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ORIGINAL ARTICLE

Use of videos to teach basic science concepts in a doctor of chiropractic training program

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Objective: This study examined the effectiveness of teaching biochemical concepts by video in a doctor of chiropractic training program.
Methods: Students in a biochemistry class were taught the Krebs cycle through a video exercise and glycolysis in a traditional lecture format. They received a review of both concepts and were tested. Test performance was examined. Students answered a questionnaire following the exercise.
Results: There were no significant differences in test performance on the topic learned by the video exercise. However, students felt that both lecture and review were more effective learning tools than video.
Conclusion: Despite the results of other authors, our students preferred traditional didactic lecture with review rather than video. With no difference in test scores observed, the role of videos in our basic science course remains unclear, perhaps only used as an occasional supplement. These results were not expected, given the often-preferred use of technology by current learners.

Key Indexing Terms: Chiropractic; Internet; Video Recording; Education; Biochemistry

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INTRODUCTION

Delivery of course content in education is changing because of new technology. The use of video, for example, YouTube (San Bruno, CA) to enhance teaching and learning is becoming commonplace in education. Several studies support the use and effectiveness of videos to aid in learning. Twoney[1] was one of the first researchers to examine the benefits and pitfalls of Internet videos, concluding that the Internet was an innovative and beneficial teaching and learning aid. Later, Gadbury-Amyot et al.[2] examined the use of tablets and instructional videos to enhance preclinical dental laboratory training. Students using tablets and videos performed better than those who did not. Bykhovsky et al[3] and AlJamal et al[4] observed similar results in their studies evaluating the use of videos to teach pharmacy and surgery, respectively. Moreover, simulation sessions were also found to be cost effective.[4]

A common approach to the use of videos is embedding them within a PowerPoint (Microsoft Corp, Redmond, WA) presentation. This allows students to view the videos and review them as many times as necessary. Clifton and Mann[5] found that embedded videos increased student engagement and facilitated deeper learning when used in their nursing program. Similarly, Jaffar[6] examined the usefulness of supplying students with YouTube links to supplement lectures in anatomy. This author also concluded that properly screened videos can be an effective aid to teaching and learning.

In our training program, we noticed an increase in the number of students using videos to help reinforce lecture material, learn physical examination procedures, review various techniques that had been previously demonstrated in class, and to help prepare for national board examinations. We felt that this increase in use warranted an investigation of their effectiveness and desirability to help us determine their utility in our program. Specifically, we wanted to know if students would perform better if they used video rather than traditional lecture to learn material. Moreover, we wanted to know if our students had a preferred learning method.

METHODS

We recruited 2 incoming classes of biochemistry students for this study. We taught both glycolysis and the Krebs cycle to 1 class ("didactic") by way of traditional lecture. For the 2nd class ("video"), we taught

glycolysis using traditional lecture, but taught the Krebs cycle using a video exercise. For the video exercise, we instructed the class to divide themselves into 6 groups of 6–7 students per group. We challenged each group to find a video on YouTube that taught the Krebs cycle, was 10–15 minutes long, and met certain learning objectives. Those objectives included discussions of topics such as reactions comprising the process, products of the process, and regulation.

Each group watched the videos selected by the other groups. Thus, all students watched at least 6 videos on the Krebs cycle. Some videos covered learning objectives that were not covered in other videos, providing more in-depth coverage of the topic. In totality, the video exercise took time equivalent to that usually used to cover the Krebs cycle in a typical lecture. After both concepts were covered (either by lecture or video), we reviewed both concepts in class. Reviews consisted of a 45-minute summary of the key concepts of each process. We then tested both classes of students using the same test questions for both. Test questions were multiple-choice questions. We also asked students to complete a short Likert-item questionnaire to help us determine if they preferred lecture, video, or both.

Since the quantitative data regarding test questions were recorded as percentages, we first arcsine transformed the data. We then checked for outliers and performed tests of normality. When assumptions were satisfied, we performed 5 *t* tests. First, we used 2 sample *t* tests to help control for the effect of biochemical cycle, 1 for "didactic" class and 1 for the "video" class. Then, to help control for the effect of class, we performed a paired *t* test to compare test scores (glycolysis and Krebs cycle questions combined) between classes. Next, we performed a paired *t* test to determine if there was a difference in test scores on glycolysis questions alone. Lastly, to test the hypothesis regarding the use of videos to assist learning, we conducted a paired *t* test to determine if there was a difference in test scores on the Krebs cycle questions between the "didactic" class and the "video" class. To account for increased error rate when computing multiple *t* tests on the same data set, a Bonferroni correction (α/number of comparisons) was applied to a family-wide α of 0.05. This resulted in $\alpha = 0.01$ for each comparison.

To analyze questionnaire data, we treated the responses to the first 2 questions as ordinal data and responses to the 3rd question as categorical data. We analyzed each question separately using a χ^2 goodness-of-fit test with α set at 0.05. All statistical analyses were performed using Minitab 17 Statistical Software (Minitab Inc, State College, PA).[7] An exemption was granted for this study by the Palmer College of Chiropractic institutional review board (assurance no. X2014-7-31S).

RESULTS

Students in both classes performed equally well on glycolysis questions as on Krebs cycle questions ($t_{class134} = 0.47$, $p = .654$, $n = 18$; $t_{class142} = 0.67$, $p = .510$, $n = 18$; Table 1). There was no statistically significant difference in overall test scores (glycolysis and Krebs cycle combined) between classes ($t = -1.28$, $p = .219$, $n = 18$; Table 1). There was no statistically significant difference in glycolysis test scores ($t = -0.95$, $p = .373$, $n = 8$; Table 1) or Krebs cycle test scores ($t = -0.97$, $p = .359$, $n = 10$; Table 1) between classes.

Table 1 - Comparison of Test Performance Between Didactic and Video Classes

Comparison	Mean ± 1 SD	*n*	*t*	*p*
Didactic class				
Glycolysis questions	88.6 ± 8.5	8	0.46	.654
Krebs cycle questions	87.1 ± 6.4	10		
Video class				
Glycolysis questions	85.8 ± 11.3	8	0.067	.510
Krebs cycle questions	85.9 ± 9.7	10		
Glycolysis & Krebs cycle questions combined				
Didactic class	87.8 ± 7.47	18	−1.28	.219
Video class	85.9 ± 10.45	18		
Glycolysis questions				
Didactic	88.6 ± 8.5	8	−0.95	.373
Video	85.8 ± 11.3	8		
Krebs cycle questions				
Didactic	87.1 ± 6.4	10	−0.97	.359
Video	85.9 ± 9.7	10		

n, sample size; t, t test; p, p value for t. $\alpha = 0.01$ for all tests.

Subjectively, students felt that the traditional lecture was more effective than videos ($\chi^2_{4,31} = 27.69$, $p < .001$), that they learned more from the review than videos ($\chi^2_{4,31} = 35.81$, $p = .001$), and that they did not go back and watch videos again ($\chi^2_{3,31} = 33.25$, $p = .000$). Questionnaire and results are presented in Table 2.

DISCUSSION

Students in both classes performed equally well on glycolysis questions as on Krebs cycle questions. Thus, we are reasonably confident that there was no effect of biochemical cycle on our results. Overall exam scores (glycolysis and Krebs cycle questions combined) did not differ between the 2 classes, so we are also reasonably confident that there was no effect of class on our results. There was no difference in performance on glycolysis questions between classes. This was expected given that both classes were taught this cycle using the traditional lecture and that there are no apparent effects of class on outcome. However, there was also no difference in performance on Krebs cycle questions between the "didactic" class and the "video" class.

Considering that there was no effect of biochemical cycle on outcomes, it appears, quantitatively, that students learned equally well with traditional didactic lectures and videos. Qualitatively, however, students felt that traditional lecture was more effective than videos. They also felt that the review was more effective than videos, and most students did not watch the videos more than once. Considering the results of other authors and that the

Table 2 - Questionnaire Administered Following Collection of Test Question Data

Response Option[a]	*n*
Question 1. We covered glycolysis in a traditional lecture format. We covered the Krebs cycle by searching for and sharing our videos. You have now been tested on both. Now, which one do you think was more EFFECTIVE?	
A. Traditional lecture was MUCH MORE effective	15
B. Traditional lecture was a LITTLE MORE effective	11
C. They were equal	6
D. Traditional lecture was a LITTLE LESS effective	0
E. Traditional lecture was MUCH LESS effective	0
Question 2. We did a quick (45-minute) review of the Krebs cycle before the test. Do you feel like you learned more from the videos or from the review?	
A. I learned MUCH MORE from the videos	1
B. I learned a LITTLE MORE from the videos	0
C. I learned EQUALLY from the videos and the review	6
D. I learned a LITTLE MORE from the review	6
E. I learned MUCH MORE from the review	19
Question 3. After the class in which you watched each other's videos, did you ever go back and watch any of the videos again? (Circle all that apply)	
A. I watched my group's video again	2
B. I watched another group's video again	3
C. I watched a video that I found myself/on my own	5
D. I didn't watch any videos	22

[a] Responses differed significantly at the $\alpha = 0.05$ level for all 3 questions.

majority of our current chiropractic students are tech-savvy, we did not expect these results. Students did report that they enjoyed the video exercise, but many felt that it was only useful as a supplement to the traditional lecture, not a replacement.

Rather than watching multiple Krebs cycle videos, it is more likely that the students spent their study time on notes taken during the review. Our reviews focused on key concepts, concepts that are clinically relevant and hence likely to be part of their national board examinations. They are first taught, then repeated, reviewed, tested, and reviewed again. This repetition is by design as repetition is known to be a highly effective strategy, but it probably also leads to some degree of predictability regarding potential exam questions. Perhaps our students felt it was more time effective to focus on review material. Considering the volume of information they are required to learn, we believe that this is the likely explanation for our findings.

Alternatively, the issue of assessing video quality may be a factor and is perhaps a limitation of our study. Because students are learning, they may not feel confident in their own personal judgments of the validity of videos, especially considering the volume of information available on the Internet. Azer[8,9] and Azer et al[10] examined the quality of YouTube videos for learning various topics (ie, cardiovascular and respiratory physical examination, surface anatomy) and found that despite the abundance of videos available, only roughly half of those were of sufficient quality. Duncan et al[11] found similar results when assessing videos available to aid in teaching of clinical skills to nursing students. Given their observations, perhaps our students felt that their instructors were a more valid and reliable source of information than videos found on the Internet.

Another potential explanation for our results and/or limitation to our study is that we measured outcomes only in a basic science course. Videos may prove more useful than other teaching methods when learning topics that require kinesthetic skills such as physical examinations, x-ray positioning, physical therapies, chiropractic adjustments, and so forth, and this is an area of future research.

CONCLUSION

In our study, videos were equally effective quantitatively as a traditional lecture for our biochemistry students in the doctor of chiropractic program. While there were no significant differences in test scores, it appeared to us through classroom observations that some students saw some value in watching videos as a supplement, but not as an alternative, to a traditional lecture. Our students also preferred review sessions to videos, perhaps because they are more time effective and presumably from a more valid and reliable source. Thus, instructor-screened videos may be useful in reinforcing basic science concepts, but not as a primary method of instruction.

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There are no funding sources or conflicts of interest to declare.

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