Received: 10 May 2021 | Revised: 12 August 2021 | Accepted: 16 August 2021

DOI: 10.1096/fba.2021-00052

FASEB BioAdvances WILEY

RESEARCH ARTICLE

The effect of Snapchat on learner satisfaction and anatomical knowledge retention: Preliminary observations

Michael A. Pascoe

Physical Therapy Program, Department of Physical Medicine & Rehabilitation, University of Colorado Anschutz Medical Campus, Aurora, CO, USA

Correspondence
Michael Pascoe, Physical Therapy Program, Department of Physical Medicine & Rehabilitation, University of Colorado Anschutz Medical Campus, Aurora, CO, USA.
Email: mike.pascoe@cuanschutz.edu

This article is part of the Biomedical Education Special Collection

Abstract

Biomedical educators have turned to technologies, like social media, to supplement progressive reductions in time spent in class. Many studies of social media have been limited to quantifying learner satisfaction and studies on the effects on learning outcomes are sparse. The purpose of this study was to examine the effects of using Snapchat on learner satisfaction and learning outcomes. A Snapchat account was used to share blood flow diagrams during the anatomy course of a physical therapist education program. Viewing statistics were recorded, a survey was distributed, and learning outcomes quantified at the end of the course and 12 months later were compared with a control group that did not have access to the account. Eighty-two percent of the class subscribed to the Snapchat account and 86.7% of the subscribers completed viewing of the five drawings posted. Learners rated the account as extremely accurate, were quite interested in more content presented, and felt quite confident in the diagrams. Performance on blood flow questions on the end of course examinations were similar between experimental and control groups. Assessments administered 12 months later revealed greater scores for the Snapchat group (90.7% correct) compared with the control group (86.7% correct, $p = 0.04$). These findings suggest that Snapchat is an effective way to deliver educational content and that learners found the content useful, accurate, and helpful in preparing them for the assessment. The ephemeral nature of disappearing content has potential to garner greater student attention and can be leveraged to improve knowledge retention.

KEYWORDS

attention, ephemerality, learning outcomes, snapchat, social media, working memory

1 | INTRODUCTION

Anatomical knowledge is essential to safe and effective clinical practice.[1] A significant challenge toward the successful attainment of this knowledge was the reduction of contact hours dedicated to anatomy instruction from 2002 to 2014, which has been observed in medical education.[2,3] Anatomy instructors have often turned to emerging technologies to supplement preexisting practices.[4-8] The COVID-19 pandemic and ensuing social distancing

protocols have accelerated the shift to online content delivery and interaction[9] and the value of having knowledge of how to effectively utilize online platforms has been acknowledged.[10]

Social media is a type of online platform that has gained the attention of biomedical educators, including those that deliver anatomy curricula.[11-19] Social media is attractive to utilize for several reasons. It has been shown to be an effective method of rapidly disseminating information to a large audience beyond the time and space constraints of scheduled learning sessions.[20] It has also been established that a vast majority of learners, including anatomy students specifically, have a presence on social media platforms and access these networks on a regular basis.[21] A recent systematic review by Pollock and Rea included 155 studies of social media use in biomedical education demonstrated that there was a large amount of support (79.8% of studies) for the use of social media in education.[22] There is additional evidence that learners have increased their traffic on social media platforms during the quarantine period following COVID-19 (March 2020 to present) and it is reasonable to expect this traffic to remain elevated for quite some time after. A survey performed on March 12, 2020 revealed that a large share of respondents anticipated increased usage of social media (YouTube, Facebook, Instagram, Twitter, and Snapchat) if they became confined at home due to COVID-19.[23]

Snapchat is a multimedia messaging app developed by Snap Inc. (Santa Monica, CA, USA) that was initially released in September of 2011 and most recently updated, at the time the paper was written, in December of 2020. Snapchat has distinguished itself in several ways from the sea of preceding social media platforms. Principally, posts, referred to as "snaps," by the user (photos or video clips) disappear after 24 h. The app is also entirely based on mobile platforms and content cannot be accessed in a web browser. The number of followers a user has and the number of interactions on posts (e.g., likes) are not displayed like they are on early social media platforms. The model developed by Snapchat is also different from traditional social media in that it conveys activities that are taking place right now. The content is viewed as being more authentic (not staged) and more personal.[24] For these reasons, Snapchat can be considered the original "anti-social media platform" and it is appealing to consider it as a vehicle to reach lots of students. There are many examples of other social media platforms that have emulated Snapchat by creating their own parallel stream of content that expires after 24 h––Facebook stories, Twitter fleets, and Instagram stories.

These unique characteristics of Snapchat have made it successful and has led to impressive usage statistics[25] and imitation by competitors. There are on average 265 million daily active users as of March 2021 (22% year over year growth from 2020). The penetration of Snapchat has recently been estimated at 90% of the United States population ages 13–24. It is important to note that this age demographic corresponds to a large segment of individuals either entering or preparing to enter biomedical programs. There is an average of over 5 billion snaps created every day, making Snapchat one of the most used camera apps in the world. Snapchat users opened the app on average 30 times per day in the fourth quarter of 2020. Nursing students recently reported that their Snapchat use was second (45.5% of respondents) only to Facebook (used by 90.9% of respondents).[26] There has also been a surge in Snapchat content development within certain biomedical specialties, such as dermatology.[27] It should be noted that this expanse of Snapchat was directed at the education of patients, aspiring physicians, and colleagues and was not aimed at improving healthcare pedagogy.

Snapchat's unique configuration may make it a powerful platform for improving learner knowledge by leveraging its unique ability to capture attention of the user. This idea is supported by a conceptual framework of memory termed the "stage theory." This frameworks states that attention is intimately linked to working memory.[28] Working memory is created by paying attention to information presented. The longer we can maintain attention, the stronger the commitment to our working and ultimately long-term working memory. In the context of anatomy education, the mechanism of delivery that results in the greatest amount of attention by the learner is most likely to result in the formation of short- and long-term memory. Study participants have reported paying closer attention to content that expires (e.g., Snapchat) than to archived content (e.g., Facebook)[29] and the current understanding of working memory predicts that a Snapchat user would have better recall of information compared to presentation in an archived format. It has been recently suggested that medical educators utilizing social media may benefit from focusing efforts on the strengths of the platform.[30] In the case of Snapchat, the educator may be able to successfully augment learner attention to the material and improve learning outcomes.

Gaps in the efficacy of social media in anatomy education as related to learner reactions (Kirkpatrick Level 1) are beginning to be filled.[22] However, a recent narrative review revealed that no studies have assessed the higher level change of knowledge skills (i.e., learning outcomes; Kirkpatrick Level 2) associated with use of a social media platform.[31] Therefore, the present study was undertaken to address the need to determine if utilization of an anatomy-themed Snapchat account would result in improved assessment outcomes.

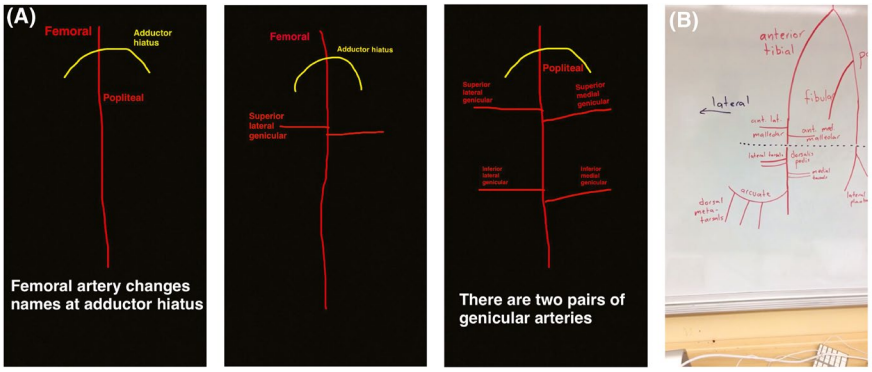

FIGURE 1 A, Smartphone screenshots of a series of posts ("Snaps") that comprised a "Story" from the Snapchat messaging application. Each Snap was displayed for 10 s and the entire story remained viewable for 24 h. These posts summarized the arterial supply of the popliteal region and were created using line art and text labeling tools within the application. B, A screenshot of a blood flow review video of the anatomy instructor explaining a whiteboard drawing of the arterial supply of the leg and foot

In summary, this study sought to explore the effect of implementation of Snapchat as a platform for anatomy reviews on learner satisfaction and learning outcomes in an entry-level physical therapist anatomy course. It was hypothesized that learners would have high satisfaction with the Snapchat platform and that the group of learners that viewed the Snapchat reviews would have higher immediate and long-term assessment scores than a cohort that did not use Snapchat.

2 | METHODS

An anatomy-themed Snapchat account was created and used to deliver a series of blood flow drawing reviews during the first-year clinical anatomy course of an entry-level doctor of physical therapy program. Viewing statistics were collected, a learner satisfaction survey was distributed, and learner performance on a blood flow question was assessed immediately at the end of the unit of the course and retention assessed 12 months later. Learner performance was also compared with a previous cohort (control group, Class of 2019) that took the course during the year prior to the availability of the Snapchat account. The procedures described below were in accordance with the ethical standards of the institutional and/or national research committee (Colorado Multiple Institutional Review Board, Protocol #18-0927) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants in this study.

2.1 | Snapchat content & viewing statistics

A course specific account was created on the Snapchat app (Snap Inc.) and the user name (ClinAnat) shared with only the first-year class of 2020 ($N = 68$ students) of the University of Colorado Doctor of Physical Therapy Program. Snapchat stories summarizing blood flow pathways of the lower limb were created on the instructor's smartphone (iPhone, version 6s, Apple Inc.) and published to the account on the same day as the same content was delivered in class. Students were notified of content publication and of the aims of this study in advance of the lower limb unit of the course to allow enough time to find and follow the account. Students were not given a tutorial on how to use Snapchat itself. Content from the account would appear in the "followers" section of the Snapchat app for each learner and they could choose to select and view the content or to allow it to expire without viewing. Viewers of the content could save images of each snap to their own device for later viewing by taking a screen shot. The content used in each Snapchat story was modeled after the blood flow drawings presented in lecture. Stories were posted as either a series of still images that presented stages of the drawings using line art and text labels (no audio; Figure 1A) or a series of video recordings of the instructor explaining a drawing on a whiteboard (Figure 1B),. Learners could choose to initiate a snap story by viewing the first snap and then exit the story at any point or watch until the end (i.e., finish the story).

Viewing statistics were manually recorded from the "user account" section of the Snapchat app on the instructor's smartphone. The following metrics were recorded just prior to the expiration of each Snapchat story (~23 h and 50 min following the publication of each story): number of snaps in the story, total number of followers of the account, number of followers that viewed the first snap, number of followers that viewed the last snap, number of screen shots taken. The percent of followers that started each story was calculated by dividing the number of followers that viewed

TABLE 1 Summary of viewing statistics for the five blood flow review stories shared on the course Snapchat account. By the time the fifth story was shared, 56 out of 68 (82%) students in the class were following the Snapchat account. Total views were calculated as the product of the number of snaps in a story and the mean of started and finished a story

Snap story subject	Snap story format	Snaps in story	Total account followers	Started story (% Total)	Finished story (% Started)	Total views	Screen shots
Pelvis arterial supply	Video	24	49	39 (79.6)	31 (79.5)	840	5
Popliteal arterial supply	Still image	12	50	35 (70.0)	30 (85.7)	390	5
Ankle & foot arterial supply	Video	36	51	30 (58.8)	25 (83.3)	990	7
Thigh venous return	Still image	12	55	25 (45.5)	22 (88.0)	282	0
Leg venous return	Video	30	56	35 (62.5)	34 (97.1)	1,035	3
Mean		*23*	*52*	*33 (63.3)*	*28 (86.7)*	*707*	*4*
TOTAL		**114**				**3,537**	**20**

the first snap by the number of followers of the account at the time the story expired. The completion percentage for each story was calculated by dividing the number of followers that viewed the last snap by the number of followers that viewed to first snap. An estimate of the total number of views for each story was calculated by taking the mean of the number of followers that viewed the first snap and last snap and multiplying that by the number of snaps in the story.

2.2 | Learner satisfaction survey

A survey was designed to determine what degree learners in the experimental group reacted favorably to utilizing the Snapchat account (Kirkpatrick Level 1; Reaction).[32] The survey was constructed and administered using a web-based platform (Qualtrics, Provo) and consisted of 12 items presented in three sections. The first item asked students if they followed the anatomy Snapchat account and the survey was ended immediately if the respondent selected "No". Respondents that selected "Yes" continued to complete the following sections. Section one contained two items related to usage frequency, section two contained eight items related to ratings usability presented with a five-point Likert evaluation scale, and section three contained two open-ended questions. Five response anchors were chosen to achieve stable participant responses.[33] The median is the most appropriate measure of central tendency for Likert scale (i.e., ordinal level) data and the range most appropriate for variability,[34] therefore these values were calculated. The number of 4- and 5 out of 5 ratings were also counted and expressed as a percentage of the total to provide a greater level of detail. Responding to the open-ended questions was optional.

Survey data were collected at the end of the course, between 8 August and 11 August 2018. Only surveys with responses to all items were included in the analysis. Survey data were imported into Excel (version 2016, Microsoft) for data cleaning and organization. A reliability analysis was performed on the eight Likert scale survey items to determine Cronbach's alpha (Statistical Package for the Social Sciences, version 26, IBM). A Cronbach's alpha of greater than 0.7 demonstrates high internal consistency. The full survey can be reviewed in the Appendix.

2.3 | Learner performance

The effect the Snapchat account had on learner acquisition of knowledge of lower limb blood flow (Kirkpatrick Level 2; Learning)[32] was assessed by comparing scores on blood flow content on anatomy course examinations between the class that had access to the Snapchat account (experimental group) and the class the year prior that did not have access to the Snapchat account (control group). The effect of viewing the account on retention of knowledge was assessed by comparing the difference (delta) between scores at the end of the course and scores from a blood flow quiz administered 12 months later. An alpha level of $p < 0.05$ was defined to identify significant differences and statistical analyses were performed using the Statistical Package for the Social Sciences (version 24, IBM). Parametric statistics were used to compare blood flow content scores between control and experimental groups. Learner performance data are presented in the text and figure as mean ± standard deviation. An a priori power analysis assuming a moderate effect size of $f = 0.83$, $\alpha \leq 0.05$, and $1-\beta = 0.80$ determined a necessary sample size of $N = 14$ within each group (G*Power, version 3.1.9.3).[35]

3 | RESULTS

3.1 | Snapchat content & viewing statistics

Five stories were created that provided overviews of blood flow diagrams of the lower limb, three using a still image format (Figure 1A) and two using a video format (Figure 1B). The mean number of snaps in a story was 23 and varied between the five stories (range: 12−36). The total number of account followers increased from 49 (72.1% of the class) to 56 (82.4% of the class) from the time of publication of the first to the last story. An average of 33 followers (63.3% of total account followers) viewed the first snap in a story, and of these, 28 (86.7%) viewed the last snap in a story. The mean total views per story was 707 and varied between the stories (range: 282−1,035). The estimated total number of snaps viewed by all followers across all five stories was 3,537. An average of four screen shots were taken per story (range: 0−7) (Table 1).

3.2 | Learner satisfaction survey

A web-based survey was administered to obtain learner perceptions of the anatomy-themed Snapchat account. Surveys were submitted by 67 of the 68 students in the class (99% response rate) and of these, one submission was incomplete and excluded from analysis. The average time to complete a survey was 2.8 min. Fifty-six students indicated they followed the Snapchat account, which matches the observed total number of account followers presented in the viewing statistics section above. The reported average number of stories viewed was three and varied across students (range: 1−5). The total number of stories viewed was 172. Of the eight Likert scale survey items, two had a median rating of 5 out of 5, four a median rating of 4 out of 5, and two a median rating of 3 out of 5 (Table 2).

Forty-nine students (88% of account followers) provided responses to the open-ended question asking for strengths of the Snapchat account. Forty-five students (80% of account followers) provided responses to the open-ended questions asking for suggestions on improvements. Selected responses to these questions are presented in Tables 3 and 4.

The reliability analysis demonstrated the survey reached acceptable reliability (Cronbach's alpha = 0.830).

3.3 | Learner performance

Scores on blood flow content on anatomy course examinations were analyzed between the class that had access to Snapchat (experimental group, $N = 57$ learners) and the class the year before that did not have access to Snapchat (control group, $N = 68$ learners) to determine the impact of using the Snapchat account on learning outcomes. All participants in both the experimental and control groups

TABLE 2 For all statements a five-point Likert scale was used with 1 = Not at all..., and 5 = Extremely... All 56 followers of the account completed this section of the survey. Statements are presented in descending or by percentage of total receiving Likert ratings of 5 & 4 (out of 5)

Statements rated by survey respondents	Median (range)	Likert 5 & 4 ratings (%)
How accurate was the content presented in the Snapchat account?	5 (3–5)	96%
How familiar were you with the Snapchat platform prior to using it this summer?	5 (1–5)	75%
How interested are you in having more course content summarized using the anatomy Snapchat account?	4 (2–5)	75%
How confident did you feel in blood flow diagrams because of using the Snapchat account?	4 (1–5)	63%
How useful was the Snapchat account in reviewing blood flow diagrams?	4 (2–5)	59%
How helpful was the Snapchat account in preparing you for blood flow questions on the examinations?	4 (1–5)	52%
How much did you learn from viewing the Snapchat account?	3 (1–5)	38%
How frequent was your discussion with classmates on a higher level because of using the Snapchat account?	3 (1–5)	27%

TABLE 3 Selected responses to the open-ended questions from survey respondents

What are the strengths of the anatomy Snapchat account?
The quick review was helpful.
Another way to view the material.
It's a different way to reinforce information- I'm usually flipping through snapchat while I'm procrastinating and when I see a course snapchat, I open it right away because it's a more modern and fun way to see the information.
Keeps me studying when I'm distracted by my phone.
Good summaries and practice in a different context.
It's quick and to the point. Also, it was easy to access.
Fun! Easy to review anatomy content when I'm on the go (waiting for the bus and I don't want to take out all my notes).
The Snapchat is a great review and a good way to get more exposure to content. Almost everyone uses Snapchat and frequently looks at it so it's easy to use and find time to learn more anatomy! Learning more about blood flow and anastomoses that occur helped prepare me for the blood flow with a blockage questions on the examination.
I loved the opportunity to easily view anatomy content and integrate it into otherwise "unproductive" minutes of the day.

TABLE 4 Selected responses to the open-ended questions from survey respondents

What about the anatomy Snapchat account needs improvement?
Each individual snap should be on repeat so I have control over when to tap to the next video and I can keep watching the same section until I get it.
I would like to see more content in which you clarify confusing concepts.
Not really an improvement but just more postings.
More snaps including relations and other lecture content
Start earlier in the semester.
More! Also, could they be archived in case we missed one?
Maybe pose quiz/test like questions (with answers of course at the end of the snap story). That's just one idea to make it interactive and allow us to review content and answer a question ourselves. I loved the Snapchat! It was super lit, had great filters and I learned a lot from it!!
More videos on other content in the class.

scored 100% on the end of course score blood flow assessment. The difference (delta) between the end of course scores and the scores 12 months later were greater ($p = 0.04$) for the control group (13.3% ± 14.1% correct) compared to the experimental group (9.1% ± 11.5% correct).

4 | DISCUSSION

An anatomy-themed Snapchat account was created and used to deliver a series of blood flow drawing summaries to first-year doctor of physical therapy students to improve learner performance on assessment outcomes. Eighty-two percent of the class followed the account and an estimate of 3,537 total snaps was viewed. Students rated the content presented in the Snapchat account as extremely accurate and were quite interested in having more course content presented through the account. It was not possible to discern the end of course effect of the Snapchat account on learner performance. The difference between end of course scores and scores 1 year later (i.e., knowledge lost) was 4.2% less for the group that used Snapchat, which was large enough to reach statistical significance ($p = 0.04$).

4.1 | Snapchat content & viewing statistics

Two formats were used to present reviews of blood flow diagrams on the Snapchat account. The viewing statistics demonstrated that no one format was viewed more than the other. It is advisable to use the video format (Figure 1B) due to the reduced creation time compared with drawing blood flow diagrams using line art tools on a smartphone screen. The gradual increase and less than maximal total account followers (82.4% of the class) over a 2-week period was most likely explained by the introduction late in the course and the optional nature of the resource. This magnitude of followers was greater than reported in a previous study (45.5%) of biomedical students[26] and suggests that Snapchat is a popular platform used among today's learners. It is possible that publishing content in a Facebook story would be a good alternative given the similarity of the feature to Snapchat and the high degree of usage. A more rapid increase and greater percentage of the class following the account could be realized if the Snapchat account were introduced early in the course and aligned with more course objectives.[36] It has been shown that learners are more likely to complete videos with short durations (<20 min).[37] Learners in the present study, on average, did not view every snap in a story (86.7%), despite their reasonably short duration (mean: 3 min 16 s). The relatively low number of screen shots might be expected because the Snapchat drawings were similar to what students already had created from lecture. It is also possible that the absence of a Snapchat use tutorial contributed to the low number of screen shots.

4.2 | Learner satisfaction survey

The response rate and reliability of the learner survey was very high and this may be attributable to the students' interest in providing feedback on course resources and the brevity of the survey. It was reassuring to find that the number of students that indicated on the survey that they followed the account matched the number of followers obtained from the viewing statistics. The student group reported viewing 172 stories on the account. This is close, yet greater than the number of followers that started all stories (164) as determined from the viewer statistics. This overestimate is typical of self-reported data and the proximity to the actual viewing figure suggests that the remainder of the survey data were based on actual user experience.

Learners reported that they were quite interested (4 out of 5 rating) in having more course content summarized using the anatomy Snapchat account. This may be attributable, in part, to positive experiences the learners have by interacting with other peers on the Snapchat platform. This has been shown in previous research, in which it was demonstrated that sharing positive emotions increased overall mood of an experience.[38]

Learners reported that they were extremely familiar (5 out of 5 rating) with the Snapchat platform prior to using it during this experiment. This likely accounted for the high level of adoption seen in this study (82.4% of the class), as student familiarity with learning technology has been identified as crucial for its acceptance.[39-41] It will be of interest to observe if such a high level of adoption is sustained over time given the recent reports of drops in learner engagement using course-specific Twitter hashtags and Facebook Pages despite the constant level of promotion from the course faculty.[42]

4.3 | Learner performance

The most important contribution of this work is the demonstration that time invested in deploying novel platforms can results in improved learning outcomes, which is something that has been called for in the literature.[43] The end of course examination scores were essentially identical, with both groups scoring an average of 100% correct. This was likely due to the format of the blood flow question, which was multiple choice. Instead of providing blood vessel names from memory, learners had a bank of options to choose from. Although some might argue that the use of an open-ended question could have better discriminated the responses, this is not guaranteed, because multiple choice questions have been shown to have as much discrimination power as more open-ended questions.[44] Another interpretation of similar scores is that it demonstrates that both cohorts were close in their capacity for knowledge. Similarities in knowledge capacity are helpful to demonstrate in order to strengthen claims that the modality of content distribution was more significant than characteristics of the experimental group.

Despite similar end of course scores, learners that interacted with the Snapchat reviews had greater retention as evidenced by a significantly smaller difference between end of course scores and 12 months after course scores. This may be attributable to greater attention given to information that was anticipated to disappear after a short period of time, which has been shown to produce more durable memory.[28,29] It is worth noting that the loss of basic science knowledge after 12 months in this study (Snapchat group = 9.1%; Control group = 13.3%) was less than has been previously reported (33%).[45] Lastly, the content used in each Snapchat story was modeled after the blood flow drawings presented in lecture. This was primarily to maximize the effects of the modality of delivery (i.e., increased attention) and to minimize the effects of receiving different information. Perhaps presenting the visual information in a different way would further enhance the retention of information seen in this study. This idea is worthy of future investigation.

4.4 | Limitations & future directions

The use of a convenience sample of a small number of learners was a limitation of this study and a larger number of participants would likely strengthen the statistical analysis. Detailed demographic data for the survey respondents were not collected, including directly asking learners if they were already users of Snapchat. Although it is suspected the cohorts of students in this study were similar to those of other institutions, demographic data would assist in determination of generalizability. Increasing the difficulty of the blood flow assessment may improve the sensitivity of detecting short- term differences between groups, which is detailed above. It must also be acknowledged that the knowledge retention demonstrated here (blood flow) may not translate to other biomedical concepts and fields of study. It is also important to acknowledge that the difference in memory loss between the two groups (4.2%) was small, despite the statistical significance, and that this is likely due to the nature of the multifactorial educational system.[46] Many other social media platforms have added a disappearing content option in their application since data were collected for this experiment. It would be interesting to examine if these other platforms impact knowledge retention in the same way and be equally as useful as Snapchat. Lastly, the age of these data (collected

in August 2018) should also be considered when interpreting these results.

5 | CONCLUSIONS

These results demonstrated that an anatomy-themed Snapchat account was used by most of the class and was extensively viewed by learners. The learner survey revealed satisfaction with the usefulness, accuracy, and ability of the account to prepare them for the assessment. There were no significant improvements observed in short-term assessment outcomes; however, 12 months later the Snapchat group demonstrated significantly less loss of knowledge compared with the control group. This initial work demonstrates that learners were receptive to reviewing anatomy concepts using Snapchat and that the ephemeral nature of the platform may lead to greater levels of attention that can be leveraged to improve memory and learning outcomes.

ACKNOWLEDGMENTS

The author thanks the students of the University of Colorado Physical Therapy Program for their willingness to participate in the study, Warren Capell, MD for his advice on the experimental design, and James McAfee, PT, DPT for his advice on tracking viewing statistics in Snapchat.

CONFLICT OF INTEREST

No conflict of interest to declare.

AUTHOR CONTRIBUTIONS

MAP planned and executed the experimental design, analyzed data, prepared the figure and tables, and composed the manuscript.

ORCID

Michael A. Pascoe https://orcid.org/0000-0003-0281-8167

REFERENCES

1. Travill AA. The anatomical basis of clinical practice: an anatomy learning programme. *Med Educ*. 1977;11:377-379.
2. Drake RL, McBride JM, Lachman N, Pawlina W. Medical education in the anatomical sciences: the winds of change continue to blow. *Anat Sci Educ*. 2009;2:253-259.
3. Drake RL, McBride JM, Pawlina W. An update on the status of anatomical sciences education in United States medical schools. *Anat Sci Educ*. 2014;7:321-325.
4. Lewis TL, Burnett B, Tunstall RG, Abrahams PH. Complementing anatomy education using three-dimensional anatomy mobile software applications on tablet computers. *Clin Anat*. 2014;27:313-320.
5. Gould DJ, Terrell MA, Fleming J. A usability study of users' perceptions toward a multimedia computer-assisted learning tool for neuroanatomy. *Anat Sci Educ*. 2008;1:175-183.
6. Pascoe MA, Betts K. Use of a digital, profession-specific dissection guide is associated with improved examination performance and student satisfaction. *Med Sci Educ*. 2020;30:1025-1034.
7. Pascoe M, Monroe F, Macfarlane H. taking constructivism one step further: post hoc analysis of a student-created wiki. *JMIR Med Educ*. 2018;4:e16.
8. Pascoe MA, Lee LMJ. Incorporation of light field photography into an online anatomy resource does not influence student quiz performance or perceptions of usability. *Med Sci Educ*. 2018;27:465-474.
9. Nuland SEV, Hall E, Langley NR. STEM crisis teaching: curriculum design with e-learning tools. *Faseb Bioadvances*. 2020;2:631-637.
10. Goh P-S, Sandars J. A vision of the use of technology in medical education after the COVID-19 pandemic. *Mededpublish*. 2020;9:1–8.
11. Pickering JD, Bickerdike SR. Medical student use of Facebook to support preparation for anatomy assessments. *Anat Sci Educ*. 2017;10:205-214.
12. Jaffar AA, Eladl MA. Engagement patterns of high and low academic performers on facebook anatomy pages. *J Medical Educ Curric Dev*. 2016;3:JMECD.S36646.
13. Jaffar AA. Exploring the use of a facebook page in anatomy education. *Anat Sci Educ*. 2014;7:199-208.
14. Marsland MJ, Lazarus MD. Ask an anatomist: Identifying global trends, topics and themes of academic anatomists using twitter. *Anat Sci Educ*. 2018;11:270-281.
15. Hennessy CM, Kirkpatrick E, Smith CF, Border S. Social media and anatomy education: Using twitter to enhance the student learning experience in anatomy. *Anat Sci Educ*. 2016;9:505-515.
16. Barry DS, Marzouk F, Chulak-Oglu K, Bennett D, Tierney P, O'Keeffe GW. Anatomy education for the YouTube generation. *Anat Sci Educ*. 2016;9:90-96.
17. Raikos A, Waidyasekara P. How useful is YouTube in learning heart anatomy? *Anat Sci Educ*. 2014;7:12-18.
18. Azer SA. Can "YouTube" help students in learning surface anatomy? *Surg Radiol Anat*. 2012;34:465-468.
19. Jaffar AA. YouTube: an emerging tool in anatomy education. *Anat Sci Educ*. 2012;5:158-164.
20. Junco R, Heiberger G, Loken E. The effect of Twitter on college student engagement and grades. *J Comput Assist Lear*. 2011;27:119-132.
21. Stone DM, Barry DS. improving online interactions: reducing the transactional distance of online anatomy modules. *Anat Sci Educ*. 2019;12:686-687.
22. Pollock W, Rea PM. The use of social media in anatomical and health professional education: a systematic review. *Adv Exp Med Biol*. 2019;1205:149-170.
23. Tankovska H. Share of social media users in the United States who believe they will use select social media more if confined at home due to the coronavirus as of March 2020. 2021; https://www.statista.com/statistics/1106343/social-usage-increase-due-to-coronavirus-home-usa/.
24. Xu B, Chang P, Welker CL, Bazarova NN, Cosley D. Automatic archiving versus default deletion: What snapchat tells us about ephemerality in design. Proceedings of the 19th ACM

Conference on Computer-Supported Cooperative Work & Social Computing, 1660-1673; 2016.
25. Snap. Snap. Inc. Investor Presentation Q4 2020. pp. 1-42, Snap. Inc.; 2021.
26. Sadd R. Student nurse attitudes and behaviours when using social network sites. *Stud Health Technol*. 2019;264:1342-1346.
27. Patel RR, Yazd NKK, Dellavalle RP. Dermatology on snapchat. *Dermatology Online J*. 2017;23:1-3.
28. Oberauer K. Working memory and attention – a conceptual analysis and review. *J Cognition*. 2019;2:36.
29. Bayer JB, Ellison NB, Schoenebeck SY, Falk EB. Sharing the small moments: ephemeral social interaction on Snapchat. *Inform, Commun & Soc*. 2015;19:956-977.
30. Carman KL, Minns A, Garber S, Hammoud MM, Hortsch M. ObGyn delivered: social media serving medical students' learning needs. *Medical Sci Educ*. 2021;31:1-10.
31. Chytas D. Use of social media in anatomy education: a narrative review of the literature. *Annals Anat*. 2019;221:165-172.
32. Kirkpatrick DL, Francisco JDKS. *Evaluating training programs*. San Francisco, CA: Berrett Koehler Publishers; 2006.
33. Artino AR Jr, La Rochelle JS, Dezee KJ, Gehlbach H. Developing questionnaires for educational research: AMEE Guide No. 87. *Med Teach*. 2014;36:463-474.
34. Jamieson S. Likert scales: how to (ab)use them. *Med Educ*. 2004;38:1217-1218.
35. Faul F, Eridfelder E, Lang A-G, Buchner A. G*power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behav Res Methods*. 2007;39:175-191.
36. Chatterjee D, Corral J. How to write well-defined learning objectives. *J Educ Perioperative Med*. 2018;19:1-4.
37. Ozan O, Ozarslan Y. Video lecture watching behaviors of learners in online courses. *Educ Media Int*. 2016;53:1-15.
38. Gable SL, Reis HT, Impett EA, Asher ER. What do you do when things go right? The intrapersonal and interpersonal benefits of sharing positive events. *J Pers Soc Psychol*. 2004;87:228-245.
39. Volery T, Lord D. Critical success factors in online education. *Int J Educ Management*. 2000;14:216-223.
40. Nuland SEV, Eagleson R, Rogers KA. Educational software usability: artifact or design? *Anat Sci Educ*. 2017;10:190-199.
41. Bringman-Rodenbarger L, Hortsch M. How students choose E-learning resources: the importance of ease, familiarity, and convenience. *Faseb Bioadvances*. 2020;2:286-295.
42. Border S, Hennessy CM, Pickering JD. The rapidly changing landscape of student social media use in anatomy education. *Anat Sci Educ*. 2019;12(5):577-579.
43. Hortsch M, Markovac J, Woolliscroft JO. Introduction to the special collection on biomedical education. *Faseb Bioadvances*. 2020;2:629-630.
44. Norman GR, Smith EKM, Powles ACP, Rooney PJ, Henry NL, Dodd PE. Factors underlying performance on written tests of knowledge. *Med Educ*. 1987;21:297-304.
45. Custers EJFM. Long-term retention of basic science knowledge: a review study. *Adv Health Sci Educ*. 2010;15:109-128.
46. Clunie L, Morris NP, Joynes VCT, Pickering JD. How comprehensive are research studies investigating the efficacy of technology-enhanced learning resources in anatomy education? A systematic review. *Anat Sci Educ*. 2017;11:303-319.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Pascoe MA. The effect of Snapchat on learner satisfaction and anatomical knowledge retention: Preliminary observations. *FASEB BioAdvances*. 2021;3:909–917. https://doi.org/10.1096/fba.2021-00052

APPENDIX

Full learner satisfaction survey exported from Qualtrics.