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How Dental Hygiene Undergraduate Learning is Influenced by Educational Videos

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HOW DENTAL HYGIENE UNDERGRADUATE LEARNING IS INFLUENCED BY EDUCATIONAL VIDEOS

by

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B.S., DENTAL HYGIENE, UNIVERSITY OF NEW MEXICO, 2015

THESIS

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ABSTRACT

This pilot experimental research study evaluated the efficacy of educational videos in comparison to traditional learning with print media and evaluated the student's knowledge and retention of utilizing the periodontal screening and recording (PSR) method. The sample size consisted of 23 undergraduate students enrolled in their second year in a baccalaureate dental hygiene program. Participants were placed into two randomized groups, labeled Group A consisting of 12 students and Group B consisting of 11 students and evaluated with a 10 question pre test before exposure to the educational intervention, followed by a 10 question post test. Group A, n = 12, was exposed to a 5 minute educational video and the results showed a mean score difference of 0.467, df = 11, SD = 0.137, SEM (standard error of difference) = 0.040. Group B, n = 11, was exposed to traditional print media and the results showed a mean score difference of 0.473, df = 10, SD = 0.119, SEM = 0.036. By conventional criteria, the difference between the two groups is considered to be not statistically significant.

When comparing the results of the group exposed to the educational video to the group that learned via traditional print media, the lack of statistical difference in the student's

results indicates that the educational videos are just as effective as the print media when used as a learning tool. Future studies could provide a more thorough investigation including a larger sample size with various levels of students to help determine if the educational video method utilized in this pilot study shows a statistical improvement in student learning over traditional print media methods.

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Chapter I

Introduction

Technology advancements in the 21st century continue to impact and influence the field of dentistry on a clinical and educational level. With new techniques, skills, methods and processes seen in education and clinical practice, it is becoming more relevant for dental professionals to remain current and knowledgeable on the technology needed for quality patient care as well as personal and professional career growth.

Clinical education and training is primarily obtained through faculty professors giving verbal or written instruction along with live demonstrations, lectures, laboratory and clinical sessions. Clinical education of specific skills continues to be the most time consuming aspect of education in dental hygiene programs. Incorporating the use of instructional videos made for specific clinical skills have been advocated to assist students in achieving better academic outcomes and better clinical skill performances while also being cost effective by decreasing the demand on faculty resources.

Statement of the Problem:

Incorporating the use of educational videos in undergraduate dental hygiene education can increase academic outcomes.

Significance of the Problem

Information and Communication Technology (ICT) continue to be more heavily utilized in clinical courses in health and dental education. Besides being a major component of a student's entertainment in their leisure time, videos are becoming the most frequently used

media application in a classroom setting. Based on technology advances and faculty striving to remain relevant, videos are becoming an integral part of the educational environments students will encounter.[6,7] Faculty need to utilize a variety of methods in teaching to reach the generation of students that are constantly exposed to computer based technology, known as the Net Generation. The Net Generation includes people born between 1982 and 1991 who have grown up in an environment in which they have been constantly exposed to computer-based technology. This generation of students are technologically savvy and immersed in the web, heavily engaged in gaming and internet surfing and social networking applications such as YouTube, Facebook and MySpace. These students tend to prefer pictures and videos over lengthy demonstrations, expect immediate feedback, and demand instructions that are fun, interactive and non-linear.[3] Due to the pressure exerted by advances in technology, faculty shortages and student demand for flexible learning, the momentum of educational technology growth is likely to continue to increase in the future.[6]

Operational Definitions

- Information and Communication Technology (ICT): broad term describing the use of technology and media to share knowledge and information
- Video Streaming: a video which can be played by a means of internet data stream directly on a website in real time. The web user does not have to wait to download a file to play it. Instead, the media is sent in a continuous stream of data and is played as it arrives.
- Net Generation: individuals born between 1982 and 1991 who have grown up in an environment in which they are constantly exposed to computer-based technology.

- Common Video: features allow the user to browse through the video's contents with a slider, stop the video at any given time, and indicators are available for the time left to work with the video and the video running time
- Enhanced Video: features allow the user to browse through the video's contents with a slider, stop the video at any given time, navigate through the video via a table of contents and an index in chronological order, and has indicators for the time left to work with the video and the video running time

Chapter II

Review of Literature

Introduction

This review of literature aims to explore different studies and universities that are utilizing online educational videos as a method of instruction used to influence student learning. While this method of instruction is a relatively new concept as technology become more influential in education, studies have been conducted to evaluate the level of comprehension and retention gained by students utilizing online educational media. Medical, dental and educational peer reviewed publications and resources were reviewed utilizing several different databases such as ScienceDirect.com and PubMed search engines focusing on keywords such as "educational videos" "dental videos" "online education", among several others. General information on the specific types of media and videos currently being utilized along with a comparison of print versus media will be discussed.

Types of Media Utilized

Innovations in multimedia applications and the availability of high-speed bandwidth internet has increased in the past 20 years. The utilization of streaming videos in health education, specifically for learning complex clinical procedures, have become more readily available and easier to access with this advancement in technology.[6] Streaming videos involve a video which can be played via an internet data stream accessed directly on a website in real time. This prevents the web user from having to wait to download a file to play the video content. Instead, the media is sent in a continuous stream of data and is played in real time as it arrives. Preferred video length ranged from five to twenty minutes, depending on the video topic, type, and relevance.[6, 13]

There are different types of videos that can be used specifically for education which differ based on the amount of interactivity they allow. A common video has features that allow the user to browse through the video's contents with a slider, stop the video at any given time, and provides indicators for the time left to work with the video and the video running time. An enhanced video has all the same features of a common video with the addition of navigation controls throughout the video via a table of contents and an index in chronological order. An essential finding across multiple studies reviewed at the Knowledge Media Research Center in Tübingen, Germany, as outlined in the study "*How does interactivity in videos affect task performance?"*, shows that on-demand streaming content increases student engagement. [(9)] Individual control over the pace of learning enables students to review complex segments or topics repeatedly and give the student a sense that they are learning autonomously and more effectively.[(10)]

Print versus Media

With an increase in technology and media use in an educational setting, more research and information is needed to determine the efficacy of educational videos on learning outcomes and student comprehension versus the use of a standard printed text.[(9)] Several studies related to reading comprehension have demonstrated the importance of self-regulated information processing when learning via traditional print media. Skilled readers adapt their reading pace to the complexity of the text and to their individual cognitive needs but also actively reread important or difficult passages and skip unimportant or uninteresting passages. Successful readers were shown to deliberately review and re-read the text as a method of enhancing their memory and comprehension of the text. In contrast, recent digital forms of video give the viewers the opportunity to interactively control its presentation. Enabling this level of interactivity seemed to be more beneficial for learning by giving the student control over the

information and how it is processed, such as stopping the video or browsing the content. Giving students the opportunity to control the pacing of information interactively any time they feel, may be a promising approach to improve the video's potential as a learning tool.[10]

Reported studies conducted at the University of Tübingen in Tübingen, Germany, show that interactive videos are just as effective as print media when it comes to student learning. [9] Videos used in an educational setting may serve as a measure to diversify the students' learning experience in the classroom, therefore influencing the students' overall achievement by contributing to a more stimulating classroom environment. Videos have also been shown to offer students the opportunity to gain insight into events or scenarios that they usually cannot experience otherwise. The effective use of videos, just as with the effective use of print, requires active and self-regulated information processing by students in order to achieve positive learning outcomes.[10]

Clinical Outcomes of Video Training

A study conducted by the Department of Emergency Medicine and Resuscitation Science at the Maricopa Medical Center in Phoenix, Arizona aimed to measure the effectiveness of how brief and ultra-brief cardiopulmonary resuscitation (CPR) videos influence training and responsiveness on lay responders.[4]

The study used an experimental design, with a prospective trial of 336 adults without recent CPR training randomized to 1 of the following 4 groups: (1) control (no training) (n=51); (2) Ultra-brief 60-second video training (n=95); (3) Brief 5-minute video training (n=99); and (4) Brief Video with practice of an 8-minute video training, including manikin practice (n=91).

The results of the study showed that 23.5% of subjects in the control group did not make any attempt to perform CPR in the evaluation scenario. This result compares to only 4.2%

of subjects in the ultra-brief video group. All subjects in the other groups, brief video training and brief video with practice, attempted CPR in the evaluation scenario. The conclusions of study stated that laypersons exposed to an ultra-brief Hands-Only CPR video were more likely to attempt Hands-Only CPR and showed superior skills compared to untrained laypersons.[4]

Denture Instructional Video

An article published in the Journal of Prosthodontic Research in 2015, looked at evaluating the effectiveness of a clinical instructional video with a structured worksheet for independent self-study in a complete denture program. The methods of this study included 47 multilingual dental students which completed a task by watching an instructional video with subtitles regarding clinical denture procedures. After completion, students evaluated their learning experience, and 11 students participated in focus group interviews to gain further insight.[8]

Over 70% of students had favorable opinions of the learning experience and indicated that the speed and length of the video were appropriate. The use of a video resource was considered valuable as the replay and review functions allowed better visualization of the procedures, which was considered a good recap tool for the clinical demonstration. It was also a better revision aid than textbooks. If the students were able to view these videos at will, they believed that videos supplemented their self-study. Despite the positive response, videos were not considered to replace live clinical demonstrations but complement them as a supplemental learning tool.[8]

Video Based Lectures

A study conducted in a Bachelor of Nursing Program at an International College for Medical Science in Saudi Arabia aimed to assess the learning outcomes of student nurses' and

the acceptance and satisfaction with the video-based lectures versus the traditional method of teaching human anatomy and physiology courses. The objectives and content of the lectures, both traditional and video-based, were identical; the only difference between them was the delivery method. The results of this study found that teaching human anatomy and physiology courses using video-based lectures attained nearly the same exam results and students reported that the use of videos improved their understanding to the topic of the lecture and that videos had a positive impact on their motivation as well as concentration levels. Video based lectures can become a cost effective teaching method in that they can be created once, and then saved in libraries to be used by a large number of academic educators.[5]

Video-based teaching materials have been sought to offer a promising alternative in delivering the intended learning content that may not be available in the traditional print-based illustration.[4, 12] Video-based lectures provide a unique opportunity to present, teach, and internalize information; they are also excellent venues for focusing the students' attention on specific details based on the prepared material itself. Learning is not something that happens in isolation, or is just inside the head, but it is shaped by the context, learning environment, and tools in the learning situation.[4, 10] Among the various technologies that become currently available, video technology is suitable for context-based learning because it can convey the information or knowledge in a more interesting way and allows the portrayal of complicated contexts.[4]

Student Learning

Although the impact of video and multimedia technologies in educational outcomes is a field of ongoing research, a summary of the impact of videos can be defined by three key concepts; interactivity with content, engagement, and knowledge transfer and memory.

Interactivity can be measured and defined in multiple ways based upon how the learner relates to the visual content. Note taking, thinking, verbal interaction or by applying concepts are some ways students relate to visual content. Engagement is measured or defined based upon how the learner connects to the visual content. This can be achieved by becoming drawn in and focused on the video, whether on demand or real-time. Lastly, knowledge transfer and memory can be measured and defined by how the learner may remember and retain concepts, which may be better than with other instructional media.[10, 12]

Because videos combine many kinds of data, such as, images, motion, sounds, and text, in a complementary fashion, learning can be adjusted more easily than with other tools to cater to the diverse learning styles and individual learning pace of students. With videos, the learner has more control over the information he or she receives and an additional opportunity for deeper learning and comprehension by being able to stop, rewind, fast-forward, and replay content as many times as needed.[3, 10]

These are part of a continuum in which interactivity with multimedia content becomes the key principle and a means for cognitive development: the learner interacts with visual content, whether verbally, note taking, thinking, or by applying concepts. Engagement occurs when the learner connects to the visual content, becoming drawn in by video, either on-demand or real-time. Interactivity and engagement begin in the affective realm, the feeling side of learning. In order for interactivity to take place, the quality of the video experience should be high. Once engagement occurs, the continuum then flows into knowledge transfer and memory: the learner, according to some studies, may remember better. The net result, in theory, is a combination of affective and cognitive development, and retention of content.[10, 11]

Chapter III

Research Approaches

This pilot experimental research study evaluated the use and incorporation of educational videos to a student's learning and analyzes the results attained with the use of videos. The study explored the student's knowledge and retention of the periodontal screening and recording (PSR) method with the use of an education video outlining the benefits, limitations and interpretation of this clinical skill.

In 1982, the World Health Organization (WHO) created the Community Periodontal Index of Treatment Needs (CPITN). This method of periodontal evaluation estimated the periodontal disease prevalence and severity was based on the probing depths and condition of the periodontium. In 1992, the American Academy of Periodontology (AAP) modified the Simplified Periodontal Examination (SPE), used in New Zealand, and developed the PSR system for use in North America. The PSR system was designed to initiate the promotion, prevention, and early treatment of periodontal diseases by introducing a simplified screening method that met legal dental recording requirements, encouraging dentists to incorporate the PSR system into every oral examination and educating members of the public to value periodontal health and to request a periodontal screening from dentists (PSR Training Program, 1992).

The most common method used for the measurement of the depth of the gingival crevice and the clinical attachment level is periodontal probing. The system of periodontal screening and recording (PSR) was developed by the American Dental Association and the American Academy of Periodontology to simplify early detection of periodontal pathology. Early detection and diagnosis are significant components in the prevention of periodontal disease.

During this study, the efficacy of educational videos versus traditional print media will be evaluated based on a post-test evaluation of the content presented to the students. All data obtained from these evaluations will be analyzed and evaluated.

Hypothesis

The use of educational videos in undergraduate dental hygiene education can increase the student's academic outcomes.

Research Design

This pilot research study evaluated the efficacy of educational videos in comparison to traditional learning with print media and evaluated the student's knowledge and retention of utilizing the periodontal screening and recording (PSR) method. The sample size consisted of 23 undergraduate students enrolled in their second year in a baccalaureate dental hygiene program. Participants were randomized and placed into two groups, labeled Group A consisting of 12 students and Group B consisting of 11 students. A 10 question pre-test was administered to all participants to test the student's previous knowledge of the PSR method before being exposed to the educational media in the study. Group A was exposed to a short (approximately 5 minute) video outlining the benefits, limitations and interpretation of this clinical skill, while Group B learned via traditional print media. A 10 question post-test was administered following the student's exposure to the specific media to evaluate the efficacy of the content presented to the students in each of the groups.

Procedures

Research began after receiving approval from the university's Human Research Protection Office (HRPO) and consent forms requiring respondents' signature were waived in order to maintain confidentiality.

Students enrolled in the undergraduate baccalaureate degree dental hygiene program were recruited to participate. Participation was voluntary and participants were not penalized for withdrawing from the study at any time. For their time and participation in the study, participants were given a new dental hygiene instrument valued at $60.00 as compensation. No identifying information was collected from the participants. Unique ID numbers were assigned to each participant in a randomized order separating the 23 participants into two groups, Group A with 12 participants and Group B with 11 participants. Permission was obtained from Tayna Villalpando Mitchell, RDH, MS, and the Procter and Gamble Company to utilize the educational content for the PSR method to create the printed materials including the questions for our pre and posttest material. A 10 question multiple choice pre-test was administered initially to all participants to test any previous knowledge of the PSR method before being exposed to the educational media in the study.

Following the pre test, Group A was exposed to a 5 minute video outlining the benefits, limitations and interpretation of the PSR clinical skill and had up to 30 minutes to watch and replay the video collectively as a group. The video was viewed a total of two times in its entirety during the allotted 30 minutes. Group B was given a detailed handout to represent traditional print media containing the exact content included in the video. Group B also had up to 30 minutes to read and review the content before taking the post test. A 10 question multiple choice post-test was administered to both groups following the exposure to the specific media

to evaluate the efficacy of the content presented to the students in each of the groups. Participants were not informed on how they performed or scored on the pre test or the post test.

Outcome Measurements and Analysis

Utilizing the scores collected from each participant's initial knowledge on the pre test and the information gained with each group on the post test, the data was collected and a statistical analysis was performed using GraphPad Software and Microsoft Excel. A one-sample t-test was used to test whether the mean of the entire population is equal to zero or is different from zero. Specifically, the mean difference was evaluated from the pre-test to post-test for the subjects tested (μ) to determine if it is greater than zero, indicating an improvement. It was assumed the null hypothesis, H_0: μ = 0, was true unless sufficient evidence warrants rejection of the null in favor of the alternative, H_1: μ > 0, determined by the p-value of the test being less than chosen type-I error rate α=0.05. A paired t-test was then performed to test the efficacy of the educational video of the specific clinical skill in comparison with student learning via traditional print as assessed by the difference in results from the pre-test from the post-test score between the two groups (Group A and B).

Chapter IV

Results

Following the conduction of the experimental study, it was concluded that the overall learning increased between both groups. Considering all the subjects as one group, n=23, the one sample t-test shows that the actual mean of the differences between the pre test and the post test is 0.470 (p-value = 0.0001), t = 17.887, df = 22, SD = 0.126. This is considered to be statistically significant compared to the null hypothetical mean = 0. Utilizing a paired t-test, both groups were considered independently to compare the data between Group A and Group B (p-value = 0.9113). Group A, n = 12 showed a mean score difference of 0.467, df = 11, SD = 0.137, SEM (standard error of difference) = 0.040. Group B, n = 11 showed a mean score difference of 0.473, df = 10, SD = 0.119, SEM = 0.036. By conventional criteria, the difference between the two groups is considered to be not statistically significant. Both groups show considerable improvement based on their mean score difference, but the sample sizes are small and there is not enough evidence to determine a statistical difference between the two groups.

The data in Table 1 and Table 2, shows the randomly assigned candidate number, results of the pre test and post test and the score difference between the two tests for both groups.

Table 1: Group A Pre Test and Post Test Scores

a.

Candidate	Pre Score	Post Score	Score Difference
A01	5	10	5
A02	5	7	2
A03	3	9	6
A04	4	8	4
A05	6	10	4
A06	5	9	4
A07	6	10	4
A08	6	10	4
A09	4	8	4
A10	4	10	6
A11	3	10	7
A13	2	8	6

b.

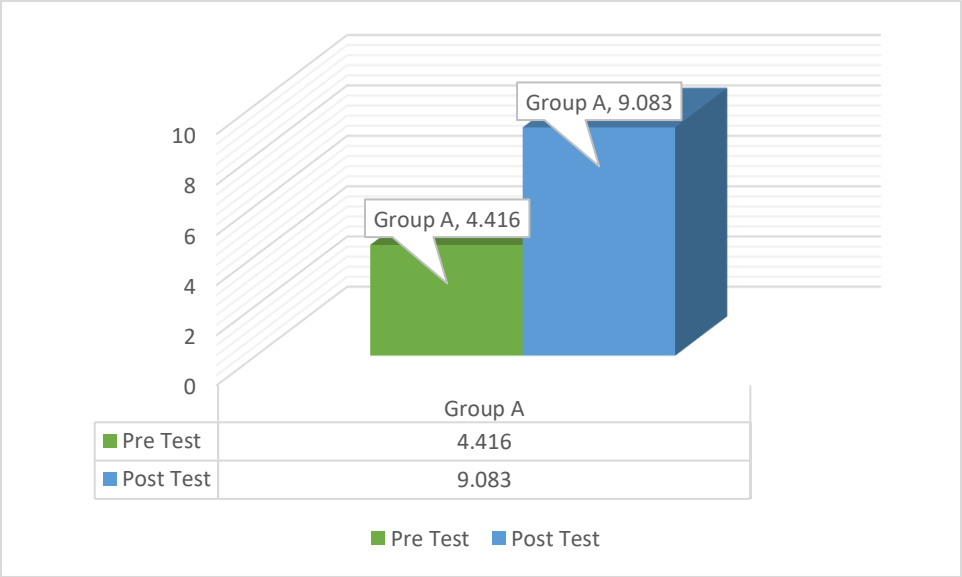

Table 1b. Shows the difference between the mean score of the pre test and post test for Group A

Table 2: Group B Pre Test and Post Test Scores

a.

Candidate	Pre Score	Post Score	Score Difference
B01	4	9	5
B02	5	10	5
B03	6	10	4
B04	3	9	6
B05	5	10	5
B06	4	8	4
B07	6	9	3
B08	5	10	5
B09	5	10	5
B10	3	10	7
B11	6	9	3

b.

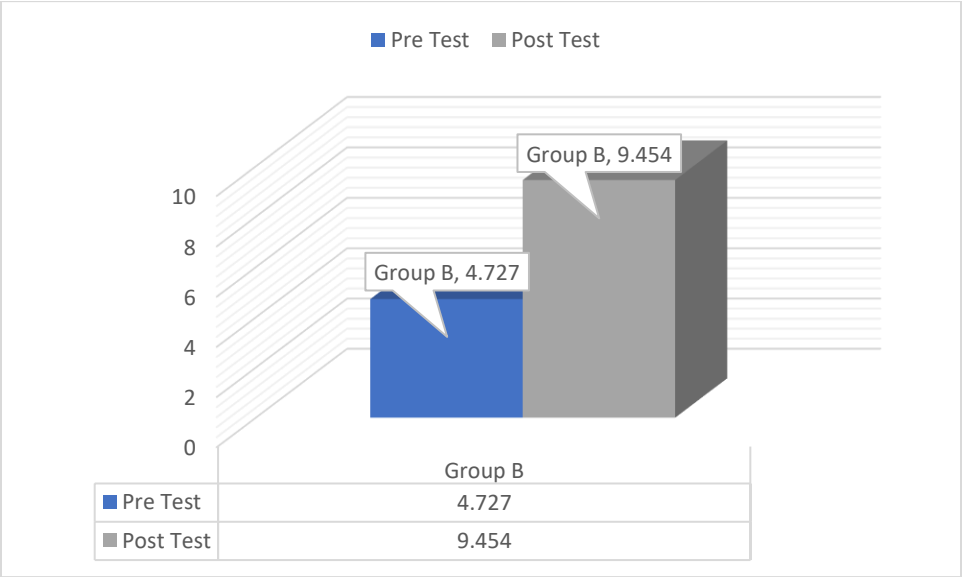

Table 2b. Shows the difference between the mean score of the pre test and post test for Group B

Table 3: Statistical Data for Groups A and B

GROUP	N	M	SD	SEM	MIN SCORE	MAX SCORE
COMBINED	23	0.470	0.126	0.026	0.2	0.7
GROUP A	12	0.467	0.137	0.040	0.2	0.7
GROUP B	11	0.473	0.119	0.036	0.3	0.7

Table 3. Shows the statistical data obtained from Group A, Group B and the two groups combined in terms of sample size (N), mean (M), standard deviation (SD), standard error of difference (SEM), and the minimum and maximum score difference between the pre test and post test.

Discussion of Results

Principal Findings

The purpose of this study was to determine the efficacy of educational videos on undergraduate student learning compared to traditional print media. Using two groups, the study revealed that both groups showed a significant increase in learning and comprehension yielding a mean of 0.470 and standard deviation of 0.126 (p-value = 0.0001). When comparing both interventions independently, Group A (video learning) showed a mean of 0.467 and standard deviation of 0.137 while Group B (print media learning) showed a mean of 0.473 and a standard deviation of 0.119 (p-value = 0.9113). These results indicate the difference between both interventions is not statistically significant, thus learning via educational video can be equally as effective as learning via traditional print media.

When analyzing the specific questions in the pre and post test that was administered to both groups (Appendix C, iii.), the intervention of the educational video in Group A shows more improvement, by 30% or greater, in questions 2, 6, 9, and 10 (Appendix B) compared to the improvement seen with traditional print media given in Group B. Although this may not be as statistically rigorous, it does show how educational videos can be used to impact and improve student learning in the dental hygiene curriculum.

Limitations

The limitations present in this experimental study could have an impact on the given results, interpretations and future implications. The sample size was small as it only evaluated one undergraduate class size of 23 students in their second year in the dental hygiene program with the University of New Mexico. When comparing the two groups, the sample sizes are small

enough that there is not enough evidence to determine a statistical difference between the two groups which limits the results and the outcome of the study.

The study was only conducted on students in their second year of the program which primarily teaches with traditional print media as a supplement to live teaching. This factor can influence the results as all of the students have had multiple years of experience studying with this particular intervention method and therefore know how to evaluate, retain and test on information presented with print media.

Recommendation for Future Studies

In future studies, it would be beneficial to survey the participants of the study to determine what percentage of the participants would benefit from learning via traditional print media versus educational videos and what method of learning each student might prefer. Because the educational video intervention is shown to be just as effective as traditional print media, it is more important to determine which intervention method would encourage more engagement in learning or which method is more widely accepted with students. It would also be recommended that a future study be conducted with first year dental hygiene students to confirm whether or not the results of these learning intervention methods are still statistically similar.

Conclusion

This study showed a positive correlation in the student's knowledge and retention in utilizing the periodontal screening and recording (PSR) method after being exposed to an education video outlining the benefits, limitations and interpretation of this clinical skill.

Clinical training in dentistry is usually obtained by receiving experts' written and verbal instructions, often in combination with live demonstrations, content lectures, tutorials, laboratory and clinical sessions. However, this is considered one of the most time-consuming parts in clinical education. Because of this, there has been increasing advocacy for the use of multimedia applications among medical educators due to their perceived benefits in assisting students to achieve better academic outcomes and clinical skill performances. In dentistry, videos also provide better viewing access and visualization of the small oral cavity that can eliminate students' missing opportunities for learning. Video instruction can also be used as a calibration tool that ensures standardized information which may be problematic when delivered by different tutors or faculty.

The results of this study indicate that all participants showed significant improvement in academic outcomes after learning with either the educational video or traditional print media intervention in two individual groups. When comparing the results of the group exposed to the educational video to the group that learned via traditional print media, the lack of statistical difference in the student's results indicates that the educational videos are just as effective as the print media when used as a learning tool. Future studies could provide a more thorough investigation including a larger sample size with various levels of students to help determine if the educational video method utilized in this pilot study shows a statistical improvement in student learning over traditional print media methods.

Chapter V

Article For Submission

Title Page

HOW DENTAL HYGIENE UNDERGRADUATE LEARNING IS INFLUENCED BY EDUCATIONAL VIDEOS

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ABSTRACT

Purpose

The purpose of this study was to determine the efficacy of educational videos in comparison to traditional learning with print media and evaluated the student's knowledge and retention of utilizing the periodontal screening and recording (PSR) method.

Methods

The sample size consisted of 23 undergraduate students enrolled in their second year in a baccalaureate dental hygiene program. Participants were randomized and placed into two groups, labeled Group A consisting of 12 students and Group B consisting of 11 students. Both groups were evaluated with a 10 question pre test before exposure to the educational intervention, followed by a 10 question post test.

Results

Group A, n = 12, was exposed to a 5 minute educational video and the results showed a mean score difference of 0.467, df = 11, SD = 0.137, SEM (standard error of difference) = 0.040. Group B, n = 11, was exposed to traditional print media and the results showed a mean score difference of 0.473, df = 10, SD = 0.119, SEM = 0.036. By conventional criteria, the difference between the two groups is considered to be not statistically significant.

Conclusion

When comparing the results of the group exposed to the educational video to the group that learned via traditional print media, the lack of statistical difference in the student's results indicates that the educational videos are just as effective as the

print media when used as a learning tool. Future studies could provide a more thorough investigation including a larger sample size with various levels of students to help determine if the educational video method utilized in this pilot study shows a statistical improvement in student learning over traditional print media methods.

INTRODUCTION

Technology advancements in the 21st century continue to impact and influence the field of dentistry on a clinical and educational level. With new techniques, skills, methods and processes seen in education and clinical practice, it is becoming more relevant for dental professionals to remain current and knowledgeable on the technology needed for quality patient care as well as personal and professional career growth.

Clinical education and training is primarily obtained through faculty professors giving verbal or written instruction along with live demonstrations, lectures, laboratory and clinical sessions. Clinical education of specific skills continues to be the most time consuming aspect of education in dental hygiene programs. Incorporating the use of instructional videos made for specific clinical skills have been advocated to assist students in achieving better academic outcomes and better clinical skill performances while also being cost effective by decreasing the demand on faculty resources.

With an increase in technology and media use in an educational setting, more research and information is needed to determine the efficacy of educational videos on learning outcomes and student comprehension versus the use of a standard printed text.[1] Several studies related to reading comprehension have demonstrated the importance of self-regulated information processing when learning via traditional print media. Skilled readers adapt their reading pace to the complexity of the text and to their individual cognitive needs but also actively reread important or difficult passages and skip unimportant or uninteresting passages. Successful readers were shown to deliberately review and re-read the text as a method of enhancing their memory and comprehension of the text. In contrast, recent digital forms of video give the viewers the opportunity to interactively control its presentation. Enabling

this level of interactivity seemed to be more beneficial for learning by giving the student control over the information and how it is processed, such as stopping the video or browsing the content. Giving students the opportunity to control the pacing of information interactively any time they feel, may be a promising approach to improve the video's potential as a learning tool.[2]

Reported studies conducted at the University of Tübingen in Tübingen, Germany, show that interactive videos are just as effective as print media when it comes to student learning. [1] Videos used in an educational setting may serve as a measure to diversify the students' learning experience in the classroom, therefore influencing the students' overall achievement by contributing to a more stimulating classroom environment. Videos have also been shown to offer students the opportunity to gain insight into events or scenarios that they usually cannot experience otherwise. The effective use of videos, just as with the effective use of print, requires active and self-regulated information processing by students in order to achieve positive learning outcomes.[2]

There are different types of videos that can be used specifically for education which differ based on the amount of interactivity they allow. A common video has features that allow the user to browse through the video's contents with a slider, stop the video at any given time, and provides indicators for the time left to work with the video and the video running time. An enhanced video has all the same features of a common video with the addition of navigation controls throughout the video via a table of contents and an index in chronological order. An essential finding across multiple studies reviewed at the Knowledge Media Research Center in Tübingen, Germany, as outlined in the study "*How does interactivity in videos affect task performance?"*, shows that on-demand streaming content increases student engagement. [1] Individual control over the pace of learning enables students to

review complex segments or topics repeatedly and give the student a sense that they are learning autonomously and more effectively.[2]

A study conducted by the Department of Emergency Medicine and Resuscitation Science at the Maricopa Medical Center in Phoenix, Arizona aimed to measure the effectiveness of how brief and ultra-brief cardiopulmonary resuscitation (CPR) videos influence training and responsiveness on lay responders.[3]

The study used an experimental design, with a prospective trial of 336 adults without recent CPR training randomized to 1 of the following 4 groups: (1) control (no training) (n=51); (2) Ultra-brief 60-second video training (n=95); (3) Brief 5-minute video training (n=99); and (4) Brief Video with practice of an 8-minute video training, including manikin practice (n=91).

The results of the study showed that 23.5% of subjects in the control group did not make any attempt to perform CPR in the evaluation scenario. This result compares to only 4.2% of subjects in the ultra-brief video group. All subjects in the other groups, brief video training and brief video with practice, attempted CPR in the evaluation scenario. The conclusions of study stated that laypersons exposed to an ultra-brief Hands-Only CPR video were more likely to attempt Hands-Only CPR and showed superior skills compared to untrained laypersons.[3]

A study conducted in a Bachelor of Nursing Program at an International College for Medical Science in Saudi Arabia aimed to assess the learning outcomes of student nurses' and the acceptance and satisfaction with the video-based lectures versus the traditional method of teaching human anatomy and physiology courses. The objectives and content of the lectures, both traditional and video-based, were identical; the only difference between them was the delivery method. The results of this study found that teaching human anatomy and physiology courses using video-

based lectures attained nearly the same exam results and students reported that the use of videos improved their understanding to the topic of the lecture and that videos had a positive impact on their motivation as well as concentration levels. Video based lectures can become a cost effective teaching method in that they can be created once, and then saved in libraries to be used by a large number of academic educators.[4]

Video-based teaching materials have been sought to offer a promising alternative in delivering the intended learning content that may not be available in the traditional print-based illustration.[3, 5] Video-based lectures provide a unique opportunity to present, teach, and internalize information; they are also excellent venues for focusing the students' attention on specific details based on the prepared material itself. Learning is not something that happens in isolation, or is just inside the head, but it is shaped by the context, learning environment, and tools in the learning situation.[2,3] Among the various technologies that become currently available, video technology is suitable for context-based learning because it can convey the information or knowledge in a more interesting way and allows the portrayal of complicated contexts.[3]

Although the impact of video and multimedia technologies in educational outcomes is a field of ongoing research, a summary of the impact of videos can be defined by three key concepts; interactivity with content, engagement, and knowledge transfer and memory. Interactivity can be measured and defined in multiple ways based upon how the learner relates to the visual content. Note taking, thinking, verbal interaction or by applying concepts are some ways students relate to visual content. Engagement is measured or defined based upon how the learner connects to the visual content. This can be achieved by becoming drawn in and focused on the video, whether on demand or real-time. Lastly, knowledge transfer

and memory can be measured and defined by how the learner may remember and retain concepts, which may be better than with other instructional media.[2, 5]

Because videos combine many kinds of data, such as, images, motion, sounds, and text, in a complementary fashion, learning can be adjusted more easily than with other tools to cater to the diverse learning styles and individual learning pace of students. With videos, the learner has more control over the information he or she receives and an additional opportunity for deeper learning and comprehension by being able to stop, rewind, fast-forward, and replay content as many times as needed.[2, 6]

These are part of a continuum in which interactivity with multimedia content becomes the key principle and a means for cognitive development: the learner interacts with visual content, whether verbally, note taking, thinking, or by applying concepts. Engagement occurs when the learner connects to the visual content, becoming drawn in by video, either on-demand or real-time. Interactivity and engagement begin in the affective realm, the feeling side of learning. In order for interactivity to take place, the quality of the video experience should be high. Once engagement occurs, the continuum then flows into knowledge transfer and memory: the learner, according to some studies, may remember better. The net result, in theory, is a combination of affective and cognitive development, and retention of content.[2, 7]

Hypothesis

Incorporating the use of educational videos in undergraduate dental hygiene education can increase academic outcomes.

METHODS AND MATERIALS

This pilot experimental research study evaluated the use and incorporation of educational videos to a student's learning and analyzes the results attained with the use of videos. The study explored the student's knowledge and retention of the periodontal screening and recording (PSR) method with the use of an education video outlining the benefits, limitations and interpretation of this clinical skill. The efficacy of educational videos was compared to learning via traditional print media and was evaluated based on a post-test evaluation of the content presented to the students. All data obtained from these evaluations was be analyzed and evaluated.

The sample size consisted of 23 undergraduate students enrolled in their second year in a baccalaureate dental hygiene program. Participants were randomized and placed into two groups, labeled Group A consisting of 12 students and Group B consisting of 11 students. A 10 question pre-test was administered to all participants to test the student's previous knowledge of the PSR method before being exposed to the educational media in the study. Group A was exposed to a short (approximately 5 minute) video outlining the benefits, limitations and interpretation of this clinical skill, while Group B learned via traditional print media. A 10 question post-test was administered following the student's exposure to the specific media to evaluate the efficacy of the content presented to the students in each of the groups.

Research began after receiving approval from the university's Human Research Protection Office (HRPO) and consent forms requiring respondents' signature were waived in order to maintain confidentiality.

Students enrolled in the undergraduate baccalaureate degree dental hygiene program were recruited to participate. Participation was voluntary and participants

were not penalized for withdrawing from the study at any time. For their time and participation in the study, participants were given a new dental hygiene instrument valued at $60.00 as compensation. No identifying information was collected from the participants. Unique ID numbers were assigned to each participant in a randomized order separating the 23 participants into two groups, Group A with 12 participants and Group B with 11 participants. Permission was obtained from Tayna Villalpando Mitchell, RDH, MS, and the Procter and Gamble Company to utilize the educational content for the PSR method to create the printed materials including the questions for our pre and posttest material.[8] A 10 question multiple choice pre-test was administered initially to all participants to test any previous knowledge of the PSR method before being exposed to the educational media in the study.

Following the pre test, Group A was exposed to a 5 minute video outlining the benefits, limitations and interpretation of the PSR clinical skill and had up to 30 minutes to watch and replay the video collectively as a group. The video was viewed a total of two times in its entirety during the allotted 30 minutes. Group B was given a detailed handout to represent traditional print media containing the exact content included in the video. Group B also had up to 30 minutes to read and review the content before taking the post test. A 10 question multiple choice post-test was administered to both groups following the exposure to the specific media to evaluate the efficacy of the content presented to the students in each of the groups. Participants were not informed on how they performed or scored on the pre test or the post test.

Utilizing the scores collected from each participant's initial knowledge on the pre test and the information gained with each group on the post test, the data was collected and a statistical analysis was performed using GraphPad Software and Microsoft Excel. A one-sample t-test was used to test whether the mean of the entire

population is equal to zero or is different from zero. Specifically, the mean difference was evaluated from the pre-test to post-test for the subjects tested (μ) to determine if it is greater than zero, indicating an improvement. It was assumed the null hypothesis, H_0: μ = 0, was true unless sufficient evidence warrants rejection of the null in favor of the alternative, H_1: μ > 0, determined by the p-value of the test being less than chosen type-I error rate α=0.05. A paired t-test was then performed to test the efficacy of the educational video of the specific clinical skill in comparison with student learning via traditional print as assessed by the difference in results from the pre-test from the post-test score between the two groups (Group A and B).

RESULTS

Following the conduction of the experimental study, it was concluded that the overall learning increased between both groups. Considering all the subjects as one group, n=23, the one sample t-test shows that the actual mean of the differences between the pre test and the post test is 0.470 (p-value = 0.0001), t = 17.887, df = 22, SD = 0.126. This is considered to be statistically significant compared to the null hypothetical mean = 0. Utilizing a paired t-test, both groups were considered independently to compare the data between Group A and Group B (p-value = 0.9113). Group A, n = 12 showed a mean score difference of 0.467, df = 11, SD = 0.137, SEM (standard error of difference) = 0.040. Group B, n = 11 showed a mean score difference of 0.473, df = 10, SD = 0.119, SEM = 0.036. By conventional criteria, the difference between the two groups is considered to be not statistically significant. Both groups show considerable improvement based on their mean score difference, but the sample sizes are small and there is not enough evidence to determine a statistical difference between the two groups.

The data in Table I and Table II, shows the randomly assigned candidate number, results of the pre test and post test and the score difference between the two tests for both groups.

Table 1: Group A Pre Test and Post Test Scores

a.

Candidate	Pre Score	Post Score	Score Difference
A01	5	10	5
A02	5	7	2
A03	3	9	6
A04	4	8	4
A05	6	10	4
A06	5	9	4
A07	6	10	4
A08	6	10	4
A09	4	8	4
A10	4	10	6
A11	3	10	7
A13	2	8	6

b.

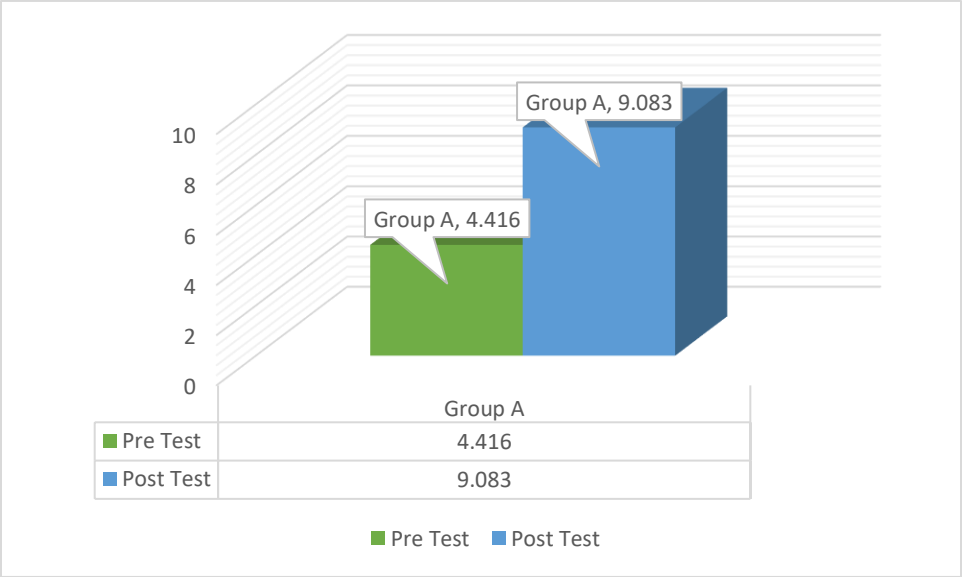

Table 1b. Shows the difference between the mean score of the pre test and post test for Group A

Table 2: Group B Pre Test and Post Test Scores

a.

Candidate	Pre Score	Post Score	Score Difference
B01	4	9	5
B02	5	10	5
B03	6	10	4
B04	3	9	6
B05	5	10	5
B06	4	8	4
B07	6	9	3
B08	5	10	5
B09	5	10	5
B10	3	10	7
B11	6	9	3

b.

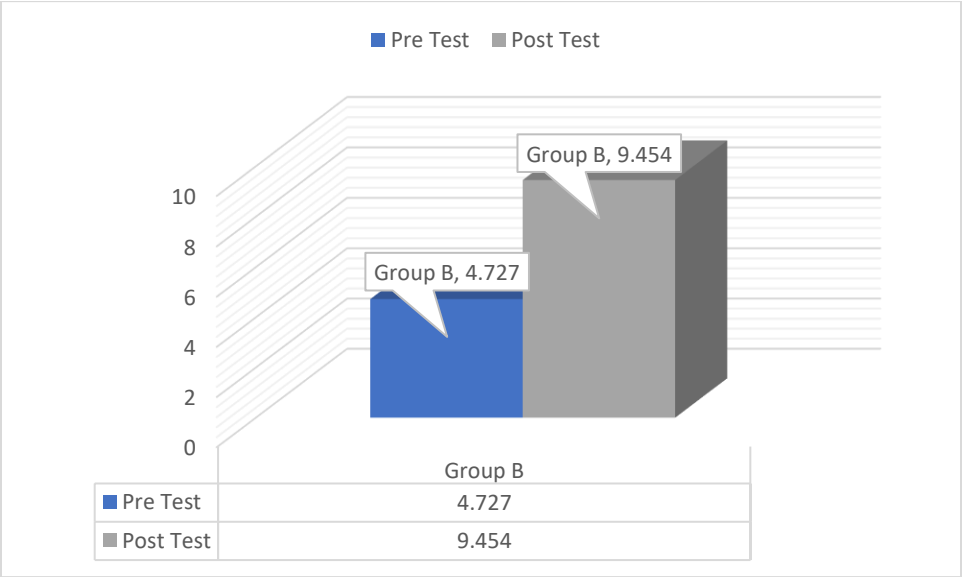

Table 2b. Shows the difference between the mean score of the pre test and post test for Group B

Table 3: Statistical Data for Groups A and B

GROUP	N	M	SD	SEM	MIN SCORE	MAX SCORE
COMBINED	23	0.470	0.126	0.026	0.2	0.7
GROUP A	12	0.467	0.137	0.040	0.2	0.7
GROUP B	11	0.473	0.119	0.036	0.3	0.7

Table 3. Shows the statistical data obtained from Group A, Group B and the two groups combined in terms of sample size (N), mean (M), standard deviation (SD), standard error of difference (SEM), and the minimum and maximum score difference between the pre test and post test.

DISCUSSION

The purpose of this study was to determine the efficacy of educational videos on undergraduate student learning compared to traditional print media. Using two groups, the study revealed that both groups showed a significant increase in learning and comprehension yielding a mean of 0.470 and standard deviation of 0.126 (p-value = 0.0001). When comparing both interventions independently, Group A (video learning) showed a mean of 0.467 and standard deviation of 0.137 while Group B (print media learning) showed a mean of 0.473 and a standard deviation of 0.119 (p-value = 0.9113). These results indicate the difference between both interventions is not statistically significant, thus learning via educational video can be equally as effective as learning via traditional print media.

When analyzing the specific questions in the pre and post test that was administered to both groups (Appendix C, iii.), the intervention of the educational video in Group A shows more improvement, by 30% or greater, in questions 2, 6, 9, and 10 (Appendix B) compared to the improvement seen with traditional print media given in Group B. Although this may not be as statistically rigorous, it does show how educational videos can be used to impact and improve student learning in the dental hygiene curriculum.

The limitations present in this experimental study could have an impact on the given results, interpretations and future implications. The sample size was small as it only evaluated one undergraduate class size of 23 students in their second year in the dental hygiene program with the University of New Mexico. When comparing the two groups, the sample sizes are small enough that there is not enough evidence to determine a statistical difference between the two groups which limits the results and the outcome of the study.

The study was only conducted on students in their second year of the program which primarily teaches with traditional print media as a supplement to live teaching. This factor can influence the results as all of the students have had multiple years of experience studying with this particular intervention method and therefore know how to evaluate, retain and test on information presented with print media.

In future studies, it would be beneficial to survey the participants of the study to determine what percentage of the participants would benefit from learning via traditional print media versus educational videos and what method of learning each student might prefer. Because the educational video intervention is shown to be just as effective as traditional print media, it is more important to determine which intervention method would encourage more engagement in learning or which method is more widely accepted with students. It would also be recommended that a future study be conducted with first year dental hygiene students to confirm whether or not the results of these learning intervention methods are still statistically similar.

CONCLUSION

This study showed a positive correlation in the student's knowledge and retention in utilizing the periodontal screening and recording (PSR) method after being exposed to an education video outlining the benefits, limitations and interpretation of this clinical skill.

Clinical training in dentistry is usually obtained by receiving experts' written and verbal instructions, often in combination with live demonstrations, content lectures, tutorials, laboratory and clinical sessions. However, this is considered one of the most time-consuming parts in clinical education. Because of this, there has been increasing advocacy for the use of multimedia applications among medical educators due to their perceived benefits in assisting students to achieve better academic outcomes and clinical skill performances. In dentistry, videos also provide better viewing access and visualization of the small oral cavity that can eliminate students' missing opportunities for learning. Video instruction can also be used as a calibration tool that ensures standardized information which may be problematic when delivered by different tutors or faculty.

The results of this study indicate that all participants showed significant improvement in academic outcomes after learning with either the educational video or traditional print media intervention in two individual groups. When comparing the results of the group exposed to the educational video to the group that learned via traditional print media, the lack of statistical difference in the student's results indicates that the educational videos are just as effective as the print media when used as a learning tool. Future studies could provide a more thorough investigation including a larger sample size with various levels of students to help determine if the educational video method utilized in this pilot study shows a statistical improvement in student learning over traditional print media methods.

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Appendices

Appendix A. Traditional Printed Material

Periodontal Screening and Recording

The dental hygienist is most often the person in the professional dental setting who screens patients and measures probing depths. The most commonly used screening method for the measurement of depth of the gingival crevice and the clinical attachment level is periodontal probing. Early detection and diagnosis are significant components in the prevention of periodontal disease. The American Academy of Periodontology (AAP) recommends every dental patient should receive a comprehensive periodontology evaluation annually. The Periodontal Screening and Recording (PSR) system is one example of a diagnostic aid used to assess the gingival health of patients.

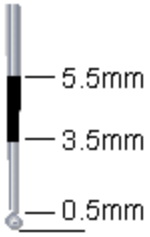
In 1982, the World Health Organization (WHO) created the Community Periodontal Index of Treatment Needs (CPITN). This method of evaluation estimated the periodontal disease prevalence and severity based on the probing depths and condition of the periodontium. In 1992, the American Academy of Periodontology (AAP) modified the Simplified Periodontal Examination (SPE), used in New Zealand, and developed the PSR system for use in North America. With the corporate sponsorship of the Procter & Gamble Company, the AAP and the American Dental Association (ADA) adopted the PSR system.

The PSR system was designed to initiate the promotion, prevention, and early treatment of periodontal diseases by:

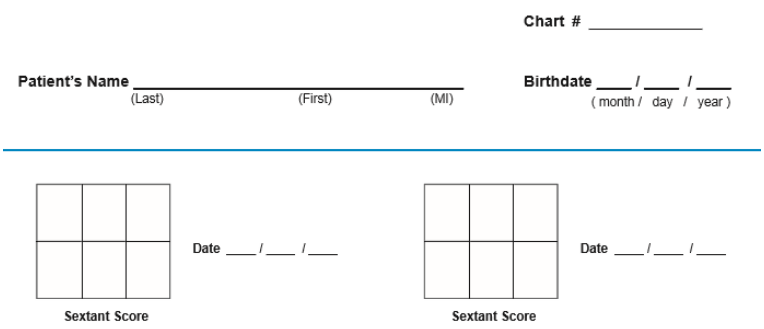
- Introducing a simplified screening method that met legal dental recording requirements.
- Encouraging dentists to incorporate the PSR system into every oral examination.
- Educating members of the public to value periodontal health and to request a periodontal screening from dentists (PSR Training Program, 1992).

The PSR system does not replace the need for a comprehensive periodontal examination. It acts as a time saving screening of periodontal health to indicate when a partial or full-mouth examination is required. When the clinician becomes familiar with the PSR system examination process, it should only take a few minutes to conduct a screening. Similar to a traditional comprehensive periodontal examination, the PSR system measures each tooth individually with implants examined the same way as natural teeth. However, the mouth is divided into sextants.

Six measurements for each tooth are obtained, utilizing a special ball-tipped probe. This probe has a 0.5 mm ball at the tip and a color-coded area 3.5 to 5.5 mm from the tip. The ball at the end of the probe is intended to enhance patient comfort and assist in detecting overhanging margins and subgingival calculus.



The probe is inserted into the sulcus or pocket and walked around the circumference of each tooth. This method is the same technique used as with a comprehensive periodontal examination. However, the PSR system is unique in the way the probe is read. The clinician need only observe the position of the color-coded band in relation to the gingival margin. The presence of furcation involvement, mobility, mucogingival problems, or recession should also be noted. After each tooth in the sextant has been examined, only the highest code obtained is recorded and only one score is recorded for each sextant. Measurements are recorded in a special box chart.

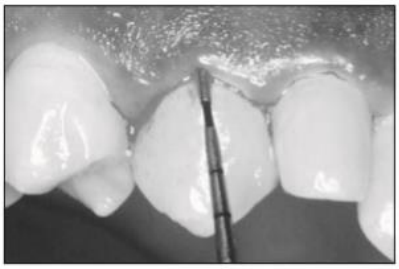


If a sextant is edentulous, an "X" is placed. The asterisk symbol (*) should be added to a sextant score whenever the following is found: furcation involvement, mobility, mucogingival problems, or recession extending to the colored area of the probe (indicating 3.5mm or greater).

Code Interpretation

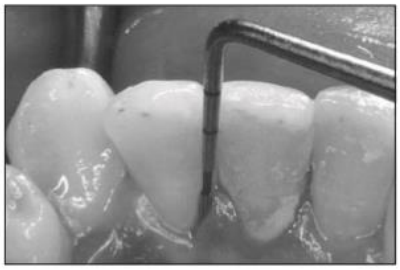
Code 0

- The colored area of the probe remains completely visible in the deepest crevice of the sextant. There is no calculus or defective margins detected. The gingival tissues are healthy with no bleeding after gentle probing.



Code 1

- The colored area of the probe remains completely visible in the deepest probing depth in the sextant. There is no calculus or defective margins detected. However, there is bleeding after probing.



Code 2

- The colored area of the probe remains completely visible in the deepest probing depth in the sextant. Supragingival or subgingival calculus and/or defective margins are detected.

Code 3

- The colored area of the probe remains partly visible in the deepest probing depth in the sextant

Code 4

- The colored area of the probe completely disappears indicating a probing depth of greater than 5.5 mm.

Patient Management

Code 0-2:

Appropriate preventive care should be given as well as a review of daily plaque control habits. Individualized oral hygiene instruction and appropriate therapy, including subgingival plaque removal, as well as the removal of calculus and the correction of plaque-retentive margins and restorations should be performed.

Code 3-4:

A comprehensive full mouth periodontal examination and charting are necessary to determine an appropriate care plan. This examination and documentation should include the following: identification of probing depths, mobility, gingival recession, mucogingival problems, furcation involvement, and radiographs. It can be assumed that complex treatment will be required.

Conclusion

The PSR system is a valuable tool in the early detection of periodontal disease. This system can indicate when a more comprehensive periodontal examination should be performed. The unique way the probe is read and the limited number of recordings needed when performing an examination is easy to incorporate into every patient's appointment.

Appendix B. Pre-Test/Post Test

Periodontal Screening and Recording (PSR) Pre/Post Test

Graduate Thesis Study: Alyssa Klenke, RDH, MS(c)

1. The PSR system is intended to replace a comprehensive periodontal exam
    a. True
    b. False

2. The PSR system divides the mouth into quadrants.
    a. True
    b. False

3. When the colored area of the PSR probe is completely visible in the deepest probing depth in the sextant and there is supra- or subgingival calculus detected or defective margins present, the PSR assigned would be which of the following?
    a. Code 1
    b. Code 2
    c. Code 3
    d. Code 4

4. Which symbol indicates a sextant that is edentulous?
    a. 0
    b. *
    c. X
    d. #

5. In each sextant, only the lowest PSR score is recorded.
    a. True
    b. False

6. The probe used with the PSR system has a 0.5mm ball tip. Which of the following is NOT a purpose of this tip?
    a. Gives a more accurate reading
    b. Enhances patient comfort
    c. Detects subgingival calculus
    d. Detects overhanging margins

7. When utilizing the PSR system, the code asterisk (*) in a sextant indicates which of the following?
    a. A tooth needs to be extracted in that sextant
    b. A tooth is supra-erupted in that sextant
    c. A mucogingival defect is present on a tooth in the sextant
    d. Localized scaling and root planning (SRP) needs to be treatment planned in that sextant

8. For each sextant, how many codes are recorded in the PSR method?
    a. 2
    b. 6
    c. 36
    d. 1

9. Implants are examined in the same way as natural teeth utilizing the PSR method.
    a. True
    b. False

10. Which of the following represents the best management of a patient who presents with a score of Code 3 in two or more sextants?
    a. Subgingival plaque removal and oral hygiene instruction
    b. Comprehensive full mouth periodontal examination to determine appropriate treatment plan
    c. Prophylactic calculus and plaque removal
    d. Continue to monitor the sextant over one year time span

Appendix C. Raw Scores

i. Pre-Test/Post-Test Key

KEY

1 B
2 B
3 B
4 C
5 B
6 A
7 C
8 D
9 A
10 B

ii. Raw Scores: Group A

Candidate	Pre Score	Post Score	X-Y	Difference/10
A01	5	10	5	0.50
A02	5	7	2	0.20
A03	3	9	6	0.60
A04	4	8	4	0.40
A05	6	10	4	0.40
A06	5	9	4	0.40
A07	6	10	4	0.40
A08	6	10	4	0.40
A09	4	8	4	0.40
A10	4	10	6	0.60
A11	3	10	7	0.70
A13	2	8	6	0.60

iii. Raw Scores: Group B

Candidate	Pre Score	Post Score	X-Y	Difference/10
B01	4	9	5	0.50
B02	5	10	5	0.50
B03	6	10	4	0.40
B04	3	9	6	0.60
B05	5	10	5	0.50
B06	4	8	4	0.40
B07	6	9	3	0.30
B08	5	10	5	0.50
B09	5	10	5	0.50
B10	3	10	7	0.70
B11	6	9	3	0.30

iv. Missed Question Analysis

	Group A	Pre	Post	Group B	Pre	Post
Question 1		5	0		4	0
Question 2		8	0		5	0
Question 3		5	5		6	1
Question 4		3	0		0	0
Question 5		1	0		6	0
Question 6		8	0		4	1
Question 7		12	1		11	0
Question 8		11	4		10	2
Question 9		11	0		8	0
Question 10		5	1		4	2

Above table shows number of students that missed each question in the respective groups

Appendix D. Statistical Analysis

i. Unpaired t test results

P value and statistical significance:

The two-tailed P value equals 0.9113

By conventional criteria, this difference is considered to be not statistically significant.

Confidence interval:

The mean of Group A minus Group B equals -0.006

95% confidence interval of this difference: From -0.118 to 0.106

Intermediate values used in calculations:

t = 0.1127

df = 21

standard error of difference = 0.054

GROUP	GROUP A	GROUP B
MEAN	0.467	0.473
SD	0.137	0.119
SEM	0.040	0.036
N	12	11

ii. One sample t test results

P value and statistical significance:

The two-tailed P value is less than 0.0001

By conventional criteria, this difference is considered to be extremely statistically significant.

Confidence interval:

The hypothetical mean is 0.000

The actual mean is 0.470

The difference between these two values is 0.470

The 95% confidence interval of this difference:

From 0.415 to 0.524

Intermediate values used in calculations:

t = 17.8874

df = 22

standard error of difference = 0.026

Mean	0.470
SD	0.126
SEM	0.026
N	23

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