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How much do preclinical medical students utilize the internet to study physiology?

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O’Malley D, Barry DS, Rae MG. How much do preclinical medical students utilize the internet to study physiology? Adv Physiol Educ 43: 383–391, 2019; doi:10.1152/advan.00070.2019.—Medical students increasingly utilize social media platforms to supplement their preclinical learning; however, the prevalence of social media use for physiology learning in medical education remains unclear. The aim of the present study was to determine how first-year medical students from both direct entry medicine and graduate entry medicine interacted with social media as a learning tool by assessing its prevalence, perceived benefits, favored platforms, and reason(s) for its use. Seventy-one percent of surveyed students (out of 139 participants) stated that they interacted with social media in general more than 12 times per week. However, 98% had previously used internet platforms to source physiology information, with 89.2% doing so at least once per week during term. YouTube was the primary source of learning for 76% of students. Significantly, 94% of students indicated that they would first search for answers online if they did not understand something in physiology rather than contacting their instructor in person or by e-mail. However, only 31% of students “fact-checked” physiology information obtained from online sources, by using textbooks, papers, and/or instructors. Our study has revealed that most preclinical medical students utilize social media extensively to study physiology. However, the absence of academic and ethical oversight, paired with students’ lack of critical appraisal of possibly inaccurate information, does raise concerns about the overall utility of social media as part of physiology education.

fact-checking; physiology; preclinical medical students; social media; YouTube

INTRODUCTION

Physiology remains among the most essential of the basic sciences learned by medical students for their subsequent clinical training (1, 4, 9, 19, 34, 49). Although traditional didactic lectures and practical sessions remain at the core of most physiology syllabi (8, 33), many institutions are moving toward a more technology-enhanced learning approach as one way of facilitating the change in approach of today’s students to their education compared with students of previous eras (6, 18, 25, 42, 43, 46). Indeed, acknowledging students’ love of social media, several higher education programs, including those in the medical and allied healthcare sectors, have investigated integrating the use of social media platforms into their courses (3, 20, 21, 40).

Deployment of social media tools in this way enables students to study more efficiently (54), permits rapid and effective communication between users, and facilitates feedback to students from faculty (12, 36, 50). Furthermore, students who regularly use social media and other learning technologies report higher levels of engagement within the university, an enhanced sense of community (11, 31, 32, 48), and increased confidence/reduced anxiety (40). Social media also provides platforms for collaborations (27) and allows students to feel a heightened sense of community (11, 31, 32, 48), and increased confidence/reduced anxiety (40). Social media also provides platforms for collaborations (27) and allows students to feel that they are in control of their own education rather than relying on tutors to provide them with information (2, 18).

Within medical education, the impact of social media has been reported as near exclusively positive and desired by medical students (Refs. 2, 3, 6, 10, 17, 20, 21, 30, 32, 40, 43, 48; for reviews see Refs. 12, 53). However, it is currently unclear to what extent students are utilizing and relying on social media in physiology education. Therefore, we gauged how first-year preclinical medical students [both graduate entry medicine (GEM) and direct entry medicine (DEM)] within the medical school at the University College Cork (UCC) employed social media and other Web 2.0 tools to supplement their physiological learning.

METHODS

GEM vs. DEM programs. The GEM program at UCC is an accelerated professional degree that usually spans only 4 yr, rather than the 5 yr of the more traditional DEM degree program. This is accomplished by compressing the preclinical teaching for GEM students into just over 1 rather than 2 yr. As such, GEM students must learn the same amount of material as their DEM counterparts in approximately one-half of the time. Social media is not incorporated into existing student medical curricula.

The taught physiology component of both first year DEM and GEM courses is delivered over a duration of 7 and 8.5 mo, respectively (four modules for DEM students, three for GEM students) and comprises a mixture of both didactic lectures and laboratory practical classes. Academic material for each module is supported by Blackboard Academic Suite, into which lecture presentations, practical laboratory guides, and supplemental learning resources are posted.

Data collection and analysis. Ethical approval for the present study was granted by University College Cork Social Research Ethics Committee. Both DEM and GEM students could access an itemized survey through UCC’s virtual learning environment, Blackboard Academic Suite (https://www.blackboard.com/) from the start of April 2018 to the end of June 2018 before the data were downloaded for analysis.
The survey instrument consisted of 25 items that, in addition to collecting demographic data, including age and sex, sought to interrogate students’ use of social media websites generally, and specifically in relation to physiology, with one free comment option. Seventeen of the survey items were Likert-scale options. For topics related to social media use in physiology learning, the survey items were designed to determine the following: 1) how comfortable, and how frequently, students were using social media to access information on physiology; 2) what online sources students used to access physiology information; 3) under what circumstances students used social media to access information about physiology; 4) how students viewed the reliability of social media-derived physiology information; 5) students’ preference for social media-derived physiology information over their lecture notes; and 6) their views on a faculty-led social media physiology page. The entire questionnaire is available in the appendix.

For statistical comparisons, Likert-scale responses and frequency-of-use data were each converted to a 0–5 numerical value: specifically, strongly agree = 5, agree = 4, neither agree nor disagree = 3, disagree = 2, strongly disagree = 1; and for frequency-of-use data, never = 0; 1–2 times = 1; 3–5 times = 2; 6–8 times = 3; 9–11 times = 4; and ≥12 times = 5. All survey data from respondents were downloaded from Blackboard Academic Suite, collated, and entered into GraphPad Prism for statistical analysis. For comparisons between GEM and DEM students overall, Student’s unpaired t-test was utilized to analyze data. For comparisons across all DEM and GEM male and female subgroup data, one-way analysis of variance (ANOVA) with Tukey’s multiple-comparisons test was employed.

RESULTS

Student demographics. One hundred and thirty-nine respondents completed the survey, of which 78 were women (40 DEM, 38 GEM) and 61 were men (32 DEM, 29 GEM).

Most students (83/139; 59.7%) indicated that their region of origin was Europe, with the second largest grouping consisting of students from Canada/North America (25.2%; 35/139). Thirty-three of thirty-five Canada/North American students were in the GEM cohort. Although most students were aged 18–20 yr (43.2%), the age of the GEM cohort was significantly greater (P = 0.001, unpaired t-test) than that of the DEM class. However, there was no significant difference in the ages of either the DEM male vs. female students or the GEM male vs. female students.

Use of internet-enabled devices and web-based resources. All students surveyed possessed at least one internet-enabled device (iPad, laptop, tablet, smartphone, etc.), with 138/139 students possessing at least two (data not shown; no significant differences for GEM vs. DEM, or male vs. female, students). Although the majority of students (81.5%) reported that they were comfortable using social media [“strongly agree” and “agree” combined; mean score = 4.07 (SD 0.99); Fig. 1A], with 84% of respondents having used social media to discuss general GEM course-related issues with their colleagues [84% strongly agree and agree combined; mean score = 4.07 (SD 0.94); no significant differences in the responses of GEM vs. DEM or male vs. female students; Fig. 1A], we found that a remarkable 98.5% of GEM and 97.3% of DEM students had used social media specifically to find information about physiology [strongly agree and agree combined; overall mean score = 4.63 (SD 0.58); no significant difference for DEM vs. GEM or male vs. female students; Fig. 1A].

The video-sharing platform, YouTube, was by far the most popular source of physiology information for students (76.3%; Fig. 1B), with, for those who expressed a preference, Khan Academy being the most popular (41% of students) specialized content channel within YouTube itself (although it should be noted that 36% of students did not express a preference for any particular channel; Fig. 1C).

![Fig. 1. Students’ social media usage. A: graph depicts combined direct entry medicine (DEM) and graduate entry medicine (GEM) students’ general and physiology-specific social media use, with each line representing the mean ± SD. Pie charts illustrate overall student responses to the questions, “If you use YouTube to source online physiology material, what channel do you view most frequently?” (B), and “If you have used online video clips to help you with your understanding of physiological concepts, where do you mostly source them from?” (C). NA, not applicable; UA, unanswered.](http://advan.physiology.org)
In terms of how frequently the students actually used social media, 98.6% accessed general social media sites at least once per week during the academic term, with 70.5% doing so at least 12 times per week (no significant differences for DEM vs. GEM or male vs. female students; Fig. 2A). Specifically, with regard to their study of physiology, however, where 89.2% of students accessed physiology-related “online video clips” at least once per week during term time, we did uncover some statistically significant differences between groups (Fig. 2B). For example, GEM students accessed social media to source physiology material significantly more frequently than DEM students ($P = 0.03$, unpaired $t$-test; e.g., 20.9% of GEM students vs. 6.9% of DEM students viewed physiology videos at least 6 times per week), with GEM men also doing so more frequently than DEM women ($P = 0.047$, one-way ANOVA, Tukey’s multiple-comparisons test; e.g., 27.6% of GEM men vs. 2.5% of DEM women viewed physiology videos at least 6 times per week), but not more than DEM men or GEM women (Fig. 2C).

**Students’ perceived usefulness of online physiology material as a tool for learning.** We found that, although near equally large percentages of DEM and GEM students found online video clips “generally useful for understanding physiological concepts” [strongly agree and agree combined; 83.3% DEM, mean score = 4.32 (SD 0.77) vs. 86.3% GEM, mean score = 4.28 (SD 0.79)], there was a difference in how useful each cohort of students perceived them to be (Fig. 3A). For example, we found that, whereas 79.1% of GEM students strongly agreed or agreed that they found online video clips “generally more useful for [their] understanding of physiological concepts than taught lecture material/lecture slides” [mean score = 3.64 (SD 0.95)], only 47.2% of the DEM cohort expressed similar views [mean score = 3.46 (SD 0.85)], although this difference was not statistically significant (one-way ANOVA). Indeed, just under one-half (40.3%) of DEM students were equivocal about the benefit of YouTube videos to their studies over lecture material (Fig. 3B).

Interestingly, we also found that significantly more GEM women than either DEM men or women (but not GEM men) felt that online physiology videos were better study aids than taught lecture material/slides [GEM women, 68% strongly agree or agree, mean score = 3.82 (SD 0.8) vs. DEM women 50% strongly agree or agree, mean score = 3.45 (SD 0.93), $P = 0.04$, vs. DEM men, 44% strongly agree or agree, mean score = 3.47 (SD 0.76); $P = 0.04$; Fig. 3B].

**Circumstances underlying social media use for supplemental physiology study.** We next wished to identify the motivation(s) for student’s use of web-based resources in physiology learning. We found that 49.7% of students overall disagreed or strongly disagreed [mean score = 2.86 (SD 1.27)] that they would contact an instructor in person if they had a physiology-related question (Fig. 4A). This apparent reluctance of students to engage with faculty directly seemed to be supported by the finding that only 13.8% of students overall strongly agreed or agreed that they would contact their instructors by e-mail if they had a physiology query, with 69.8% indicating that they strongly disagreed or disagreed with the statement [mean score = 2.24 (SD 0.98)]. No significant differences existed for

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**Fig. 2.** Students’ general social media use. Pie charts illustrate the number of times per week during term time that both graduate entry medicine (GEM) and direct entry medicine (DEM) students combined accessed social media generally per week (A) and frequency of use of “online video clips” to facilitate students’ physiology learning per week (B). C: histogram illustrates the same data as pie chart in B, but includes GEM/DEM and male/female composition. Overall, GEM students viewed physiology video clips significantly more frequently than did DEM students ($P = 0.053$), with GEM men viewing these significantly more frequently than DEM women ($P = 0.047$), UA, unanswered.
DEM vs. GEM or between groups (Fig. 4A). There were 92.8% of respondents who strongly agreed or agreed [mean score = 4.54 (SD 0.73)] with the statement, “If I don’t understand something when I study Physiology I first search for an answer online” (Fig. 4A).

We also gauged how students regarded the physiology information sourced from web-based resources: 41.7% of all students disagreed or strongly disagreed that they automatically trusted information from online sources, such as YouTube, Wikipedia, and Facebook [mean score = 2.88 (SD 1.12)], whereas one-third (34.6%) trusted this information, and 23.7% neither agreed nor disagreed (Fig. 4B). Probing the same area, we sought to determine whether students ever “fact-checked” information obtained from online sources by using textbooks, research papers, and/or instructors. There were 31% who did fact-check information, although 43.9% did...
not [mean score = 2.83 (SD 1.1)]. There were no significant differences in the responses of GEM vs. DEM, or male vs. female students (Fig. 4B).

Instructor-led social media page. Finally, we wished to determine whether medical students “would enjoy interacting with course materials on a social media page,” such as Facebook. In both GEM and DEM cohorts, 45.3% strongly agreed or agreed [mean score = 3.18 (SD 1.04)]. Nearly one-third (29.2%) of students did not express an opinion either way, and 25.6% indicated that they would not want to interact with a physiology-focused social media page (Fig. 5). Moreover, DEM students overall were more in favor of a physiology-devoted social media page than the GEM students [DEM mean score = 3.44 (SD 1.0) vs. GEM mean score = 2.91 (SD 1.02); P = 0.003, unpaired t-test], with DEM women being particularly strongly in favor [66.7% DEM female vs. 37.5% DEM male (P = 0.02, one-way ANOVA, Tukey’s multiple-comparisons test) vs. 42.1% GEM female (P = 0.004, one-way ANOVA, Tukey’s multiple-comparisons test) vs. 28.6% GEM male (P = 0.001, one-way ANOVA, Tukey’s multiple-comparisons test)], of those who agreed or strongly agreed with the setting up of a physiology-related social media page (Fig. 5). There was no significant difference for DEM men vs. GEM men, or for GEM men vs. GEM women.

DISCUSSION

We wished to gauge the relevance and roles of social media for physiology learning in medical education. First-year GEM and DEM medical students were invited to complete a survey designed to assess frequency of use, perceptions, and preferences of physiology-related social media, with response rates of 81.7% (n = 67) and 56.3% (n = 72), respectively, and almost proportionally equal numbers of male and female student respondents. GEM students originated mainly from North America or Europe and were aged between 21 and 29 yr, whereas DEM students were predominantly European and aged between 18 and 20 yr.

Irrespective of sex, the majority of first-year medical students were comfortable using social media, with most using these tools 12 times or more per week to facilitate their physiology learning, as well as to discuss physiology content with classmates (Fig. 2). YouTube was the students’ favorite social media information source, with Khan Academy being the most popular video channel for both DEM and GEM students (Figs. 1, A and B). Interestingly, GEM students used social media content to aid their learning more than DEM students (Fig. 1C). GEM women, in particular, found online videos more helpful than lectures to aid their learning physiological concepts, as exemplified by the following comments from two female GEM students:

I usually use online material to clear up a topic that seems convoluted in the lecture slides and/or textbooks. Videos with animations are particularly helpful for my understanding of [physiology] because I can “see” certain processes happen rather than just looking at a picture.

Also, “I usually use online material to clear up a topic that seems convoluted in the lecture slides and/or textbooks.”

These data indicate that the extent of social media integration into medical education is greater than has been previously reported (6, 12, 22, 24, 26, 28, 50, 53, 54). The reason for such integration most likely lies in the immediacy of responses to questions and/or a lack of instructor accessibility. Indeed, in alignment with previous anatomy-oriented reports (6, 39), only 14% of students indicated that they would seek academic guidance if they encountered an issue in their physiology learning, opting to first search for an answer online. For example, one female DEM student commented, “I just find it less time consuming to search for something online rather than look for it in a physiology textbook.”

I find it easier to look any questions that I have up online because often I find there is not enough time to ask a lecturer a question after a class because they are rushing to another class or I am rushing to another class (mainly this reason).

Another female DEM student commented, “I tend to use online resources mainly for videos of complicated concepts or simple factual questions with a definite answer.”

Significantly, 34.6% of GEM and DEM students indicated that they “automatically trust[ed] information” from online sources without verification, with only 31.3% of students indicating that they did fact-check information using textbooks (e.g., one GEM woman wrote, “If I am looking for more detail on a conceptual question, I generally will use a textbook over an online source”), research papers, or instructor input. Two other students addressed this topic directly in the survey free-comment section, with one (DEM woman) stating:

Most times when I fact check, it would be because the information given is different or stated in a different approach than my lecturer or seems like it doesn’t make sense or seems weird. Other than that, the information I have gathered online regarding academics have been quite sound.
Another student (GEM woman) wrote:

I do not fact check unless there is a major contradiction. Usually, it is very obvious what online resources are most trustworthy i.e. based on the quality of the video, number of view [sic], comments, correlation with previous knowledge from lectures and notes.

This latter comment reflects a common student misconception that the number of views, likes, or comments about educational videos on YouTube are reliable indicators of their reliability or usefulness, when in fact no such correlation exists (50).

The rise of social media platforms in undergraduate medical education is likely due to eroding student-instructor interactions, their increasing number and accessibility, and their emergence as primary interstudent communication tools (23). However, student interdependence on Physiology-based web resources raises several issues. For example, there is an enormous variation in the quality and accuracy of online life science content (18, 53). Inaccuracies in YouTube videos, in particular, have already been documented with, for example, the majority of anatomy material falling far below a useful learning standard (5, 45). Moreover, in addition to the fact that many students are “conditioned to select the first or most easily accessible information resource” available to them (18), they also generally lack the media literacy and critical analytic skills to determine whether information sourced from online resources is correct or not (15, 16, 18, 35, 47, 52). It is, however, worth noting that, in the present survey, three students specifically commented that they would appreciate being directed toward “reputable” physiology videos, i.e.: “In general, I find watching a video can be useful in helping to retain information and would be very grateful if there were more signposts/links to reputable video channels for more of the concepts we cover in Physiology” (GEM woman). “For every lecture, it might be useful to have some youtube [sic] links to videos explaining the contents of the lecture” (GEM man). “Lecturers could . . . put recommended videos in lectures notes for better understanding” (DEM woman).

However, these sentiments aside, in an era of increasing time constraints for academics, their continued peer monitoring of social media physiology content is unlikely, and developing students’ digital insights is not a generalized curricular component (14, 18).

The solution to this issue would seem to lie in the development of dedicated academic-led physiology social media content, where, for example, links to physiology-orientated videos that had been checked for accuracy of content could be provided. However, there is often a generational and technological gap between students and faculty (41). So-called “digital immigrants,” who were born before the rapid rise in digital technology (36), may not only be skeptical about the benefits of utilizing social media platforms to support their teaching (29, 37, 41), but may also be less than comfortable using them (7). As such, it is possible that some academics will be unaware of the full versatility of the social media platforms that they are instructed/requested to use in their teaching. This, in turn, means that such platforms are unlikely to be used optimally, to the overall detriment of student learning (53).

Nonetheless, social media does allow faster communication with, and feedback from, instructors (21, 30, 50) and may reduce overall academic workload (53). However, in our study, only 45.3% of students stated that they would enjoy interacting with course materials on a social media page. Significantly, more DEM than GEM students were in favor of such an idea, with women almost as twice as enthusiastic as men. The reasons for these demographic differences are unclear, but, in terms of the DEM vs. GEM differences, the significantly older GEM students may simply be more academically autonomous. However, it may simply be due to a lack of clarity about the exact purpose(s) and content that such a social media page would contain, e.g.:

I’m not sure what you mean by course materials on a social [sic] media page: if you mean facebook [sic], then I disagree because it is distracting for me; if you mean videos and interactive activities/quizzes, then I strongly agree (GEM woman).

Limitations. One potential drawback of our study is that it did not quantitatively measure the impact of social media usage on student learning and/or exam performance. A further limitation of the study is that students were recruited from two different medical programs within UCC that are each taught and assessed differently. While associated alterations in data could be attributable in some way to the fact that they are taught and assessed separately and distinctly, it may also indicate that their significantly different educational backgrounds and age demographics engender different and distinct educational requirements.

Conclusion. Here, we contribute to medical/physiology education literature by revealing the extent of social media use in graduate and direct entry preclinical medical physiology learning. It is clear that medical students are becoming increasingly reliant on digital resources to supplement their academic-led curricular resources (6, 12, 13, 22, 41). As such, awareness of the growing digital divide that exists between students and faculty is rapidly becoming a key asset in addressing the educational and communication needs of the next generation of medical students.

APPENDIX

Physiology Internet Usage Survey 17–18

This questionnaire is designed to provide Dr. Rae with information as to how both GEM and DEM students utilize online material for their understanding of physiology. It is hoped that this little researched question will be disseminated to other interested parties (e.g., as a research paper) but that no personal information (names, student numbers, etc.) will be linked to any of the information provided. Indeed, I can give you my word that I will not even attempt to gather this type of information from the survey responses. Thank you in advance for your participation.

Please note that, by completing the survey, either in full or in part, you are indicating that you are voluntarily participating in the study and that any anonymized information provided by you may be analyzed and disseminated by the designer of the survey, Dr. Mark G. Rae.

Which gender do you identify as?

Male
Female
Other

Please specify your age profile:
A. 18–20
B. 21–23
C. 24–27
D. 28+
Please specify your region of origin:
A. Africa
B. Asia
C. Europe
D. Middle East
E. North America/Canada
F. Other

Would you consider your educational background to be biomedical or non-biomedical (this question probably only relates to graduate entry students)?
Biomedical
Non-biomedical
Not applicable

Which one of the following is your preferred method of sourcing physiology information?
A. Recommended textbooks
B. Instructor
C. Social media platforms (e.g., Facebook, Twitter, WhatsApp, etc., not including YouTube or Wikipedia)
D. YouTube
E. Wikipedia
F. Random internet search engine hits
G. Other

How many internet-ready devices (laptop, smartphone, iPad, etc.) do you possess?
A. 1
B. 2
C. 3
D. 4
E. 5
F. 6+

“I am very comfortable using social media (Facebook, Twitter, etc.).”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

During the academic term, how often do you interact with social media (e.g., Twitter, Snapchat, Facebook, etc.) in a week?
A. Never
B. 1–2 times
C. 3–5 times
D. 6–8 times
E. 9–11 times
F. 12 times or more

“I use social media to discuss Physiology-related issues with my classmates on a regular basis (e.g., every 1-2 weeks).”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

“If I don’t understand something when I study Physiology, I contact my instructor by e-mail.”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

“If I don’t understand something when I study Physiology, I ask my instructor a question in person.”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

“If I don’t understand something when I study Physiology, I first search for an answer online.”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

How quickly do you expect a response from an instructor regarding a Physiology question? Within:
A. Two hours
B. Six hours
C. The same day
D. The same week
E. I don’t mind as long as I receive a reply at some point.

“The speed at which I want an answer to my question determines whether I ask my instructor or search for an answer online.”
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

During the academic year, how often do you use online video clips to facilitate your Physiology learning in a week?
A. Never
B. 1–2 times
C. 3–5 times
D. 6–8 times
E. 9–11 times
F. 12 times or more

If you use online video clips, do you find them generally useful for your understanding of Physiological concepts?
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

If you use online video clips, do you find them generally more useful for your understanding of Physiological concepts than taught lecture material/lecture slides?
A. Strongly Agree
B. Agree
C. Neither Agree nor Disagree
D. Disagree
E. Strongly Disagree
F. Not Applicable

If you have used online video clips to help you with your understanding of Physiological concepts, where do you mostly source them from?
A. YouTube
B. Facebook or other social media site
C. Random search engine hits
D. Physiology/medical textbook online material
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REFERENCES
