stegeman, C., & Zydney, J. (2010). Effectiveness of multimedia instruction in health professions education compared to traditional instruction. *Journal of Dental Hygiene, 84(3)*, 130-136.

Summers, A.N., Rinehart, G.C., Simpson, D., & Redlich, P.N. (1999). Acquisition of surgical skills: A randomized trial of didactic, videotape, and computer-based training. Surgery, 126(2), 330-336.

Wannan, G., & York, A. (2005). Using video and role-play to introduce medical students to family therapy: Is watching better than appearing? *Journal of Family Therapy,27,* 262-271.

Williams, C., Aubin, S., Harkin, P., & Cottrell, D. (2001). A randomized, controlled, single-blind trial of teaching provided by a computer-based multimedia package versus lecture. *Medical Education, 35,* 847-854.

Willis, J. (2006). *Research-based strategies to ignite student learning.* Alexandria, VA: Association for Supervision & Curriculum Deve.

APPENDIX A

INSTRUMENT COMPETENCIES USING EXTRAORAL FULCRUMS

Student_____ Date_____ Evaluator_____

Instructors: Please provide the student with input by giving the score that best identifies the student's proficiency level for each given task. Use the criteria scores listed below.

2 =Excellent	No improvement needed
1 =Acceptable	Appears to comprehend the step but should consider practice time in addition to what is scheduled in class
0 =Unacceptable	Student **requires** additional time with the faculty for help.

Clinical Practicum Competency Exam

* Each student will have 15 minutes to complete the competency exam.
* Completion of all 5 instrumentation situations are required.
* Three minutes maximum per situation will be given.
* Once instrumentation on a tooth surface has begun (as indicated by the student verbally), the student cannot make corrections during the three minutes. A maximum of three minutes will be allowed per situation.
* **To receive points for a situation, the correct tooth, surface, instrument, and end MUST be used.**
* Examiners will not prompt or tutor the student during the exam.

Demonstrate the correct use of the following instruments on the specified surface.

Instrument	R L	Correct Instrument & end	Op/pt position	Lighting	Grasp	Extraoral Fulcrum	Insertion (sub only)	Angulation Shank position	Activation	All surfaces instrumented	Infection control	TOTAL POINTS	Comments
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	TOTAL POINTS/SCORE												

Criteria	Description	Sample Errors
Correct Instrument & end	• Appropriate instrument and end are used.	• Using wrong instrument or end for the situation.
Op/pt position	• Pt is positioned to allow clinician to be in a neutral position. • Operator is in neutral position.	• Pt too high or low or head not turned appropriately; • Clinician leaning over, elbows up, neck bent, arms too high or low.
Lighting	• Instrumentation area is well lit by direct or indirect illumination	• Dim or no light on instrumentation area
Grasp	• Grasp is lower on instrument handle and father away from working end • Appropriate grip—light (explorer), firm (curet)	• Grip is inappropriate for task. Too tight w/ explorer; too loose w/ curet -
Infection control	Does not use gloves to touch anything that is not barriered or cannot be disinfected. Does not touch anything that may be 'dirty'.	Touching glasses, hair, uniform w/ gloves
Extraoral Fulcrum	• Fulcrums on patient's chin, mandible or cheek bone • Uses strong fulcrum to make a controlled stroke • Lengths of middle, ring and little finger rest securely against the skin and underlying bone of the mandible • All three fingers press against the mandible • Middle, ring and little fingers are in contact acting as a unit	• No fulcrum • Weak fulcrum • Middle, ring and little fingers are not together acting as a unit. One-finger fulcrum is ineffective
Insertion (sub only)	• Closes angle by dropping the handle (distals) or rotating the face towards the surface to be worked on. • Slips working end beneath gingiva atraumatically.	• Not closing angulation (face to tooth surface) before inserting working end beneath gingival margin. • Rough, heavy-handed, or aggressive insertion. • Inserts subgingivally with a sickle (except anterior proximal)
Angulation/ Shank position	• For sickles and universal curets, shank should tilt slightly towards the tooth surface being instrumented. • Area specific shanks should be parallel to the instrumented surface.	• Angle too open—angle >90': For sickles and universal curets, shank is parallel or tilted away from the tooth surface; For area specific curets, shank tilts away from surface. • Angle too closed—less than 45' angle of face to tooth surface.
Activation	• Controlled stroke • Tip/toe is adapted to tooth surface.	• Lack of control of working end. • Working end slips off tooth. • Tip/toe not adapted to tooth surface. Not rolling handle or not pivoting on fulcrum to remain adapted to tooth.
All surfaces instrumented	• For a facial or lingual *aspect*, the distal, facial/lingual, and mesial surfaces are all instrumented. This applies to posterior areas with explorers, sickles, and universal curets. • For anteriors, starts at the mesial/distal line angle and continues around to just past contact area. • For area specific surfaces, instruments the entire surface beginning at the first line angle. • When ending on a proximal surface, strokes should continue past contact area.	• Not starting at distal line angle for distal surfaces. • Not starting at distal line angle for facial/lingual surfaces. • For 'aspects', not instrumenting distal AND facial/lingual AND mesial. • Not going subgingival with a curet. • Not going subgingival on interproximal areas w/ anterior sickle. • Not instrumenting past the contact area on proximal surfaces.

Appendix B

Informed Consent Form

Study Title: EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

We are asking you to be in a research study.

You do not have to be in this study.

If you say yes, you may quit the study at any time.

Please take as much time as you want to make your choice.

Why is this study being done?

We want to learn more about using Multimedia Information (MMI) to teach dental hygiene students the use of extraoral fulcrums.

We are asking students like you who are enrolled in an accredited dental hygiene program, in their first year of study, to help us.

What happens if I say yes, I want to be in the study?

If you say yes, we will:

- Study will measure the effect of using MMI in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based teaching experience. A total of fourteen dental hygiene undergraduate students will take part in the study. Students will voluntarily take part in the didactic presentation on extraoral fulcrums. The study is not part of any other course work. If the participant decided not to take part in the study, nothing would be missed from any program classes. All procedures within the study are for the purpose of research and not associate with any class. Seven will be anonymously selected to view extraoral fulcrum use on a set of instructional videos on instrumentation. Learning will be measured using a competency based examination and evaluated by clinical observation.

How long will the study take?

This study will take approximately two weeks.

Where will the study take place?

Location of Study is at the University of Alaska, Anchorage. Principal Investigator (Carri Shamburger) will obtain approved IRB from the University of Alaska, Anchorage.

What happens if I say no, I do not want to be in the study?

No one will treat you any differently. You will not be penalized.

Declining to participate will have no effect on your course grade, or standing in the dental hygiene program.

- This study is strictly for research. There may be a benefit from learning the technique, however, it is not a requirement or graded procedure. This study is strictly for research and a separate event. Your course grades will not be affected by your decision.

What happens if I say yes, but change my mind later?

You may stop being in the study at any time. You will not be penalized. Your relationship with the dental hygiene faculty at the University of Alaska, Anchorage will not change. Declining to participate will have no effect on your course grade or effect your standing within the program itself.

Who will see my results**?**

The only people who will see your competency results will be the people who work on the study and those legally required to supervise our study.

Your survey answers, demographic information, and a copy of this document will be locked in our files.

When we share the results of our study in the Journal of Dental Education, we will not include your name. We will do our best to make sure no one outside the study will know that you are a part of the study.

Will it cost me anything to be in the study?

No.

Will being in this study help me in any way?

Being in this study may benefit you and your dental hygiene instrumentation skills, as well as, educate you on the use of an extraoral fulcrum.

Will I be paid for my time?

No

Is there any way being in this study could be bad for me?

Yes, there is a chance that:

- Someone could find out that you were in this study and learn something about you that you do not want them to know.

We will do our best to protect your privacy.

What if I have questions?

Please call the head of the study: Carri Shamburger at 907-242-3959 if you:

- Have questions about the study.
- Have questions about your rights.
- Feel you have been injured in any way by being in this study.

You can also call the Idaho State University Human Subjects Committee office at 208-282-2179 to ask questions about your rights as a research subject.

Do I have to sign this document?

No. You only sign this document if you want to be in the study.

What should I do if I want to be in the study?

Sign this document. You will be given a copy of this document to keep.

By signing this document you are saying:

- You agree to be in the study.
- Communication about the study and the information in this document has been given to you and all your questions have been answered.

_____

Your Name (please print)

_____ _____

Your Signature: Date:

APPENDIX C

FUNDING AND DISCLOSURE

1. Check all of the appropriate boxes for funding sources for this research, including pending funding source(s) (Choose one):

_____Extramural
____X_ No Funding
_____Principal Investigator's own Funding
_____Private Industry, Please name_____

2. Do any of the researchers (principal investigator, co-principal investigators, or associated researchers) have any financial or commercial interest in the research? For each researcher, please specify their financial or commercial interest. NO

3. Will this research lead to a commercial product? What is the product? Who will have commercial control over this product? How will potential subjects be informed of the development of this commercial product? NO

4. Has this proposal, or one substantially like this, been submitted to other IRBs?

If so please list with approximate submission dates: NO

5. Are you using information secured from a health provider, such as a hospital, clinic, pharmacy, doctor's office? NO

6. Do you have a patient/provider relationship with any of the potential subjects? NO

7. FDA Approval: Does this research involve the use of investigational drugs, biologic agents or investigation devices? The appropriate sections of the protocol pertaining to investigational

drugs, biologics or investigational devices are required to be completed. In addition, please prove the IND and/or IDE paperwork from the FDA. NO

8. Locations where research is to be conducted:

____ISU Campus (Pocatello)

__X_ISU Off-campus site (specify location) - University of Alaska, Anchorage

____Non-ISU locations (Attach site permission letters) _____

PROTOCOL SUMMARY

(Complete renewal form if renewing active approved protocol. This is not the form to use for renewals.)

If proposal is expedited, PI must choose one category:

(Consult link for appropriate category. www.isu.edu/research/hsc_forms/expeditedcategories5-07.pdf)

__ 1. Drugs, IND not required Device, IDE not required.

__ 2. Blood, healthy adults and children, others

__ 3. Biological specimens, noninvasive collection

__4. Routine clinical data

__5. Materials collected for non-research purposes

__6. Voice, video, digital, image

_X 7. Individual or group behavior

1. **Purpose of the Study**: The purpose of this study is to evaluate an effective teaching method using Multimedia Information (MMI) to teach dental hygiene students the use of extraoral fulcrums.

2. **Lay Language Summary:** The purpose of this study is to compare the use of Multimedia Information (MMI) to traditional classroom instruction to teach dental hygiene students how to use an extraoral fulcrum to stabilize hand movement during dental hygiene

instrumentation procedures.

3. **Summarize current state of research with references (for full board reviews only):**

   NA

4. **Number of Subjects:** 14

5. **Inclusion/Exclusion Criteria:** The inclusion criteria is that students are junior status enrolled in the Department of Dental Hygiene at the University of Alaska, Anchorage, learning instrumentation skills. There are no exclusion criteria.

6. **Vulnerable Subjects:**

   Under 18

   Cognitive impairment

   Economically or educationally disadvantaged

   Residents in total institutional care (e.g., nursing homes)

   Prisoners

   Non-English speakers

   Terminally Ill patients

   ER patients

7. **Method of Subject Identification and Recruitment:** Participants will be first year Dental hygiene students from an accredited two year Dental hygiene program within the United States. Numbering system for the participants will be used for data collection. Numbers for specific participants will be unidentifiable to principal investigator.

8. **Payment for Participation:** None

9. **Methods and Procedures Applied to Human Subjects:** The study will measure the effect of using Multimedia Information (MMI) in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based teaching experience.

A total of 14 dental hygiene undergraduate students will take part in the study. First-year students (n=14) in the spring 2014 semester will have lecture-based classroom instruction and will be taught using traditional lecture-based classroom instruction of a PowerPoint presentation, lecture, and clinical demonstration of extraoral fulcrum use. Each first-year dental hygiene student will be randomly placed in a treatment group (MMI group) (n=7) or the control group (didactic teaching only) group. Both groups will take a survey after didactic instruction is given. For the treatment group (Multi-Media Instruction [MMI] group) (n=7), the independent variable is the use of video instruction (MMI) to facilitate extraoral fulcrums learning. The videos will be shown to the student in the latter half of their second semester.

Each student in the treatment group will view the video independently on laptops in the classroom and be allowed to start, stop, rewind and review the video at any point. The treatment group will also be given the opportunity to view the video outside of the classroom to work and practice on their own. Both groups will be given the opportunity to ask questions and get clarification prior to the clinical competency examination. All students will be given the same clinical competency based examination post instruction. The competency based exam is included as Appendix A. Each of the students will be given a post didactic learning survey (Appendix B). Another post survey will be given to all students after instruction and hands-on practice (Appendix C). The treatment group will then take a post survey after didactic leaning, hands-on practice and video instruction is completed (Appendix D).

The same faculty member will facilitate the group instruction and will receive training and materials from the principle investigator. Two other faculty members will receive training on evaluating the skill level of extraoral fulcrums use by using the Instrument Competency with Extraoral Fulcrum rubric (Appendix A). All three faculty members have no other involvement with the study. Each learning environment will require the same length of time (60 minutes) to complete.

Outcomes will be measured by comparing the clinical competency based examinations and pre/post-test surveys of first year dental hygiene students (spring 2014-MMI treatment group n=7; spring 2014- lecture-based classroom instruction: n=14). Information gathered will allow for a further analysis of the benefit of incorporating visualization tools in dental hygiene educational methodology.

10. **Data Collection, Storage, Confidentiality and Final Data Disposition:** Once results are complied, all data will be stored in a locked file cabinet in the Department of Dental Hygiene at ISU.
11. **Potential Risks and/or Discomforts:** None

12. **Risk Classification:**

__X_ Minimal Risk meaning probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological exams or tests.

____ Greater than minimal risk

____ Significant

____ Unknown risks and discomforts; cannot be considered minimal

13. **Minimizing Risks:** NA

14. **Potential Benefits:** Instruction on how to use extraoral fulcrums in Dental Hygiene instrumentation

15. **Therapeutic Alternatives (only for studies of therapies or diagnostic methods):** NA

16. **Financial Obligations of the Subjects:** None

17. **Emergency Care and Compensation for Research-Related Injury:** NA

18. **Process of Consent:** See Attached

19. **Capacity to Consent:** Excellent

20. **Information Withheld From Subjects:** Individualized results of the project

21. **Personnel Inviting Participation:** NA

22. **Consent/Assent Forms**: Specify the form(s) that will be used among the following

____ Youth Assent Form (ages 13-18) ____ Child Assent Form (ages 7-12)

__X__ Adult Consent Form

FUNDING AND DISCLOSURE

1. Check all of the appropriate boxes for funding sources for this research, including pending funding source(s) (Choose one):

_____Extramural
____X_ No Funding
_____Principal Investigator's own Funding
_____Private Industry, Please name_____

2. Do any of the researchers (principal investigator, co-principal investigators, or associated researchers) have any financial or commercial interest in the research? For each researcher, please specify their financial or commercial interest. NO

3. Will this research lead to a commercial product? What is the product? Who will have commercial control over this product? How will potential subjects be informed of the development of this commercial product? NO

4. Has this proposal, or one substantially like this, been submitted to other IRBs?

If so please list with approximate submission dates: NO

5. Are you using information secured from a health provider, such as a hospital, clinic, pharmacy, doctor's office? NO

6. Do you have a patient/provider relationship with any of the potential subjects? NO

7. FDA Approval: Does this research involve the use of investigational drugs, biologic agents or investigation devices? The appropriate sections of the protocol pertaining to investigational drugs, biologics or investigational devices are required to be completed. In addition, please prove the IND and/or IDE paperwork from the FDA. NO

8. Locations where research is to be conducted:

____ISU Campus (Pocatello)

__X_ISU Off-campus site (specify location) - University of Alaska, Anchorage

____Non-ISU locations (Attach site permission letters) _____

PROTOCOL SUMMARY

If proposal is expedited, PI must choose one category:

(Consult link for appropriate category. www.isu.edu/research/hsc_forms/expeditedcategories5-07.pdf____ISU Off-campus site (specify location) _____

____Non-ISU locations (Attach site permission letters) _____

___ 1. Drugs, IND not required Device, IDE not required.

___ 2. Blood, healthy adults and children, others

___3. Biological specimens, noninvasive collection

___4. Routine clinical data

___5. Materials collected for non-research purposes

___6. Voice, video, digital, image

X__7. Individual or group behavior

23. **Purpose of the Study** (Provide a clear, simple, BRIEF statement of what you want to learn from this study)**:** The purpose of this study is to evaluate an effective teaching method using Multimedia Information (MMI) to teach dental hygiene students the use of extraoral fulcrums.

24. **Lay Language Summary:** The purpose of this study is to evaluate an effective teaching method using Multimedia Information (MMI) to teach dental hygiene students the use of extraoral fulcrums.

25. **Summarize current state of research with references (for full board reviews only):** Proposal stage

26. **Number of Subjects:** 14

27. **Inclusion/Exclusion Criteria:**

28. **Vulnerable Subjects:**

Under 18

Cognitive impairment

Economically or educationally disadvantaged

Residents in total institutional care (e.g., nursing homes)

Prisoners

Non-English speakers

Terminally Ill patients

ER patients

29. **Method of Subject Identification and Recruitment:** Participants will be first year Dental hygiene students from an accredited two year Dental hygiene program within the United States. Numbering system for the participants will be used for data collection. Numbers for specific participants will be unidentifiable to principal investigator.

30. **Payment for Participation:** None

31. **Methods and Procedures Applied to Human Subjects:** The study will measure the effect of using Multimedia Information (MMI) in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based teaching experience. A total of 14 dental hygiene undergraduate students will take part in the study. Learning will be measured using a competency based examination and evaluated by clinical observation.The findings can provide guidance in preparing undergraduate dental hygiene educators to achieve effective teaching methods using MMI.

32. **Data Collection, Storage, Confidentiality and Final Data Disposition:** Results will be complied and stored electronically. Numbering system will keep the

participants' information confidential. Care is taken to keep data unidentifiable to the specific participant. **Potential Risks and/or Discomforts:** None

33. **Risk Classification:**

__X_ __Minimal Risk meaning probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological exams or tests.

____ Greater than minimal risk

____ Significant

____ Unknown risks and discomforts; cannot be considered minimal

34. **Minimizing Risks:** NA

35. **Potential Benefits:** Instruction on how to use extraoral fulcrums in Dental Hygiene instrumentation

36. **Therapeutic Alternatives (only for studies of therapies or diagnostic methods):** NA

37. **Financial Obligations of the Subjects:** None

38. **Emergency Care and Compensation for Research-Related Injury:** NA

39. **Process of Consent:** Consent Forms

40. **Capacity to Consent:** Excellent

41. **Information Withheld From Subjects:** Individualized results of the project

42. **Personnel Inviting Participation:** NA

43. **Consent/Assent Forms**: Specify the form(s) that will be used among the following

___ Youth Assent Form (ages 13-18) ___ Child Assent Form (ages 7-12) __X__

Adult Consent Form

APPENDIX D

DEMOGRAPIC SURVEY

General Demographic Information

What is your age? _____ years

How would you describe your racial or ethnic background? Check all that apply.

____ White/Caucasian ____ Asian American ____ Hispanic or Latin American

____ African American ____ Hawaiian/Pacific Islander ____ Native American

What is your Grade Point Average (GPA)? _____ GPA _____ Don't Know

Have you worked in a dental setting prior to this point?

_____ Never _____ Less than a year _____ More than a year

Do you have a license in another health profession? _____ Yes _____ No

If yes, please identify the discipline _____

Comments or thoughts not expressed:

All information in this survey is *confidential*.
Thank you for completing this survey and for being part of enhancing the education of future dental hygienists.

APPENDIX E

Journal of Dental Education
Information for Authors

Requirements and Policies for Submitted Manuscripts

The *JDE* considers only manuscripts that are in MS Word and submitted electronically. All manuscripts submitted to the journal should follow the "Uniform Requirements for Manuscripts Submitted to Biomedical Journals," compiled and published by the International Committee of Medical Journal Editors (ICJME). Authors are also encouraged to refer to the code on good publication practice produced by the Committee on Publication Ethics.

No Prior Publication or Duplicate Submissions. Manuscripts are considered for publication only if they are not under consideration by other journals and have not been published previously in the same or substantially similar form. Submitting authors should attest to their compliance with this requirement in their cover letters. Should a prior or duplicate publication be discovered, the Editor will address the matter with the affected author/s and the other journal's editor following guidelines published by the ICJME and by the Committee on Publication Ethics.

Plagiarism. Plagiarism is a violation of scholarly standards and will not be tolerated. If a case of plagiarism is alleged or discovered, the Editor will address it with the affected author/s, following ICJME guidelines. Authors should exercise extreme care in quoting or paraphrasing material from published sources, so as not to risk plagiarism.

Conflict of Interest. A conflict of interest exists when professional judgment concerning a primary interest may be influenced by secondary interests (professional, personal, financial, etc.). Forms declaring any conflict of interest must be submitted for each author when the

manuscript is submitted for consideration. The form can be found on ScholarOne Manuscripts in the upper right-hand corner under ‘‘Instructions & Forms.’’

Human Subjects. It is the author’s responsibility to obtain approval or exempt status from his or her institution’s Institutional Review Board for studies involving human subjects; this approval or exempt status must be mentioned at the very beginning of the Methods section. Failure to meet these requirements is likely to place the manuscript in jeopardy and lead to a rejection.

Editorial Assistance. Manuscripts considered for submission must be written in standard academic English that is comprehensible to English-speaking readers. The American Medical Writers Association (AMWA) offers a Freelance Directory with contact information for editors who provide assistance in the writing of medical literature, especially for authors whose first language is not English. Please visit their website for further information.

Writing Guidelines and Submissions for Peer Review

1. Original Articles

This type of article addresses subject matter in the following categories:

a. Allied Dental Education
b. Use of Technology in Dental Education
c. Assessment
d. Faculty Issues/Development

Original Articles should report the results of hypothesis-based research study and may be either qualitative, quantitative or of a mixed methods nature. Manuscripts must address how

the findings advance our understanding of the questions asked in the study and make a novel contribution to the literature. The limitations of the study should also be addressed. Small studies of local relevance/interest, limited to one class/course, or small course/student-based surveys may not meet the criteria to be published as an Original Article.

Original Articles should be no more than 3,500 words, excluding the abstract, illustrations and references. A maximum of six figures and tables can be submitted (the figures can be multi-panel), and the number of references should not exceed 50 (unless the article is a systematic review).

Original Articles should have the following general organization:

Title: An informative and concise title limited to 15 words with no more than 150 characters.

Abstract: For research studies, a structured abstract of no more than 250 words should be submitted with the following subheads:

Purpose/Objectives: Briefly summarize the issue/problem being addressed.

Methods: Describe how the study was conducted.

Results: Describe the results.

Conclusion(s): Report what can be concluded based on the results, and note implications for dental education.

Abstracts for other types of manuscripts should be in paragraph form, with no subheads.

Introduction: Provide a succinct description of the study's background and significance with references to the appropriate published literature. Detailed literature review/discussion should be reserved for the discussion section. Include a short paragraph outlining the aims of the study.

Materials and Methods: A statement that the study has been approved or exempted from oversight by a committee that reviews, approves and monitors studies involving human subjects **MUST** be provided at the beginning of this section, along with the IRB protocol number.

In this section, provide descriptions of the study design, curriculum design, subjects, procedures and materials used, as well as a description of and rationale for the statistical analysis. If the design of the study is novel, enough detail should be given for other investigators to reproduce the study. References should be given to proprietary information.

Results: The results should be presented in a logical and systematic manner with appropriate reference to tables and figures. Tables and figures should be chosen to illustrate major themes/points without duplicating information available in the text.

Discussion: This section should focus on the main findings in the context of the aims of the study and the published literature. The authors should avoid an extensive review of the literature and focus instead on how the study's findings agree or disagree with the hypotheses addressed and what is known about the subject from other studies. A reflection on new information gained, new hypotheses and limitations of the study should be included, as well as guidance for future research.

Conclusion: The article should end with a short paragraph describing the conclusions derived from the findings and implications of the study for dental education.

Acknowledgments: The acknowledgments should report all funding sources, as well as any other resources used or significant assistance.

Disclosure: Authors must disclose any financial, economic or professional interests that may have influenced the design, execution or presentation of the scholarly work. If there is a disclosure, it will be published with the article.

Clinical Trials: Any educational research studies that are designed as "clinical trials" must register the trial before submitting to the *Journal of Dental Education*. The registration number must be provided in the manuscript.

Document Preparation, Organization and Formatting

Manuscripts submitted for consideration should be prepared in the following parts, each beginning on a new page:

Title page
Abstract and keywords
Text
Acknowledgments
References
Tables
Figures
Figure titles if figures are provided as images

Blinding. Both blinded and non-blinded manuscripts should be prepared once the original manuscript has been completed. All institutional references should be removed from the body of the manuscript to produce the blinded version; please indicate in the file name which version is blinded.

Document Format. Create the documents on pages with margins of at least 1 inch (25 mm) and left justified with paragraphs indented with the tab key, not the space bar. Use double-spacing throughout and number the pages consecutively. Do not embed tables and figures in the body of the text but place them after the references; include callouts for each table or figure in the text (e.g., see Table 1). Unless tables vary significantly in size, include all in one document. If any figures are large files, submit them as separate documents.

Title Page. The title page should cary 1) the title, which should be concise but descriptive, limited to 15 words and no more than 150 characters; 2) first name, middle initial and last name of each author, with highest academic degrees; 3) an affiliations paragraph with the name of each author or coauthor and his or her job title, department and institution, written in sentence style; 4) disclaimers if any; 5) name, address, phone and email of author responsible for correspondence about the article and requests for reprints; and 6) support or sources in the form of grants, equipment, drugs, etc. See published articles for examples. Individuals listed as authors must follow the guidelines established by the ICMJE: 1) substantial contributions to conception and design, or acquisition of data or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. It is the submitting author's responsibility to make sure that authors have agreed to the order of authorship prior to submission.

Abstract and Key Words/MeSH terms. The second page should carry the title and an abstract of no more than 250 words. For research studies, the abstract should be in the structured form described above. Abstracts should be written in the third person, and references should not be used in the abstract. The abstract should include the year of the study and, for survey-based research, the response rate. Below the abstract, provide three to five key words or phrases that will assist indexers in cross-indexing the article and will be published with the abs tract. At least three terms should come from the Medical Subject Headings listed at the National Library of Medicine. Guidelines for words found in the Medical Subject Headings can be found here. Authors should confirm these terms still exist in the Index Medicus or should search for more accurate terms if not found in our list. NOTE: Authors will also be prompted to identify Key Words when submitting their manuscripts in ScholarOne. These Key Words may differ from the items presented here. The Key Words identified in ScholarOne are generated from a list that

will best match the submitted manuscript to a Peer Reviewer with expertise in the area(s) identified.

Text. Follow American (rather than British) English spelling and punctuation style. Spell out numbers from one to ninety-nine, with the exception of percentages, fractions, equations, numbered lists and Likert scale numbers. The body of the manuscript should be divided into sections preceded by appropriate subheads. Major subheads should be typed in capital letters at the left-hand margin. Secondary subheads should appear at the left-hand margin, be typed in upper and lower case and be boldfaced. Tertiary subheads should be typed in upper and lower case and be underlined. For authors whose first language is not English, please use a medical writer or a native English-speaking colleague to edit the manuscript prior to final submission. Manuscripts will be rejected prior to peer review if there are numerous usage or grammatical errors.

Please Note: In preparing the main document for submission, save the original file with the word "unblinded" at the end of the file name. Please also remove all author names and affiliated institutions from the original manuscript, and save this version with the word "blinded" at the end of the file name.

References. Number references consecutively in the order in which they are first mentioned in the text. Each source should have one number, so *be careful not to repeat sources in the reference list*. Identify references by Arabic numerals, and place them in the text as superscript numerals within or at the end of the sentence. Do not enclose the numerals in parentheses, and be sure to follow American rather than British or European style conventions (e.g., the reference number follows rather than precedes commas and periods). Two important reminders: 1) references should not be linked to their numbers as footnotes or endnotes and 2) references to

tables and figures should appear as a source note with the table/figure, not numbered consecutively with the references for the article (Journal of Dental Education, 2014).

TITLE: EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

AUTHORS: Carri A. Shamburger, RDH, BS, JoAnn Gurenlian, RDH, PhD, and Kandis Garland, RDH, MS,

Carri A. Shamburger RDH, BS is Assistant Professor and Clinical Director at the University of Alaska, Anchorage, Dental Hygiene Department; JoAnn Gurenlian RDH, PhD is a Professor and Graduate Program Director in the Department of Dental at Idaho State University; and Kandis Garland RDH, MS is an Associate Professor in the Department of Dental Hygiene at Idaho State University.

Keywords: Clinical competence, clinical evaluation, competence-based education, dental hygiene education, extraoral fulcrum, manikin, multimedia instruction in dental education, and typodont.

Contact Information: JoAnn Gurenlian, RDH PhD

Idaho State University
921 South 8th Ave.
Mail Stop, 8048
Pocatello, ID 83209
Phone: 208-240-1443
gurejoan@isu.edu

Title: EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

Purpose: The aim was to evaluate the effect of Multimedia Information (MMI) incorporated into dental hygiene curriculum in the form of expert video presentations as an interactive educational tool to teach the skill of extraoral fulcrums compared to traditional lecture-based teaching experiences.

Methods: Fourteen, first year students of an accredited two-year dental hygiene program, participated. Each participant (n=14) received lecture-based classroom instruction, with the treatment group receiving additional MMI (n=7). Participants were randomly placed in a treatment group (MMI group, n=7) or control group (didactic teaching only) group. A competency based exam was used to measure the acquirement of an extraoral fulcrum.

Results: A Fisher Exact Test and independent t-test were performed to ensure similarities between groups. There were no significant differences between the groups in mean age, sex, and dental knowledge. All participants were scored by three coders. The intercoder reliability was 0.84. A multinomial repeated measure regression was used to assess differences between the control and experimental group to identify significance. Criteria that assessed the skill acquisition of an extraoral fulcrum appeared higher for the treatment group exposed to MMI ($p \leq .05$) compared with the control group.

Conclusion: Findings show an increase in the acquirement of the skill with MMI, however, further research is warranted for learning environments with larger samples. Additional studies should examine multimedia use in dental hygiene curriculum for instruction and training.

Keywords: Clinical competence, clinical evaluation, competence-based education, dental

hygiene education, extraoral fulcrum, manikin, multimedia instruction in dental education, and typodont.

EVALUATING THE EFFECT OF MULTIMEDIA LEARNING ON EXTRAORAL FULCRUM USE IN DENTAL HYGIENE STUDENTS

Introduction

Dental hygiene instrumentation and scaling involves the effective removal of deposits and biofilm from the tooth crown and root surfaces safely without patient or clinician injury. In order for this to occur, the clinician must use the appropriate techniques and instruments for thorough debridement. These appropriate techniques include the use of safe, stable and secure fulcrums. Fulcrums are finger rests that are used to stabilize the clinician's hand during instrumentation.[1] The fulcrum functions to support the hand during instrumentation procedures, and allows the hand and instrument to move as a unit with precise control during instrumentation. A well-established fulcrum or finger rest is needed to control the hand/instrument unit, reduce the stress on the muscles of the clinician's hand during instrumentation, increase patient comfort and provide control of instrument stroke.[1] The standard intraoral fulcrum is a necessary requirement for any dental hygienist to master; however, the addition of extraoral fulcrum techniques are needed for a clinician to properly instrument more involved periodontal cases.

Patients are presenting with advanced periodontal diseases. An estimated 8.5% of adults between the ages of 20 and 64 have periodontal disease with 5% having moderate to severe disease. Adults age 65 and older, have a higher incidence rate of 17.2% with 10.58% having moderate to severe disease.[2,3] Half of all adults in in the United States have gingivitis and approximately 48% of all adults in the United States have chronic periodontitis.[4] Periodontal health cannot be maintained without the removal of both supragingival and subgingival calculus.[5] In a literature review conducted by Lanning, Best, & Hunt (2007), greater than 90%

of scaling and root planing therapy and periodontal maintenance cases are performed by dental hygienists.[6] The adult population is presenting with complex periodontal problems and the dental hygiene student must have exposure and practice with patients with complex periodontal conditions to gain competence. Today's dental hygienist needs to be equipped to treat patients that present with involved medical and periodontal issues.

Extraoral fulcrums or external finger rests are needed for advanced instrumentation and play an important role for obtaining access into deep periodontal pockets. Learning how to use an extraoral fulcrum while in a dental hygiene program with an instructor's guidance will develop a well-rounded, knowledgeable clinician with the skills needed to enter into the work force. The Commission on Dental Accreditation for Dental Hygiene Education Programs[7], established a standard that states, "dental hygiene sciences provide the knowledge base for dental hygiene and prepares the student to assess, plan, implement and evaluate dental hygiene services as an integral member of the health team." Additional research indicates that the knowledge gained while in a formal education program is more likely to be incorporated into practice than information gained in any other setting, as with professional continuing education courses or workshops.[8] This knowledge could also include the understanding and practice of extraoral finger rests or fulcrums into formal education is essential.

There is a demand for elevated professional skills, including critical thinking skills that are needed for more involved periodontal cases.[9] Extraoral fulcrums become a necessity when intraoral fulcrums are ineffective. Using critical thinking and decision making along with correct instrumentation skills will advance a dental hygiene student's clinical skills and ability to be an effective clinician. Educating students on the use of extraoral fulcrums will prepare them for successful completion of their accredited program with advanced techniques and the ability to safely incorporate them in clinical practice. The use of multimedia information to

assist with teaching extraoral fulcrums may facilitate clinical instrumentation and critical thinking by providing visual imaging that assists dental hygiene students in understanding effective instrumentation.

Traditional educational methodology for teaching an extraoral fulcrum with instrumentation involves the students memorizing the anatomy and physiology of the tooth with no real critical thought to how to solve instrumentation problems.[10] Instrumentation instruction has the educator verbally explaining and/or demonstrating proper hand placement and techniques for instrumentation and the student is expected to copy the instruction repeatedly.[10]

Multimedia Information or MMI uses computer technology to supplement course content with that of traditional methods.[11] The principle behind multimedia learning is to use words and pictures to enhance learning.[11] When words and pictures are both presented to the learner, there is the opportunity to construct mental images and build connections between the two.[12] With the incorporation of multiple sensory learning, new information is acquired quicker and retained as compared to the use of just one type of data presentation.[13]

Research related to the use of MMI examined how iPad technology with instructional videos could be used in a preclinical dental laboratory setting to enhance the teaching and learning environment as well as identify strategies for teaching novice learners psychomotor skill acquisition that add to ideal clinical procedures. Findings showed that the use of video combined with visual and verbal instruction in the acquisition of motor skills resulted in greater accuracy and retention of learning into long-term memory.[14] MMI brings experts to the learner demonstrating skills that range from clinical reasoning to carrying out the procedure. MMI can enable the recognition of words, terms and demonstrate tasks and movement through space.[15]

The literature related to the use of MMI in dental hygiene education is limited. No studies exist concerning the use of MMI to teach extraoral fulcrums to dental hygiene students. Therefore, the purpose of this exploratory study was to compare the effect of using MMI in the form of supplemental expert video presentations as an interactive educational tool for teaching the skill of using extraoral fulcrums as compared to a traditional lecture-based experience.

Information gained through this study will support current dental hygiene curricula which prepares dental hygienists to meet the complex periodontal needs of the public. This research addresses the National Dental Hygiene Research Agenda for Professional Education and Development[16] and the evaluation of the extent to which current dental hygiene curricula prepares dental hygienists to meet the increasingly complex oral health needs of the public as well as provide information that assesses continued clinical competency.

Materials and Methods

Upon receipt of human subjects approval from Idaho State University (#4080) and the University of Alaska, Anchorage (601971-1), fourteen students were provided a description of the study and completed consent forms to participate. All students agreed to participate in the study.

Students (n=14) in the spring semester of their first year were given lecture-based classroom instruction and were taught extraoral fulcrums using traditional lecture-based classroom instruction, a PowerPoint presentation, lecture, and clinical demonstration of how to use an extraoral fulcrum with area specific curets. Each dental hygiene student was then assigned a number (one through fourteen) with the numbers placed in a pool. Students were randomly selected for either the control or treatment group. The treatment group was exposed to the independent variable of video instruction (MMI) to facilitate extraoral fulcrum learning.

Each participant in the treatment group was able to view the videos independently on laptops in the classroom and was allowed to start, stop, and rewind as well as review the videos at any point. The treatment group was also given the opportunity to view the videos outside of the classroom to work and practice on their own. The control group was given the opportunity for additional practice outside the classroom. Both the control and treatment groups were given the chance to ask questions and get clarification if needed prior to the clinical competency examination.

A faculty member facilitated the group instruction and received training and materials from the principle investigator. Two additional faculty members received training to evaluate the skill level of extraoral fulcrums use by using an Instrument Competency with Extraoral Fulcrum Rubric as shown in Table 1. Each study participant was given a clinical competency examination post instruction. All three faculty members had no other involvement with the study. Each learning environment required the same length of time (60 minutes) to complete.

Five teeth were used to evaluate skill level and an average of the scores were reported. On the skill observation competency examination, the student was evaluated using ten criteria scores. A point value was given to each of the criteria: 2 = Excellent; 1 = Acceptable; 0 = Unacceptable. 100 points were possible. Each participant was given the clinical skill examination two weeks following the intervention. Participants were familiar with the clinical competency assessment tool as it was used in preclinical evaluations. Outcomes were measured by comparing the clinical competency based examination performed on a manikin-mounted typodont as illustrated in Figure 1 and 2. Clinical faculty were trained and served as evaluators and administrators.

A Fisher Exact Test was performed to compare the treatment group and control group on gender, race, and dental experience. An independent two sample t-test was used to compare age and GPA between the treatment and control group. The level of significance was set at $\alpha=0.05$.

Intercoder reliability was calculated between the three coders by counting differences in coding and calculating the percentage agreement between all three coders. Intercoder reliability in this study was calculated at 0.84. Intracoder reliability could not be assessed due to lack of repeated evaluation on the same student.

Multinomial repeated measures regression was used to assess differences between students in the control group and treatment group. Given a high intercoder reliability, scores were averaged across all three coders for each student. A repeated measures test was used to compensate for any correlation possible within each student's performance.

Results: Fourteen participants were enrolled and completed the study. Table 2 provides a summary of the demographic characteristics of the students. As can be seen from this table, the students were homogeneous. The Fischer Exact test and independent two sample t-test were performed revealing no significant differences between the groups in grade point average (GPA), mean age, sex, and dental knowledge.

Table 3 summarizes the clinical assessment performed by the three faculty coders to determine whether or not a statistically significant difference existed in the reproducibility of using an extraoral fulcrum technique between a traditional lecure-based format and a MMI approach. A multinomial repeated measures regression was used to assess differences between the control and treatment groups. P values for this statistical analysis are listed in Table 3 and demonstrate no difference between the control and treatment group with regard to most of the criteria evaluated. However, there was a statistical difference found in the extraoral fulcurm

criteria assessed between both groups (p=0.05). Therefore, MMI appears to have had an effect on attainment of competency of extraoral fulcrum use for the treatment group.

Discussion: This exploratory study was designed to gather information about the effect of using MMI to enhance clinical skills particularly in relation to learning an extraoral fulcrum. The study showed a significant result in the use of MMI incorporated into dental hygiene curriculum using expert video presentations as an interactive educational tool to teach the skill of extraoral fulcrums compared to traditional lecture-based teaching experiences. Of interest, there was no difference in the clinical skill criteria for other areas assessed during the competency evaluation. It is anticipated that this finding is the result of students having already acquired these clinical skills.

Research has indicated that the use of visual technology in the curriculum of dental hygiene instrumentation instruction can be highly beneficial to developing the correct fine motor skills and instrumentation skills necessary to become a successful clinician and meet the complex oral health care needs of the public, which includes the development and use of extraoral fulcrums.[17] Based on this study, MMI appears to be an effective learning strategy for achieving clinical competency in dental hygiene education settings.

Comparative studies on the use of MMI in dentistry and dental hygiene are limited. One study of ninety third-year dental students evaluated the effectiveness of MMI for the diagnosis of endodontic issues. These dental students were given a pre-survey to measure knowledge along with ten lectures. The participants were then divided into three groups. Group one was exposed to lecture and MMI containing a case situation for one hour. Group two was given a lecture and participated in a seminar group that contained the identical case situation as the first group for the same amount of time, and group three received lecture only on the same case.[18] A

post-survey was given to evaluate knowledge of the presented case. The three groups then took a post-test to evaluate their diagnostic knowledge in endodontics. The improvement of scores from pre- to post-test in the three groups were statistically different ($p = 0.018$). The simulation group students improved significantly more than the seminar group ($p = 0.05$) and the control group ($p = 0.0024$). The students in group one, who received MMI and lecture scored significantly higher in knowledge than the other two groups.[18]

Another study compared the effectiveness of interactive multimedia course work versus standard lectures in the transfer of knowledge, understanding and problem solving skills was conducted in the field of orthodontics. Pre- and post-test assessments of final-year dental students ($n = 26$), who either used an interactive multimedia courseware package ($n = 15$) or attended standard lectures ($n = 11$) on equivalent material of the undergraduate orthodontic curriculum were conducted.[19] Both groups were tested by written and multiple-choice questions covering knowledge, understanding, and application areas in the curriculum. The groups improved their scores after the course. One question that investigated the extent of understanding of the instructional content of the multidisciplinary orthodontic treatment revealed that the multimedia courseware package group scored significantly better.[19]

Research was conducted on the use of videos in teaching pre-clinical dental students fixed prosthodontics with the use of a video detailing instructions of a crown preparation and placement followed by a group demonstration and independent practice on a mannequin. Students viewed the video as many times as they needed and the outcome was compared to the class of the previous year.[20] Findings showed that the group that used the videos had a better performance with pre-clinical crown preparation and placement ($p=.01$). Feedback obtained from the class revealed that the majority of the students who returned their course evaluation

(48/50) felt that the instructional video helped them prepare for the all-ceramic tooth preparation and crown fabrication practical.[20]

Video instruction can be used to provide real experiences in almost all fields of learning. It can be made to repeat information and demonstration as many times as possible; thereby, learning is made easier, realistic and concrete for learners.[21] Video instruction allows for self-instruction and a way of disseminating educational information and practical skills, and increasing learner understanding.[21-22]

In the above mentioned studies, it is interesting to note the significance MMI has had on education. This study of the use of MMI with learning extraoral fulcrum skills had similar findings, but was limited by the convenience sampling technique and small sample size. Therefore, results are not generalizable. However, this study was exploratory in nature and consistent with an established pattern of sample sizes in similar dental research.[23]

Conclusion: In today's rapidly advancing technological world of creative computer software, distance education, video simulations, and iPads being used to supplement the delivery of learning, educational technologies are becoming more mainstream. The increased use is reflected in an increase number of publications and conference presentation that are related to educational technology. Integrating multimedia technologies into dental hygiene curriculum creates a visual capability for the student to view the skill performance of an expert and allows the student the ability to reproduce that skill as well as review and analyze materials if necessary.

Although data shows an increase in the attainment of the skill of an extraoral fulcrum, further research is warranted for learning environments with larger samples. Additional studies should examine multimedia use in dental hygiene curriculum for instruction and skill training.

Acknowledgements: The authors thank thesis committee member Chris Sanford, PhD, CCC-A, from Idaho State University; Program Director Sandra Pence, RDH, MS and faculty members Sue Gregg, RDH, BS and Elizabeth Barnett, RDH, BS from the Department of Dental Hygiene at the University of Alaska, Anchorage for their assistance and support of the study. A special thank you to Sarah Shimer, MPH, Research Associate from the Institute for Circumpolar Health Studies at the University of Alaska, Anchorage for her statistical analysis.

References

1. Hui, D., Barr, A., Loomer, P., & Rempel, D. The effects of finger rest positions on hand muscle load and pinch force in simulated dental hygiene work. . J Dent Educ 2005; 69(4): 453-60.

2. Centers for Disease Control and Prevention (CDC). Third national health and nutrition examintation survey. At: www.cdc.gov/nchs/nhanes.htm. Accessed: November, 2013. Acessessed: July 28, 2014.

3. National Institute of Dental and Craniofacial Research. Data and statistics. At: www.nidcr.nih.gov/DataStatistics. Accessed: July 28, 2014.

4. Albandar, J. Epidemiology and risk factors of periodontal disease. Dent Clin North Am 2005;(49): 517-32.

5. Pattison, A., Matsuda, S., & Pattison, G. Extraoral fulcrums: the essentials of using extraoral fulcrums for periodontal instrumentation. Dimensions of Dent Hyg 2004;2(10): 20, 21-3.

6. Lanning, S. K., Best, A. M., & Hunt, R. J. Periodontal services rendered by general practitioners. J Periodontol 2007;78(5): 823-32.

7. Commission on Dental Accreditation. Self-study guide for dental education programs. 2012. At: www.ada.org/~/media/CODA/Files/pde_ssg.ashx - 335k - 2014-03-19. Accessed: October, 2013.

8. Fried, J. L., Reid, B. C., & DeVore, L. E. A comparison of health professions student attitudes regarding tobacco curricula and interventionist roles. J Dent Educ 2004; 68 (3):370-77.

9. Hodges, K. Reconsidering the explorer. Dimensions of Dent Hyg 2005; 3(4):26-8.

10. Ray, C., Gray, J., & Spoonts, L. The diagnosis of clinical remediation: Teaching dental hygiene clinicial instructors how to teach. 2011. At: www.adea.org/publications/library/Documents/clinicalRemed.pdf. Accessed: November, 2013.

11. Mayer, RE. Introduction to multimedia learning. In: Mayer RE. *The cambridge handbook of multimedia learning.* New York: Cambridge University Press, 2005:1-18.

12. Mayer, R. E., & Sims, V. K. For whom is a picture worth a thousand words: extensions of a dual coding theory of multimedia learning. J Educ Psych 1994*; 86*: 389-01.

13. Willis, J. Research-based strategies to ignite student learning. Alexandria: Association for Supervision and Curriculum Development, 2006.

14. Gadbury-Amyot, C., Purk, J. H., Williams, B. J., & Van Ness, C. J. Using tablet technology and instructional videos to enhance preclinical dental laboratory learning. J Dent Educ 2013; 78(2):250-8.

15. Gilakjani, A. P. The significant role of multimedia in motivating efl learners' interest in english language learning. IJMECS 2012; *4*:57-6.

16. American Dental Hygienists' Association. National dental hygiene research agenda. 2007. At: /www.adha.org/resources-docs/7111_National_Dental_Hygiene_Research_Agenda.pdf. Accessed: July 10, 2013.

17. Hauser, A. M., & Bowen, D. M. Primer on preclinical instruction and evaluation. J Dent Educ 2009;73(3):390-8.

18. Fouad, A. F., & Burleson, J. A. Effectiveness of an endodontic diagnosis computer-simulation program. J Dent Educ 1997; 61 (3):289-95.

19. Aly, M., Elen, J., & Willems, G. Instructional multimedia program versus standard lecture: a comparison of two methods for teaching the undergraduate orthodontic curriculum. Eur J Dent Ed 2004; 8 (1):43-6.

20. Aragon, C., & Zibrowski, E. Does exposure to a procedural video enhance preclinical dental student performance in fixed prosthodontics? J Dent Educ 2008;72(1): 67-71.

21. Al-Haliq, M. A., Oudt, M.A. & Abu Al-Taieb, M.. The effect of using video on developing physical fitness of physical education students at the hashemite university. Asian Social Science 2013; 10 (1):21-7.

22. Issa, N., Mayer, R.E., & Schuller, M., et al., Teaching for understanding in medical classrooms using multimedia design principles. Med Educ 2013; 47:338-96.

23. Rosenberg, H., Grad, H.A., & Matear, D.W. The effectiveness of computer aided, self-instructional programs in dental education: a systemic review of the literature. J Dent Educ 2003; 67(5): 524-32.

FIGURE 3. INSTRUMENT COMPETENCIES USING EXTRAORAL FULCRUMS

Student_____ Date_____ Evaluator_____

Instructors: Please provide the student with input by giving the score that best identifies the student's proficiency level for each given task. Use the criteria scores listed below.

2 =Excellent No improvement needed
1 =Acceptable Appears to comprehend the step but should consider practice time in addition to what is scheduled in class
0 =Unacceptable Student **requires** additional time with the faculty for help.

Clinical Practicum Competency Exam

* Each student will have 15 minutes to complete the competency exam.
* Completion of all 5 instrumentation situations are required.
* Three minutes maximum per situation will be given.
* Once instrumentation on a tooth surface has begun (as indicated by the student verbally), the student cannot make corrections during the three minutes. A maximum of three minutes will be allowed per situation.
* **To receive points for a situation, the correct tooth, surface, instrument, and end MUST be used.**
* Examiners will not prompt or tutor the student during the exam.

Demonstrate the correct use of the following instruments on the specified surface.

Instrument	R L	Correct Instrument & end	Op/pt position	Lighting	Grasp	Extraoral Fulcrum	Insertion (sub only)	Angulation Shank position	Activation	All surfaces instrumented	Infection control	TOTAL POINTS	Comments
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	Tooth #_____ _____ Surface_____												
	TOTAL POINTS/SCORE												

TABLE 1. Demographic characteristics of study population

	Control (n=7)	Treatment (n=7)
Female		
Caucasian	86%	100%
Age (yr)	26±6	24±8
GPA	3.86±0.18	3.70±0.39
≤ 1 Year Dental Experience	71%	71%

TABLE 2. Assessment Criteria

	P value
1. Correct instrument & end	0.99
2. Op/pt position	0.19
3. Lighting	0.15
4. Grasp	0.37
5. Extraoral Fulcrum	0.05
6. Insertion (sub only)	0.61
7. Angulation Shank position	0.92
8. Activation	0.90
9. All surfaces instrumented	0.98
10. Infection Control	1.00

Illustration 1.
(Photo taken by Carri Shamburger)

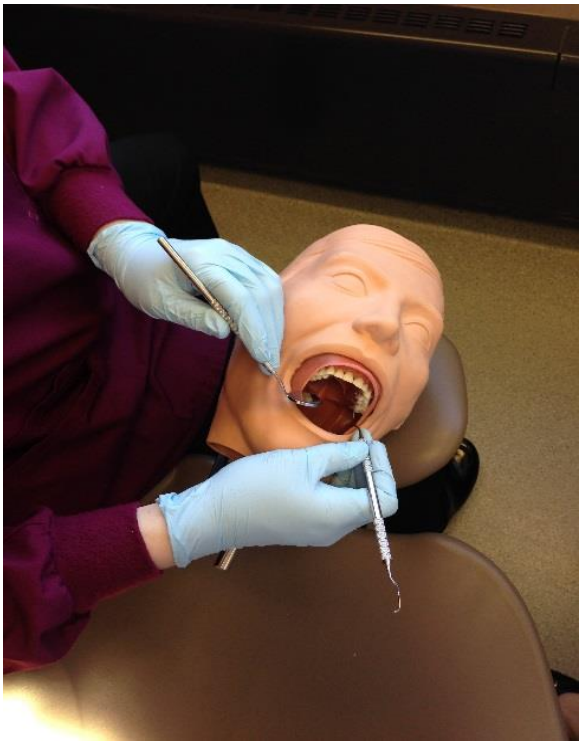

Illustration 2.
(Photo taken by Carri Shamburger)