

Dental Hygiene Students' Clinical Skill Acquisition: Activity theory and the use of videos

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Abstract

Purpose: Entry-level students in dental hygiene programs have already demonstrated a level of academic success; however they often struggle with the acquisition of psychomotor skills. Recognizing that traditional course materials were not addressing the needs of entry level dental hygiene students, instructional videos were produced to demonstrate clinical skills. The purpose of this study was to investigate students' perception of instructional videos and their impact on the learning environment in regards to students' experiences of skills acquisition.

Methods: Online surveys were distributed to all students (n=84) in the fall semesters of 2015 (n=42) and 2016 (n=42). Responses from the surveys were analyzed qualitatively, utilizing an activity theory framework, to identify the impact of instructional videos on the learning environment. The activity theory framework involves the encapsulation of the learning environment that is mediated by tools and situated in a community where a learning activity is carried out to achieve an outcome.

Results: Response rates were 76% (n=32) and 69% (n=29), respectively. Student responses concluded that the videos were very or extremely helpful, with 84% (n=27) in 2015 and 79% (n=23) in 2016. Students made comments on the usefulness of the videos and gave suggestions for future improvements. In addition, the comments demonstrated that students found the videos helpful for review purposes and for overall stress reduction associated with the process of psychomotor skill acquisition.

Conclusion: Results from this study demonstrate the positive impact instructional videos have on the acquisition of psychomotor skills even within the dynamics of a small class size. Videos can also be utilized as an on-demand review tool that can be accessed before clinical evaluation processes, reducing student stress and providing a level of clarification to support student success.

Keywords: dental hygiene education, instructional videos, clinical education, psychomotor skills, activity theory

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Introduction

Acceptance into a dental hygiene program is highly competitive; students entering these programs have already demonstrated their academic abilities in both the secondary and post-secondary educational environments. These historically successful students, often find first-year preclinical dental hygiene coursework challenging due to the focus on psychomotor skill development and the emphasis on active and self-directed learning. Pre-clinical dental hygiene coursework integrates theoretical knowledge and clinical skills to develop the abilities required for dental hygiene practice. Students demonstrate progression towards clinical competence as a result of observation, discussion, demonstration and clinical application. Pre-clinical coursework typically provides students with nine hours per week of laboratory

instruction and clinical experience over a single academic term. An average of six hours per week are completed in the laboratory during which time the clinical instructors demonstrate instrumentation skills and provide individual instruction. Students initially perform these skills in laboratory sessions on mannequins or typodonts followed by three hours per week in the dental hygiene clinic for supervised practice sessions performed on peers.

Historically, students relied on textbooks and course manuals for additional learning support of psychomotor skill development. Students have found these resources to be lacking due to their textual nature and the disconnect from the observational learning experience of instructor demonstrations. Recognition of this disconnect, and the constant evolution of technology has resulted in alternative

methods to support the education and competency development of both dental and dental hygiene students^{1,2} and lead this instructional team to investigate possible interventions to mitigate these learning challenges.

Adoption of technology in teaching and learning environments is expected by today's students² and the use of instructional videos has become a common practice.^{3,4} When used appropriately, videos are considered to be a powerful teaching medium, used for multiple learning scenarios, including clinical demonstrations and explanations.^{3,5} Instructional videos also facilitate a self-paced instruction and more independent student learning environment. Often considered as a support for large classroom settings, videos have been shown to be a valued resource by post-secondary students to facilitate learning beyond the classroom.³ A review of the literature shows that the instructional videos have been demonstrated to be effective in medical, nursing and dental education.⁶⁻¹² Similar to dental hygiene, many of the health science professions, such as medicine and nursing, involve the acquisition of psychomotor skills and the on demand availability of instructional videos has allowed for independent learning. Furthermore, videos have successfully been added to courses as supplementary learning experiences when classroom and laboratory contact hours have been reduced in the curriculum.⁶ In a study by Tapping, first year medical students rated gross anatomy videos to be highly satisfying and their test performance was higher than the control group of students who did not have access to the videos, demonstrating that videos are a positive addition to course materials and can improve student learning outcomes.⁶

Instructional videos have been used in nursing and dentistry to supplement lecture demonstrations beyond the classroom in the teaching of clinical skills.^{7,9,10,12} Student responses to instructional videos have been positive, commenting that videos allow them to review the demonstrated skill.^{7,9,10} In addition, students requiring remediation to develop their clinical skills must gain this knowledge through self-directed learning and practice. Given the limited time allowed for clinical instruction in dental education, videos can play a beneficial role in remediation or in support of clinic instruction.

Considering the identified purpose and positive impact of instructional videos in educational environments, the dental hygiene faculty at this institution decided to supplement the learning resources in the preclinical course with self-made instructional videos to demonstrate specific clinical skills. The series of short videos were created over a span of several years could be viewed on demand multiple devices including mobile phones, tablets and computers. Informal feedback indicated that the videos were a positive addition to the student learning resources and that further video development was warranted.

It can be hypothesized that the addition of instructional videos promotes self-directed learning and can contribute to student stress reduction through the addition of resources and on demand support for psychomotor skill development. The purpose of this study was to investigate the impact of the addition of instructional videos by capturing the students' experience their acquisition of clinical skills when videos are made available as part of the course materials. This study also examined the affordance of the videos, or how the students actually incorporated instructional videos into their learning process.

Methods

The Research Ethics Board of the University of Alberta approved this study. A qualitative approach was selected to understand the rationale for student preferences regarding the use of videos for the development of psychomotor skills. Qualitative studies provide alternative perspectives on approaches to teaching and learning and can complement quantitative research by shifting the focus on the numerical aspects of "what" to understanding the underlying "how and why."¹³

Students completing the preclinical dental hygiene course during the fall semesters of 2015 (n=42) and 2016 (n=42) were asked to complete a short online questionnaire regarding their use of the clinical instruction videos and to self-report on the effect these videos had on their learning experience. Students received an invitation to participate letter via email, describing the intent of the study. Responding to the anonymous online survey denoted consent for participation. Students wishing to opt out of the study could do so by not completing the survey.

The focus on the affordance (i.e., how the students actually incorporated the videos into their learning process) of the clinical demonstration videos is based on the work of Gibson^{14,15} and allowed the researchers the ability to focus on the utilization of the videos as an instructional intervention. Additionally, the researchers were able to capture the perceived affordances of the videos as a measure of the students' overall experience of stress and confidence. To provide a theoretical lens in which to perform the data analysis and present the results, an activity theory framework was incorporated into the study. Engstrom's research dating to the 1990's identified the activity theory to be a valuable framework to examine technological interventions in the field of education.¹⁶

Activity theory, based on the work of Vygotsky et al.,¹⁷ has become an integral part of academic research focusing around the exploration of innovative spaces and educational practices.^{17,18} The introduction of videos into a learning environment, to be used as a resource with specific learning outcomes, is commensurate with activity theory.¹⁷⁻²⁰ Viewing

learning as a collective activity, that is tool-mediated and situated within an individual activity with a resulting outcome, aligns with the basic underlying assumptions of this theory.¹⁶⁻²⁰ This framework, based on the work of Vygotsky²¹, began as a technique to analyze activities based on the relationship between the subject, the object and the tools. Engstrom^{17,19} expanded this framework to recognize the social component of any activity involving people by adding rules, community and the division of labor to the analysis of any activity (Figure 1). For the purposes of this research, the components of the study were aligned with the expanded activity theory framework (Table I). Figure 2 illustrates the application of the study to the activity theory framework.

Figure 1. Expanded Activity Theory Framework^{17,19}

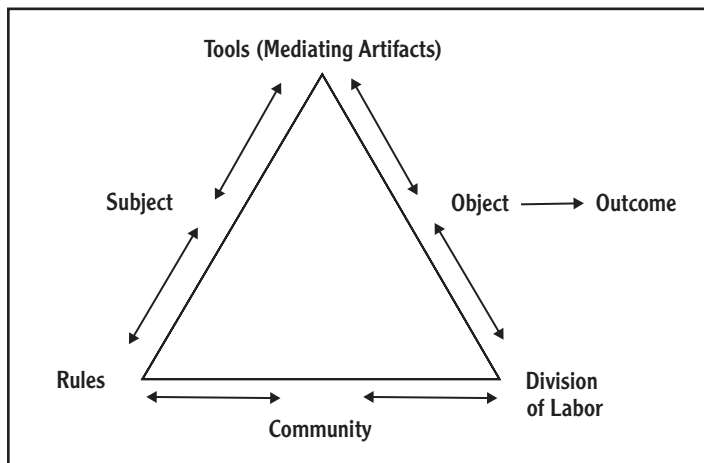
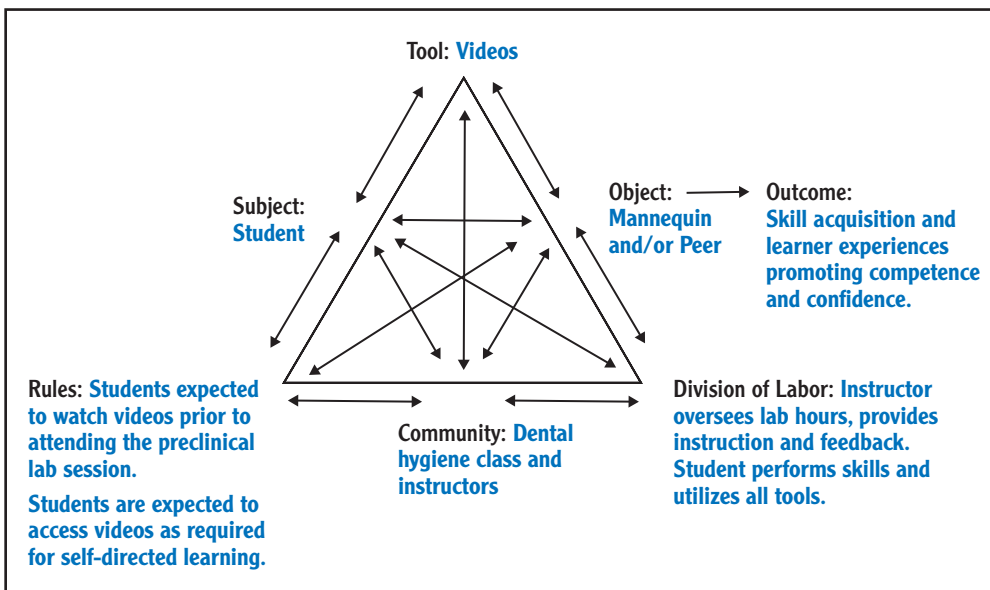


Figure 2. Application of the Activity Theory Framework



Results

Each class had a total of forty-two students enrolled; with 76% (n= 32) of the surveys completed in 2015 and 69% (n=29) of the surveys completed in 2016. The majority of student responses showed that they felt the videos were very or extremely helpful (84% (n=27) in 2015 and 79% (n=23) in 2016); the remainder still felt that the videos were somewhat helpful and no one noted that they were not useful. Participant comments fell into two categories:

Usefulness of videos

This category captured variation of experience on how the videos were utilized with their actual usefulness noted within the comments.

“They were very useful to watch beforehand to know what to expect in the sim lab while still learning basic instrumentation.”

“I found that they were useful when I was unsure of where to fulcrum for intra oral or extra oral or how to probe the quad 1 buccal and quad 2 lingual when preparing for the final instrumentation exam.”

“Watched them once in class, useful for notes, didn’t watch them on my own.”

Usefulness of videos with improvement

Although still recognized as useful, students noted suggestions for changes or improvements they personally felt would increase the videos impact on their learning.

“I found them quite helpful but wished that it was more ... zoomed in to show the proper angulation for universals and sickles”

“I feel that if the videos are less zoomed in on to the instrument and the teeth, it might be more helpful. That way, students can get a sense of the whole picture”

When asked about accessing videos the majority of the students noted they accessed the videos once or twice a week; with 78% (n=23) of the respondents in 2015 and 83% (n=24) of the respondents in 2016. The remainder of the students who responded noted that they never accessed the videos; however, these students would still have viewed the videos once as they were shown as part of the preclinical lab sessions. For

Table I. Applications of the Activity Theory^{17,21}

Activity Theory Component	Application
Subject	The starting point and primary subject of this activity is the student in the preclinical dental hygiene course.
Tools	<p>The mediating artifact under analysis within this research initiative is the addition of videos, created to demonstrate the clinical skills covered within this course.</p> <p>Additional mediating artifacts excluded from this analysis are the textbook, course manual, access to the instructor or peers, student study skills, and the simulation lab itself.</p>
Object	The clinical simulator (mannequin) or student peer in the lab session receiving dental hygiene work.
Division of Labor	<p>Clinical instructors oversee lab hours and provide demonstrations, instruction and feedback for small groups and one-on-one scenarios.</p> <p>Students perform skills and utilize all tools to enable the acquisition of identified skills.</p> <p>Students will continue to practice outside of class hours to ensure competencies are reached.</p>
Community	The community is the dental hygiene class and a team of clinical instructors.
Rules	<p>Students are expected to read their textbook, course manual and watch videos prior to the skill demonstration and practice session during the preclinical lab.</p> <p>Students are provided criteria for process evaluation and are expected to practice outside of class hours until competencies are met.</p> <p>Students are expected to utilize the textbook, course manual and videos as additional support outside of class hours.</p> <p>Clinical instructors will assess students to ensure they have acquired the necessary clinical skills.</p> <p>The research focus will be the use of the videos.</p>
Outcome	The outcome of this activity is the acquisition of identified skills and a learner experience that promotes competence and confidence.

those who commented on the reasons around their access, comments fell into one of four categories:

Viewed as part of class

These students often noted the viewing of videos as part of the lab session was when they accessed them.

“I mostly viewed them in class when they were shown...”

“Only when they were shown in class”

Viewed for review purposes

Videos were found helpful to check technique and as a review tool.

“Very helpful when you want to double check your technique.”

“I usually used them as a review tool after practicing in the lab.”

Viewed for practice sessions

Students did note they viewed the videos when practicing the skills.

“Or whenever I was practicing on my own.”

“Would depend on when I was practicing more.”

Viewed for examination purposes

Students noted that they accessed them before their evaluations.

“And before a PE [process evaluation] to review and feel confident about the upcoming examination”

“Usually before a process evaluation.”

An initial purpose was to provide access on demand; therefore, students were asked where they accessed the videos. The students primarily accessed the videos from their home desktop or laptop computer; with 90 % (n=27) of the respondents in 2015 and 71% (n=20) of the respondents in 2016. One difference identified between the two cohorts was the use of the videos within the preclinical lab. In 2015 10% (n=3) of students’ responses noted they used their phones to access the videos within the lab whereas 50% (n=14) of the students’ responses noted this usage in 2016. No comments were provided that explained this variation and further study would be required to assess this change in the utilization of the video.

The overall impact of the introduction of instructional videos on the learning process was a key question in this study. Students reported that they believed the videos clarified information and were useful for review purposes. In addition, students also indicated that the videos increased their confidence, reduced stress, and decreased the amount of time it took to learn the skills.

Discussion

Introducing videos into dental hygiene programs is a now common practice. According to a national study on educational technology within American dental hygiene programs, 88% of students surveyed noted a high usage of videos in entry-level dental hygiene programs, stating videos were the most common use of technology within their programs.² Numerous studies have indicated that videos are seen as useful in terms of demonstration of clinical skills and for review purposes,^{7,9,10,12} Data collected within this research study supports these findings with 84% (n=27) in 2015, and 79% (n=23) in 2016, of the participants noting that they found the videos very or extremely helpful and there were no students indicating that the videos were not useful. Furthermore, the usefulness of the videos was in alignment with the ability to clarify clinical skills (identified as equivalent as the demonstration experience), with 30 out of 31 students in 2015, and 26 out of 29 students in 2016, noting that the videos clarified information. Although not specifically asked, use of the videos for review was mentioned consistently in the additional comments section when participants were asked how often they accessed the videos. Student use of videos for review purposes has also been noted in studies by Jang and Kim⁷ as well as Kelly et al.,¹⁰ where participants commented positively that clinical skill videos were useful for repeated viewings in order to ensure understanding, as well as for remediation purposes.

This study aimed to investigate specifically how the availability of instructional videos impacted the students' learning process, and if this resulted in a change to the learning activity's outcome. The results showed that the students incorporated the instructional videos into their learning process as reported in previous studies. In addition to viewing the associated video(s) as part of each preclinical laboratory session, students utilized the videos for clarification, review of instrumentation process, and to prepare for evaluations. Additional findings, based on situating the analysis within the activity theory framework demonstrate the impact the videos had on student learning outcomes. Students self-reported that the use of the videos increased their confidence, reduced the stress of learning psychomotor skills, and reduced the amount of time it took to acquire these skills. The results from this study regarding increased confidence are contradictory to those of Jang and

Kim⁷ who found student use of Objective Structured Clinical Examination (OSCE) videos did not correlate with the participant's anxiety towards taking the examination. Further exploration is necessary in order to determine the impact of instructional videos on confidence levels during skill acquisition.

The impact on the learning environment through the implementation of instructional videos in a preclinical dental hygiene course is substantive when one considers that these classes frequently consist of groups of seven students during demonstrations, with one-on-one assistance from the clinical instructors available during laboratory time. While Kelly et al. concluded videos were useful for clinical demonstration in large classes,¹⁰ others have concluded that implementing videos improves clinical skills and knowledge,⁶⁻⁹ further supporting this study's findings that the use of instructional videos is impactful for students, regardless of class size and instructor accessibility.

Analysis of the student narrative revealed that many of the students responding within the survey recommended additional videos as well as suggesting additional components to the existing videos. Suggestions included making changes to the perspective of the video such as moving from a second-order perspective (viewing the demonstration as a visitor watching the skill being performed) to a first-order perspective (viewing the demonstration from the perspective of the person performing the skill); or providing multiple angles of a shot to include patient operator positioning. Selected comments reflecting this narrative include:

"I wished that it showed different perspectives and more zooming in on the instrument on the tooth."

"Maybe show more of the full picture to start out with so we can understand [patient-operator] positioning better."

"... capturing more angles in the video, more thorough left-handed videos!"

These responses are reflective of each learner's perspective and learning needs and identifies the complexity of views and decisions that need to be investigated in the planning phase of such development projects. Balancing the numerous approaches that must be considered with the development of a multimedia resource is complex; however, even with these suggestions the videos were viewed as positive additions to the students' learning resources. Student opinion regarding the positive impact of videos on their learning experience further reinforces findings from studies that conclude the addition of videos into courses enhances student learning.^{7,9,10}

Creation of videos that could show multiple positions, close-ups, variations of techniques, etc. is both time extensive and expensive. The videos

developed within this course involved multiple steps including: script development, demonstrating the technique with both right and left-handed clinicians, dubbing the video, and uploading them onto the course management system. Collaboration amongst the teaching faculty and technical support team along with designated responsibilities regarding the maintenance periodic review of the video content are necessary for a successful project. Issues relating to the use of technology must also be recognized to ensure access to the video resources over time. Careful planning and implementation is supported by Topping⁶ who reported that the intense labor and costs associated with the making of gross anatomy videos was justified as student learning improved in spite of the reductions in clinical contact hours.

A limitation of this study was the small sample size due to the relatively small class size of 42 students. There was some compensation for the small class size by running the study over two years and incorporating two cohorts of students. However, the practicality of further extending the research was limited from the perspective of evolving technology and new forms of video as well as changing techniques in instrumentation. Videos that have been created and distributed over the course of one academic year, may change in subsequent years, making longitudinal evaluation challenging.

Future research could include studies focusing on the impact of a more generic "off-the-shelf" video as compared to videos recorded with the clinical faculty. Changing the filming to the first order perspective of the clinician and the incorporation of interactive elements within or around the videos could enhance the learning experience. Student made videos could also be part of the formative or summative evaluation process for assessing clinical skills.

Conclusion

While the creation of videos demands collaboration, time and effort, their usefulness is accepted in academia and by students. Instructional videos have been shown to positively impact student confidence and reduce stress while learning a new psychomotor skill.

The affordance and impact of videos is substantive, even within the dynamics of a small class size, where students are learning in small groups and have a high level of access to clinical instructors. Videos can also be utilized as an on-demand review tool that can be accessed before clinical evaluation processes providing a level of clarification that enables student success.

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