

BRIEF

Effectiveness of Video Podcasts in a Self-Study Pharmaceutical Calculations Module

Christina Mnatzaganian, PharmD,^a Renu F. Singh, PharmD,^a Brookie M. Best, PharmD, MAS,^{a,b} Candis M. Morello, PharmD^a

^a University of California, San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences, La Jolla, California

^b University of California, San Diego School of Medicine, Pediatrics Department-Rady Children's Hospital San Diego, La Jolla, California

Corresponding Author: Christina Mnatzaganian, University of California, San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences, 9500 Gilman Dr #0657, La Jolla, CA 92093. Tel: 858-822-5642. Email: cmnatzaganian@health.ucsd.edu

Submitted December 27, 2019; accepted August 4, 2020; ePublished August 2020

Objective. To evaluate the effect of educational video podcasts in a self-taught pharmaceutical calculations module by assessing quiz performance and student qualitative feedback.

Methods. Six video podcasts were designed and posted online for students to review prior to pharmaceutical calculations quizzes over the course of one year. Video podcasts demonstrated solving the most difficult problems on each of the six quizzes. Quiz performance was compared for the 2017-2018 year (no videos available) and the 2018-2019 year (videos available); students completed a year-end survey to provide feedback on the videos.

Results. Overall quiz scores and passing rates improved during the 2018-2019 year. Enhanced performance on three of the six quizzes was demonstrated. The majority of students indicated they strongly agreed that the videos were helpful overall.

Conclusion. Video podcasts were effective in improving performance on calculations quizzes and students felt they were helpful in improving math skills and facilitated their learning of the material.

Keywords: pharmaceutical calculations, videos, video podcasts, pharmacy students, pharmacy education

INTRODUCTION

Proficiency in pharmaceutical calculations is an essential skill set for pharmacists and is a requirement for the Doctor of Pharmacy curricula in all schools of pharmacy, as mandated by the Accreditation Council for Pharmacy Education.¹ Student pharmacists need to achieve competency in performing calculations used to dispense and compound medications in a pharmacy setting. There is no standardized methodology for calculations instruction; as such, schools of pharmacy employ various instructional methods to teach pharmaceutical calculations within their curricula.²

Outcomes from a 2007 survey indicate that most pharmacy schools use live lectures and/or discussions to teach pharmaceutical calculations.² Growing evidence shows that using video instruction or video podcasts has beneficial effects on learning performance compared to traditional methods of instruction in general education and mathematics-based courses.^{3,4} As such, some pharmacy schools have started using video modules or condensed videos within pharmaceutical calculations courses in flipped classroom models where students watch pre-recorded video modules and complete practice problems prior to class.^{5,6} While student perceptions of video podcasts are positive in these models, the evidence is conflicting as to whether student performance improves with video podcasts.^{5,6} No studies have explored the effects of video podcasts on student performance in a self-study pharmaceutical calculations course or module.

The University of California (UC) San Diego Skaggs School of Pharmacy and Pharmaceutical Sciences (SSPPS) has historically offered Pharmaceutical Calculations as a self-study module within a three quarter first-year Pharmacy Practice self-care course. Pharmacy students use a required textbook to review concepts and practice review problems.⁷ The calculations material tested from the textbook is divided into two, one-hour quizzes per quarter, scheduled evenly throughout the quarters, for a total of six quizzes for the year. Each paper-based quiz, covering material from two textbook chapters, contains ten multiple-choice questions and requires that students show their work for each question. Students are allowed 50 minutes to complete each quiz. A score of at least 90% is required for passing each quiz; if a student does not pass, he/she is required to attend a quiz review session and complete and pass a make-up quiz of similar content the following week. To help students prepare for each quiz, the calculations facilitator provides review slides one week prior to each quiz. Students are encouraged to make an appointment by email (no set office hours) with the coordinator for additional assistance, though to date, it has been rare for students to request meeting for additional help.

Based on quiz topics that students performed poorest on, as well as student feedback, the calculations facilitator created six video podcasts that provided step-by-step demonstrations of how to solve textbook practice problems.

The primary objective was to assess if there was a difference in calculations quiz performance, including passing rates, compared to the previous year which did not employ the video podcast on each type of question reviewed in the video podcast. The secondary objective was to determine if students perceived the video podcasts to be valuable in learning pharmaceutical calculations.

METHODS

This descriptive study assessed all first-year (P1) pharmacy students (n=69) enrolled in the four-year SSPPS Doctor of Pharmacy curriculum, all of whom took the required Pharmacy Practice course series, and therefore enrolled in the pharmaceutical calculations module. The entering grade point average for all P1 classes to date has been 3.7, including both study cohorts. P1 students do not have other courses that are self-taught or that regularly utilize video podcasts outside of this module.

Six videos were designed to demonstrate solving calculations problems from the textbook, from which quiz content is derived. To identify the types of questions with the poorest student performance on each quiz, the calculations facilitator reviewed quiz performance from the 2017-2018 academic year. Based on these findings, the facilitator created a video podcast demonstrating how to solve similar problems from the textbook for the most difficult question on each of the six quizzes. The calculations facilitator used the Explain Everything app on an iPad Pro and an Apple Pencil to create the podcast videos, which included an overview of the concept followed by a demonstration of steps to solve each problem.⁸ Videos were brief in duration, each lasting 2-4 minutes. Videos were posted online one week prior to each quiz on a YouTube channel for all P1s to review in preparation for the quizzes for the 2018-2019 academic year.⁹ No other changes were made in the calculations module with respect to the course, facilitator, quiz content, instruction, or grading, nor were major changes made to the Pharmacy Practice course. To minimize sharing of quiz content between classes, quiz material may not be removed from the classroom during the quiz or reviews, students are required to use non-scientific calculators provided by the school, and questions are modified annually only to the extent that quantities are altered but the question remains the same.

The primary outcomes assessed were improvement in quiz performance and passing rate for both individual item analysis for each quiz problem that had a corresponding video podcast, as well as overall quiz performance. Scores from the 2018-2019 academic year (with video podcasts) were compared to scores from 2017-2018 (without video podcasts) as a control. The secondary outcome was assessed by surveying students for qualitative feedback at the end of the academic year via a brief 11-item Qualtrics online survey. The survey was administered after the sixth and final quiz during the spring quarter but prior to the end of the course. Students were given class time to complete the survey; students were emailed the survey link inviting them to complete the assessment as an alternative if they did not feel comfortable doing so in the classroom. No incentive was offered for completing the survey nor was it mandatory to do so. The assessment queried if students watched the videos and if they had watched them, if they felt they were worthwhile to watch, helped them learn the content, improved their ability to conduct pharmaceutical calculations, and suggestions for improving the videos.

Differences in numbers of students with correct versus incorrect answers pre- and post-video implementation for both individual item and overall grade were compared using Fisher's exact and Chi-Square tests between the 2018-2019 and 2017-2018 academic years, with $p < .05$ considered significant in STATA (Version 16, StataCorp LLC, College Station, TX). Survey responses were summarized with descriptive statistics. The study was reviewed and deemed as exempt research by the UC San Diego Human Research Protections Program.

RESULTS

Initial analyses determined if the quiz questions selected for video podcasts were indeed the most difficult. Student performance on these specific six quiz questions in 2017-2018 (no video podcasts) was significantly worse (fewer students were able to correctly solve these six questions) compared to the rest of the quiz questions that year ($p < .001$). Student performance after the implementation of the video podcasts did improve; the percentage of correct answers on these six quiz problems in 2018-2019 (with video podcasts) was significantly higher than the percentage of correct answers in 2017-2018 ($p < .001$). Student scores significantly improved for three of the six specific quiz questions that had corresponding videos in 2018-2019, and trended towards improvement for one question (Table 1). Performance on two of the questions that had corresponding videos were not different between the years. In the 2018-2019 year, these six quiz questions were still the most challenging topics for students to correctly solve; performance on these six questions was still significantly worse than performance on all of the remaining quiz questions ($p = .032$). Overall, student performance significantly improved in 2018-2019 compared to the year before ($p < .001$) with respect to percent of correct answers for

all quiz questions. When assessing overall first-attempt passing rates for all quizzes, there was a significant improvement in the 2018-2019 cohort ($p=.001$, Table 1). There was also a significant improvement seen in Quiz 6 first-attempt passing rates ($p=.03$). Lastly, when removing the six quiz questions associated with video podcasts, student performance was not different between the groups for the first four quizzes but improved on quizzes 5 and 6 in the 2018-2019 cohort ($p<0.05$).

The majority of the students responded to the survey with 99% of the class participating (68/69). Sixty-two (91%) students reported watching at least one video. About three-quarters of the students watched the first four videos (75%, 72%, 76%, and 74% for videos one through four, respectively). Almost two thirds of the students watched the final two videos (63% for both). The remaining survey items are displayed in Table 2. Students strongly agreed with various positive statements regarding the effectiveness of the videos, with median scores of 5 out of 5 (5=strongly agree) on all questions indicating that the videos were useful, helped teach the content, and improved math skills. Student-reported reasons for not watching the videos included: additional help was unnecessary ($n=4$); did not have enough time ($n=2$); forgot ($n=1$), and was unaware that a video was available ($n=1$) (data not displayed). Finally, common student suggestions for improvement (provided as a free-text item) included: create more video podcasts ($n=22$), provide more difficult examples ($n=8$), and create longer video podcasts ($n=3$).

DISCUSSION

This study was designed to determine if there was a difference in quiz performance and first-time passing rates when video podcasts were used to supplement a self-study pharmaceutical calculations module in the study group (cohort 2018-2019), compared to a control group (2017-2018) that did not have access to videos. The initial goal was to identify the six most difficult calculations questions that students struggled with and to create short podcasts to aid in student learning and quiz performance. Outcomes demonstrated that indeed the six most difficult questions were correctly chosen among the 60 total options to create video podcasts, as each cohort performed the poorest on the six selected questions.

Compared to the control group, overall performance on the six selected questions significantly improved in the 2018-2019 group with access to the videos. With respect to performance on each individual quiz question that had a corresponding video podcast, all scores demonstrated improvement with the exception of the question on quiz two. All students in both years who answered incorrectly solved the problem using the same incorrect method by not recognizing an abbreviation that is the focus of that problem. Fewer students viewed the second video which also may have contributed to the lower performance. Analysis of performance on non-video quiz questions further suggests that overall improvements in the first four quizzes were due to the addition of the video podcasts. With the aid of the video podcasts, overall student performance improved for all questions grouped together, and for overall quiz first-attempt pass rates.

Student feedback was positive with all strongly agreeing that the videos were helpful as a teaching method. The majority watched at least one video at some point, yet the viewing rate decreased towards the end of the year. Interestingly, quizzes 5 and 6 showed significant improvement compared to the control group and quizzes are progressively more complicated through the year. Since UC SSPPS requires a comprehensive exam at the end of the third year, prior to their final clinical year, future studies may determine if this study cohort performs better on calculations questions than the control group.

The literature evaluating instructional video podcasts for use in pharmaceutical calculations education is sparse. Flood and colleagues found online calculations video modules to be helpful for learning and receiving feedback on online pharmaceutical calculations assessments; however, the program was geared for 4th year pharmacy students in the final year of the curriculum.¹⁰ While this method may be a valuable refresher prior to graduation, pharmacy students practice as intern pharmacists and in Introductory Pharmacy Practice Experiences during the first through third years, so assistance in pharmaceutical calculations earlier in the curriculum is beneficial. Two studies assessed outcomes of pharmaceutical calculations taught using a flipped classroom model using pre-recorded video modules, and problems were completed prior to class.^{5,6} In-class time was used to teach and reinforce pharmacy calculations. Both studies used comparatively longer 40-60 minute or 7-15 minute videos, while our videos were much shorter at 2-4 minutes in length. Cotta and colleagues found that longer videos with a calculations quiz given at the end of class yielded higher exam scores and improved understanding.⁵ In contrast, Gloudeman and colleagues reported that videos did not improve performance but students felt they had improved understanding of the material. The lack of a performance effect may have been due to the low (1%) contribution to the course grade given for calculations quizzes, with corresponding low effort invested by students on this area.⁶ While the flipped class somewhat emulates our self-study calculations course, we do not dedicate time in class to reviewing calculations content as our module is purely self-taught. Further, our curriculum differs in that 10% of the Pharmacy Practice course grade is comprised of performance on pharmaceutical calculations quizzes, which may result in students emphasizing this coursework to a greater degree. These findings are in closer alignment with Cotta and colleagues, where the pharmaceutical calculations component accounts for 12% of the overall course grade.⁵ With time constraints and substantial curricular content, having a self-taught pharmacy calculations module/course enhanced by

short video podcasts, may help other schools of pharmacy achieve improved performance measures without needing additional in-classroom time.

Inherent to the study design, there are a few limitations. One such limitation is that we use the same question format annually on quizzes, however, the quantities differ. This ensures that course objectives are met and students are required to show their work for credit on each question. Another limitation in our survey of students included a lack of querying, specifically, if the quizzes aided in their understanding of the material, however, improved performance on individual questions for many of the quizzes would indicate improved understanding. Lastly, while our student class size is small, compared to some pharmacy schools, our survey response rate was very high. The outcomes are generalizable, however, since creating a podcast requires the same effort regardless of class size.

CONCLUSION

Video podcasts improved performance on pharmaceutical calculations quizzes in a self-taught calculations module within a first-year Pharmacy Practice course. Students felt the video podcasts were helpful in improving their skills and facilitated learning the material. Schools of pharmacy may consider using this additional learning modality to supplement learning of pharmaceutical calculations, particularly in self-taught modules/courses.

REFERENCES

1. Accreditation Council for Pharmacy Education. Accreditation Standards and Key Elements for the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree (“Standards 2016”). Published February 2015. <https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf>. Accessed July 20, 2019.
2. Brown MC, Hanggi A. Pharmaceutical calculations instruction and assessment in US colleges and schools of pharmacy. *Am J Pharm Educ*. 2007;71(5): Article 87. doi:10.5688.aj710587
3. Kay RH. Exploring the use of video podcasts in education: a comprehensive review of the literature. *Comput Human Behav*. 2012;28(3):820–831. doi:10.1016/j.chb.2012.01.011
4. Kay R, Kletschin I. Evaluating the use of problem-based video podcasts to teach mathematics in higher education. *Comput Educ*. 2012;59(2):619–627. doi:10.1016/j.compedu.2012.03.007
5. Cotta KI, Shah S, Almgren MM, Macias-Moriarty LZ, Mody V. Effectiveness of flipped classroom instructional model in teaching pharmaceutical calculations. *Curr Pharm Teach Learn*. 2016;8(5):646–653. doi:10.1016/j.cptl.2016.06.011
6. Gloudeman MW, Shah-Manek B, Wong TH, Vo C, Ip EJ. Use of condensed videos in a flipped classroom for pharmaceutical calculations: student perceptions and academic performance. *Curr Pharm Teach Learn*. 2018;10(2):206–210. doi:10.1016/j.cptl.2017.10.001
7. Teixeira MG, Zatz JL. *Pharmaceutical Calculations*. 5th ed. Hoboken, New Jersey: John Wiley & Sons, Inc.; 2017.
8. Explain Everything. www.explaineverything.com. Accessed July 20, 2020.
9. Dr. M’s Pharmacy Math. www.youtube.com/clmnatzag. Accessed July 20, 2020.
10. Flood M, Hayden JC, Bourke B, Gallagher PJ, Maher S. Design and evaluation of video podcasts for providing online feedback on formative pharmaceutical calculations assessments. *Am J Pharm Educ*. 2017;81(10): Article 6400. doi:10.5688/ajpe6400

Table 1. Performance on Individual Questions and First-Attempt Passing Rates of Pharmacy Calculations Quizzes

Quiz	Topic of Question	Questions Correctly Solved (%)		<i>p</i> value	First-Attempt Quiz Passing Rate (%)		<i>p</i> value
		2017-2018 (no video podcast group) n=66	2018-2019 (podcast group) n=69		2017-2018 (no video podcast group) n=66	2018-2019 (podcast group) n=69	
		1	Milligrams in Specific Quantity of Tablets Using Proportions	89	97	.087	97
2	Quantity of Sodium Bicarbonate Using Abbreviations to Compound a Powder	89	87	.793	91	94	.52
3	Micrograms of Fluoride in Glass of Water Using Parts per Million	73	96	<.001	74	87	.08
4	Quantity of Sodium Chloride to Make Eye Solution Isotonic	88	94	.236	89	93	.56
5	Milliliters of Reconstituted Solution to add to D5W (Reconstitution of Dry Powders with Volume Different than on Manufacturer's Label)	89	99	.031	91	97	.16
6	Milliliters of Varying Concentrations of Magnesium Sulfate Solutions for Injections to Compound Magnesium Sulfate for Infusion (Non-sterile Compounding of Manufactured Dosing Forms)	73	91	.006	74	90	.03
All		84	92	<.001	70	76	.001

Table 2. Student Survey Responses About Video Podcasts

Survey Items	Median ^a	Range	25 th -75 th Percentile
I found the videos easy to understand.	5	3-5	4-5
The solutions to the problems were clearly explained in the videos.	5	2-5	5-5
I found this method of learning (videos) to be useful.	5	3-5	4-5
The videos helped me learn the content.	5	2-5	4-5
I liked the videos as a method of learning.	5	3-5	4-5
The videos were helpful for extra practice.	5	2-5	4-5
The videos improved my math skills.	5	2-5	3-5

^aBased on Likert scale, where 1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree