

## Social media: Changing the paradigm for surgical education

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## **Abstract**

The role of social media in surgical education is emerging as a tool that augments and compliments traditional learning. As social media usage has steadily increased in our personal and professional lives, it is no surprise of its permeation into surgical education. Different social media sites offer distinct platforms from which knowledge can be transmitted, while catering to various learning styles. The purpose of this review is to outline the various social media platforms and their use in surgical education. Moreover, it will discuss their effectiveness in teaching and learning surgical knowledge and skills as well as other potential roles social media has to offer to improve surgical education.

**Keywords:** surgical education, social media, learning, skill training

**CME objectives:**

The goals of this review are:

- To explain the evolution of learning theories and how they pertain to surgical education
- To illustrate the different social media platforms and justify their use in surgical education
- To discuss the effectiveness of social media in surgical training
- To support the use of social media in surgical education for the acquisition of knowledge and technical skills

**CME questions:**

- 1) Which learning theory best illustrates the acquisition of knowledge through the use of social media platforms?
  - a. Behaviorism
  - b. Cognitivism
  - c. Constructivism
  - d. Connectivism

2 part question:

- 2) Which social media platform allows users to post short, 140 character messages
  - a. Facebook
  - b. Instagram
  - c. Twitter
  - d. Doximity
  - e. ResearchGate

3) This SoMe platform is an example of

- a. Blogging
- b. Social Networking
- c. Microblogging
- d. Virtual worlds
- e. Podcasts

## **Evolution of technology and social media (SoMe) <H1>**

The evolution of the world wide web from Web 1.0 to Web 2.0 technologies has revolutionized the way the world communicates. With the creation of social media, internet users are able to interact and share information online in more dynamic ways through virtual communities compared to more traditional methods. Our use of technology has become an integral part of our daily lives. Recent statistics have shown that 88% of Americans use the internet<sup>1</sup> and 77% of adults use smartphones<sup>2</sup>. According to the Pew Research Center, the percentage of US adults using at least one SoMe site has rapidly grown, with only 5% of U.S. adults using SoMe in 2005 to now 69% of U.S. adults using it as of November 2016<sup>3</sup>. Within this cohort are the “digital natives”<sup>4</sup> – individuals who are accustomed to regularly accessing online material and turning to SoMe sites for learning or pleasure/entertainment.

Surgical education is increasingly embracing the SoMe movement, incorporating online discussion and collaboration using various online platforms. Medical students and postgraduate trainees are routinely turning to online resources for learning rather than the traditional printed material. Although SoMe in surgical education is still in its infancy, it has the potential to complement existing learning techniques. A main benefit is it allows people to connect, share ideas and knowledge and engage in educational dialogue without the restriction of geographical boundaries, a feature that was not as readily available in the traditional teaching arena.

This review will examine the common SoMe tools and platforms that provide surgeons with educational resources and further discuss whether SoMe is an effective tool for surgical education.

## **Learning theory is evolving <H1>**

The strong presence of SoMe and Web 2.0 technologies in the last few years has not only changed the way information is shared but also have challenged educational psychologists who study learning theory in order to understand how technology impacts learning. The evolution of learning pedagogy throughout the 20<sup>th</sup> century has changed the way experts perceive learning. In the early 20<sup>th</sup> century, *behaviorism* believed that learners are a “clean slate” (tabula rasa) who passively gain knowledge through positive or negative reinforcement known as “operant conditioning”<sup>5</sup>, implying that individuals learn through a “stimulus-response” pathway that is mainly provided by external stimuli. Subsequently, this theory was replaced by *cognitivism*, which perceived the learner as “information processors”, whereby internal processes such as thinking, memory, and problem solving are used as part of knowledge acquisition. The focus of learning was not about what learners did but about what they knew and how they came to acquire knowledge through receiving, organizing, storing, and retrieving information in the mind<sup>6</sup>. Following this, the theory of *constructivism* emerged, which was a novel and more dynamic approach to learning theory that embraced the idea that learners construct their own knowledge by gathering and accepting new information that adds to their prior knowledge<sup>7</sup>. Basically, their experiences, surroundings, and interactions with others transforms learning into an active rather than a passive process of knowledge acquisition<sup>6</sup>. Bloom’s taxonomy of learning behaviors divides learning into three categories: cognitive (knowledge), affective (attitude), and psychomotor (skills), wherein each category consists of a hierarchy to learning behaviours. At the top of this hierarchy are higher levels of cognitive abilities such as creating new programs or hypothesizing, which requires a higher level of understanding above simple comprehension,

memorization or recall<sup>8</sup>. The *constructivist* learning theory helps learners achieve these higher levels through use of their current knowledge to create new knowledge, which is expected in learners in higher education such as surgical trainees. E-learning embraces a *constructivist* learning theory because of its ability to encourage online self-regulated learning and social interactions. However, none of these learning theories were developed in an era where technology had an important influence on the daily lives of contemporary learners.

*Connectivism*, the most recent and still controversial learning theory first introduced by Siemens and Downes, attempts to explain how people learn through sharing information across the web using internet technologies<sup>9,10</sup>. *Connectivism* embraces continued learning through networking and connections that are made and maintained using technology with the goal of staying up-to-date with pertinent information and maintaining knowledge flow. Through social collaboration, our personal knowledge grows by cycling through connections with other institutions and organizations. Surgical education has the potential to embrace this theory for its learners as the overabundance of material currently being exchanged online has already become the go-to source for learners at any level, from the novice to experts in the field. Moreover, with the millennial generation (*Generation Y*), who are considered the largest and most educated generation in history, grew up with technology and the expectation of 24/7 access to information through a variety of platforms including cell phones and computers<sup>11</sup>. This generation “expects the social environment of work to reflect the social context of the Internet”, thus educators need to understand, and cater to, their learners’ expectations<sup>11</sup>. But equally, the modern-day tools available to students promote a heuristic culture which if appropriately harnessed can prove to be far more advantageous than traditional learning.

## **Surgical education - what has changed? <H1>**

A recent survey by Mattar et al. in the *Annals of Surgery* found that the majority of Fellowship Program Directors believe General Surgery residents are not well prepared at the completion of their general surgery training<sup>12</sup>. Certainly, the implementation of duty hour restrictions has meant that trainees have limited time spent in hospitals, clinics, and operating rooms. As a consequence, an increasing amount of learning has been driven outside the hospital environment. So with less time to learn, trainees have needed to become more creative in the ways they acquire their training needs.

SoMe can play a significant role in filling in the educational gaps for knowledge acquisition for “time-poor” trainees, catering to the ever-changing learning environment as an innovative approach to promote learning. The creation of simulation platforms and virtual technology allows trainees to be exposed to a variety of quick and easy online learning tools which can cater to different learning styles, and further encourage learner-constructed knowledge and self-directed learning. The latter modality has replaced the traditional approach to teaching and learning such as didactic lectures and large, bulky textbooks. The vast majority of textbooks and journals are now accessible online. A systematic review carried out by Cheston et al. included 14 studies that assessed interventions using SoMe tools in medical education and found that these tools were associated with improved knowledge (e.g., examination scores), attitude (e.g., empathy), and skill (e.g., reflective writing)<sup>13</sup>. Moreover, these tools promoted learner engagement, feedback, collaboration, and professional development. Although challenges included technical issues, variable learner participation, and privacy/security concerns, they concluded that SoMe brings opportunity for innovation and is an emerging field of scholarship



that merits further investigation<sup>13</sup>. Surgical educators are forced to adapt to these new educational techniques and use them to meet the needs of the 21st century learner<sup>14</sup>. Within this group are current medical students and post-graduate trainees who have become accustomed to using online resources as an important part of their learning.

## **Using Social Media for surgical education - what is out there? <H1>**

Social media encompasses a variety of different platforms, with different purposes of communication. A plethora of SoMe sites have been developed over the years, the most popular of which is the social networking site Facebook. Social networking is one of many branches of SoMe platforms. Others include blogging, micro-blogging, wikis, video-sharing, collaboration sites, virtual worlds, and more, which offer another dimension to learning and are all gaining momentum in the surgical world. The potential of SoMe to share thoughts and ideas from every corner of the world using the world wide web makes this a sophisticated e-learning educational tool and is the reason why educators worldwide are turning to SoMe for teaching and learning.

## ***Blogs, microblogs and online communities <H2>***

### **Blogs <H3>**

A blog is an interactive website, usually managed by an individual, group, or organization with the opportunity to interact through comments that are regularly posted and shared<sup>15</sup>. Although blogs are not often thought of as learning tools being classified low down on the scale of evidence, they do have the potential to create a learning environment for the reader. Wordpress (<https://wordpress.com>) and Blogger (<https://www.blogger.com/>) are publishing platforms used

to create blogs and can be accessed by anyone interested in blogging<sup>16</sup>. Surgical blogging is not only for individuals who want to write about their personal experiences and share their stories, but also for those who want to share and discuss interesting articles or events pertaining to surgery as well as new surgical procedures from around the world. Blogging is a form of journaling meant to interest others who have the opportunity to actively comment and participate in the discussion. Traditionally, these discussions and exchanges typically happened in an amphitheater setting during medical/surgical conferences and society meetings or shared with medical students and residents during rounds. However, through the power of SoMe, these discussions can occur in the palm of your hand. Active bloggers turn to blogging sites to divulge their thoughts and share information they feel is important and relevant to their field, providing links to important articles to justify their commentaries. Bloggers also share personal anecdotes, which add an entertaining and more personal component to reading and are more attractive to viewers. For example, *Insidesurgery.com* is a blogging surgical site that has interesting information on a various number of surgical topics from various fields. Blogs can also be accessed directly from societies, such as the American Board of Cosmetic Surgery, which offers a blog filled with interesting questions directed not only to patients, but also to those interested in entering this field. Sauer et al. described their experience with using password protected blogs as a communication tool to share and discuss information for their research group<sup>17</sup> as a surrogate to face-to-face research meetings, which can be time consuming. For a learner, having the opportunity to read and learn from other surgeons around the world is an invaluable learning tool, one that would not be possible without the creation of SoMe. Not knowing which blogs to follow can be overwhelming as they can be immersed in a sea of other blogs, which is why microblogging has been the go-to source for information amongst surgeons.

### **Microblogs <H3>**

Unlike traditional blogs, microblogs are a fast and convenient way to share information.

Microblogging sites, the most common being Twitter, have attracted both established surgeons and trainees with its short, 140 character messages. Although the “tweets” are by necessity brief, those skilled at manipulating the word limit to get their message across are often able to stimulate much discussion. Surgeons have turned to Twitter to disseminate valuable information pertaining to surgery, including videos, journal articles, up and coming research and events due to its immediacy. This highly interactive platform is the ideal setting for learners because they are continuously being exposed to new and relevant information, shared by experts in their field. Surgeons interact with other fellow Twitter colleagues, discussing common interests and creating an expanding network of fellow surgeons and followers from all over the world<sup>18</sup>. Not surprisingly, the more connected the individuals, the more influential they become. Surgical trainees can interact and learn from experts in the field who tweet and re-tweet about the gamut of topics in surgery. Moreover, it also has the opportunity for networking and triggering one-on-one discussions with other surgeons on the international scene. By utilizing twitter handles and hashtags such as @surgery and #surgery, respectively, it allows users to interconnect with others posting about the same topic, as well as to network with other surgeons. A recent prospective study used Twitter to educate surgeons on common infectious disease (ID) and antimicrobial use. Goff et al. created an online grand rounds using the hashtag #TwitterGrandRounds to engage surgeons. Pharmacists tweeted ID topics relevant to surgeons, and tabulated impressions and engagement over a 3-month period. Surgeons engaged in 72 tweets, retweeting 31 of them tabulating over 15,000 impressions. Moreover, 81% rated the presentation as excellent, with 77%

saying Twitter was relevant to their practice (Goff et al). This scenario is an excellent example of how Twitter provided real-time, useful, and practical education to surgeons.

Through the Twitter network, surgeons can share advice and videos, very often from the user's personal video library, about surgical procedures that can be seen by followers and used to learn new techniques. Re-tweeting material creates a sea of interconnected information that disseminates over the "Twittersphere" and can then be viewed by personal followers who may not have had access to the original tweet. It is a valuable experience, one that would not be possible without the power of Web 2.0 technology. More recently, surgical conferences have now turned to Twitter to spread knowledge by creating conference hashtags that disseminate into the Twittersphere and brings together a virtual audience, including those who are not physically at the conference. For instance, during a live panel discussion, a concomitant discussion can simultaneously be occurring on Twitter about the topic in question, raising interesting questions that can be seen and addressed directly by the panel<sup>19</sup>. Surgical societies and medical/surgical journals, most notably the Annals of Surgery using the handle @annalssurg, have also turned to Twitter to announce important events and broadcast their most recent publications using visual abstracts to summarize important findings in a graphically concise way. Access to these abstracts are made possible by searching the handle or hashtag pertaining to the search such as #visualabstract or @JSurgEduc (Journal of Surgical Education).

There are hashtag movements that are being created on Twitter to help surgical specialties conglomerate and share information pertaining to their field. The #colorectalsurgery movement, created in the last year by a group of colorectal surgeons, has gained momentum and popularity

and is growing at an exponential rate. Early statistics from the first 10 weeks since its launch demonstrated that the hashtag resulted in more than 5200 tweets from 823 global users, with nearly 17 million views<sup>20</sup>. By using this hashtag, other Twitter users can instantly be connected with a plethora of information pertaining to the field of colorectal surgery without having to search very far. A recent review by Wexner et al. looking at different uses of social media in colorectal surgery commented on its use in surgical education and its potential to change surgical training through the use of online discussions and journal clubs<sup>18</sup>. Colorectal surgeons from around the world are actively participating in this venture by using this hashtag to readily interact with others in their field as well as disseminate research and educate the general public in an instant<sup>18,21</sup>. Logghe et al recently reviewed the use of Twitter in colorectal surgery using popular hashtags and Twitter handles and agreed that its global access and endless discussions with experts and peers in the field offered many benefits to surgical education<sup>21</sup>. They also outlined other useful hashtags that are currently in use such as #SurgEd for topics related to surgical education and #SurgTweeting for anything related to surgery that the colorectal community can follow and learn from<sup>21</sup>. A similar movement is underway in plastic surgery with the #plasticsurgery movement that was created with the goal of disseminating evidence-based practice in plastic surgery<sup>18,22</sup>

Twitter also facilitates journal clubs. For example, the International General Surgery Journal Club (@IGSJC), started in 2014 by a group of academic surgeons, hosts monthly Twitter journal clubs to discuss recently published articles with a guest author who is also on Twitter<sup>19</sup>. The 2-day journal club allows anyone to follow the discussion by tracking the hashtag #IGSJC on Twitter<sup>19</sup>. This is a great opportunity for anyone who wishes to learn and either join or follow

the discussion, while learning about the topic in question. It is important to note that to be active on Twitter does not necessarily imply having to continuously tweet or re-tweet. Learners can simply “lurk”, as in follow threads of tweets without retweeting<sup>19</sup>, making this SoMe platform a valuable one for all levels of training.

### **Online communities <H3>**

A similar form of discussion is found in online communities created by associations such as the American College of Surgeons (ACS). Members of the ACS have the opportunity to access “ACS Communities” (<https://www.facs.org/member-services/communities>), where members can use this networking tool to connect, engage, and share information and best practices in real time, participate in dynamic discussions and ask advice, share experiences, exchange resources, and build professional relationships. This commodity is an invaluable asset in any physicians’ armamentarium.

## ***Video channels, podcasts and collaborative projects <H2>***

### **Video channels<H3>**

Video channels are very valuable teaching tools for surgeons. Video sharing sites such as YouTube, which has over 1 billion users, allow users to search and watch surgical videos that are shared by others in the field. With more than half of the YouTube views coming from mobile devices, these videos are available to watch at anytime and anywhere in the world<sup>23</sup>. One may argue that watching a video does not necessarily teach the tactile and practical skills required for a surgical procedure when compared to simulation, however it does provide the learner with the

opportunity to learn the cognitive aspect of procedures in a step-by-step approach, and provides important learning points pertaining to decision making and technical skill refinement.

Surgical trainees are expected to be well prepared prior to undertaking an operation and having access to this impressive video library allows learners to visualize and learn the key steps of a procedure at their own pace, with the ability to rewind or pause the video to capture important steps. Learners can revisit the steps of an operation as many times as needed until it is well understood without any time constraints or pressures that may arise in the operating room. This is key because this type of learning cannot be done live in the operating room. A survey by Rapp et al. evaluated surgical preparation methods of medical students, residents, and faculty and found that most respondents reported using videos as their preferred way of preparing for surgery with YouTube being the preferred source<sup>24</sup>. Moreover, many of the links to these videos are also shared through Facebook and Twitter, thus expanding the number of views. With any open source of education comes certain drawbacks, such as quality control of the viewing content that is often not peer-reviewed or referenced as well as failure to disclose the source of data<sup>25,26</sup>. Nevertheless, the power of video-sharing for learning is beneficial and well accepted by those who use online videos as part of their surgical education.

Fortunately, educators have found novel ways to overcome these drawbacks by creating specific channels that are designed by them, and including videos that have been screened and deemed as acceptable for educational purposes. YouTube has helped medical students learn anatomy by creating a Human Anatomy Education (HAE) channel as part of a problem-based learning program<sup>27</sup>. In surgery, the Advances In Surgery (AIS) channel ([aischannel.com](http://aischannel.com)) has gained

significant momentum within the surgical community. This interactive collaborate project offers the surgical community the “ultimate surgical training experience”, with open classrooms, specialty courses, live surgeries, and live congresses, bringing together surgeons and trainees from all over the world. Members can log in at no cost and actively participate from any part of the world, interacting with leaders and experts in the field who discuss current hot topics as well as teach surgical technique for new surgical procedures. The AIS channel is revolutionary in the way that it eliminates geographical barriers and brings together expert educators from around the world.

### **Podcasts <H3>**

Podcasts, a form of internet radio, have rapidly gained wide popularity and can play an important role in surgical education. They are a series of digital media files that are made available on the internet for download<sup>28</sup>. Podcasts pertaining to surgery such as *Surgery101* or *BehindTheKnife* are lectures at ones fingertips and are excellent resources for surgical trainees. As with all other SoMe platforms, podcasts allow for any time learning and can be accessed 24/7. The *BehindTheKnife* podcast is a collection of lectures that are meant to prepare surgical trainees for the high stakes American Board of Surgery In-training Exam (ABSITE) exam. This library of lectures is created by experts in the field and break down difficult topics in surgery that trainees may not be exposed to on a regular basis. In addition, much of the content provided in these podcasts is not found in textbooks, making them valuable learning tools. During their training, surgical trainees are expected to acquire surgical knowledge and podcasts can play a significant in helping to fulfill this goal.



### **Collaborative projects <H3>**

Collaborative projects are a very popular source of information amongst students. The most widely used, Wikipedia, is an online encyclopedia available in more than 290 different languages<sup>29</sup>. It consists of “wikis”, which are collaborative webpages where users can contribute and edit information in real-time, which facilitates the sharing of online information from any part of the world<sup>30</sup>. The few studies which have evaluated the role of wikis in medical education have shown a positive outcome. One study demonstrated how students at the University of Minnesota collaborated using wiki technology by editing their classroom notes to create an online medical textbook which generated over 1 million views<sup>31</sup>. Another study demonstrated that engaging students in problem-based learning using wikis helped them to learn about professionalism by creating a positive group dynamic, encouraging collaboration, and increasing confidence<sup>32</sup>. Wikipedia was ranked highest amongst students learning anatomy as the preferred website amongst all computer-assisted learning resources<sup>33</sup>. Established learned societies have realized the benefits “wikis” bring. For example, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) has created a “SAGES wiki”, where members can log into the SAGES webpage and access a valuable resource created by its members. Moreover, SAGES actively encourages its member to participate and contribute to the wiki by either creating a new topic, improving an existing topic, or participating in an online discussion about a specific topic. This astonishing resource is accessed by over 2500 people per month seeking information about minimally invasive surgery. Regardless of the level of training, this is a great educational tool that allows for knowledge acquisition of disease processes, as well as technical tips pertaining to an operation.

## ***Virtual worlds <H2>***

Virtual worlds are a computer-based, simulated multi-media environments designed so that users can ‘inhabit’ and interact via their own graphical self-representations known as avatars<sup>34</sup>. These avatars can interact with others and navigate in this online world that encourages social interaction and networking. Second Life (Linden Research, Inc, San Francisco, CA, <http://secondlife.com>), created by Linden Lab, is one of the most popular 3D virtual worlds and has attracted attention and infiltrated itself into the field of surgical education. Patel et al. from the Imperial College in London created a virtual world using Second Life to help novices become more familiar with the operating room environment. They randomized a group of 60 novices to 4 intervention groups (control, didactic lecture, Second Life environment, and a simulated operating room) and found that all novices outside of the control group had significantly higher behavior, skills, and knowledge scores. The Second Life virtual world was well accepted and had the advantage of being easily accessible from any computer at any-time, without the need for educators to be present and training could be repeated as many times as needed until the learner felt confident of the lesson learned<sup>35</sup>. Another study by Cohen et al. looked at the feasibility of using virtual environments to train hospital clinicians in emergency response preparation using 3 scenarios. Ninety-five percent of their participants expressed a desire to use virtual environments for future training but, most importantly, they felt that this virtual environment allowed them to experience scenarios that would be inaccessible in real-life<sup>36</sup>. Another study assessed the performance of surgical trainees at different levels of training and attending surgeons during the management of three common general surgery scenarios (lower gastrointestinal bleeding, acute pancreatitis, and small bowel obstruction) using Second Life. They demonstrated high face and content validity for the performance among different

groups, with the attendings scoring the highest, showing that virtual worlds can also be used as a form of assessment in surgical education<sup>37</sup>. Despite this impressive work, virtual worlds have not yet been shown to be more effective than other immersive experiences and the issue of cost is one to consider given the developers, technicians, and faculty required to create these scenarios<sup>38</sup>. Regardless, this is a promising venture that adds innovation to surgical education.

### *Social networking sites <H2>*

Social networking has become part of our daily lives and with a generation of “digital natives” on the rise, there is no doubt that they will naturally turn to these sites for information. There are many social networking sites that are created for different purposes so that users can engage in either general (i.e. Facebook), professional (i.e. LinkedIn), medical (i.e. Doximity) or research (i.e. ResearchGate) interactions<sup>39</sup>. According to the Pew Research Statistics Center, 79% of adults who are online use Facebook, 76% of whom access the site daily<sup>3</sup>. A recent survey of emergency residents and faculty found that there is a discrepancy between the different patterns and interests in the personal and professional uses of SoMe<sup>40</sup>. Resident were more likely to use SoMe for personal interactions with friends and family or for entertainment, with Facebook topping the charts with 86% usage<sup>40</sup>. Also, within the surgical community, the ACS conducted a survey and found that 55% of respondents used Facebook<sup>41</sup>. Despite the popularity of these sites, social networks are not well studied and used in the field of surgical education<sup>39</sup>. Trainees are turning to social networking sites to access information related to residency programs, society and journal site pages, and connect with others in their field, building a sense of community with others who share similar interests. The educational value behind these sites lies in the interactions that are created, discussions that are initiated, as well as content that is shared (such

as videos and journal articles) among users. Private or closed groups on social networking sites are platforms that require access by password or by invitation. These closed groups can be used as a forum for discussion for all levels of medical education as well as faculty development programs<sup>39</sup>. For example, the International Hernia Collaborative (IHC) is a closed Facebook group created by hernia expert Dr. Brian Jacobs from New York City, that joins surgeons, or anyone interested in the topic, from around the world to discuss or debate interesting issues or collaborate on difficult cases pertaining to hernia surgery<sup>42</sup>. Participating in this group offers a unique educational opportunity that cannot be found in any textbook, as well as the privilege of engaging in discussion with experts in the field while maintaining patient confidentiality. Without SoMe technology, this would be very difficult to pursue. ResearchGate's mission is "to connect the world of science and make research open to all"<sup>43</sup>. By participating in this site, researchers of all levels have the opportunity to expose their work on the international scale and build relationships and connections with others who share the same interests. Prior to SoMe, the only access to a journal article was to it read from a print copy of the journal or by hearing about it at a conference during lectures or in discussion with colleagues. With the advent and use of social networking, published research is quickly exposed and shared, which benefits the authors as well as the readers who use it as a source of learning. LinkedIn is a professional networking site that allows others to view your resume and facilitates professional networking and communication<sup>18</sup> with others. It also offers a publishing platform where users can "blog" about important topics and share their commentaries about articles or events, adding an educational component to the LinkedIn experience.

## ***Mobile applications <H2>***

The use of mobile applications, better known as mobile “apps”, is growing with the increasing use of smart phones and tablets. These mobile apps are available through a variety of app stores and, according to Statista.com, there were 2.2 million available apps on the Google Play store and 2 billion apps available in the Apple’s App Store as of June 2016. Educators are teaming with graphic designers and gaming experts to create apps aimed to teach surgical trainees a variety of procedures. One example is the Touchsurgery app (<https://www.touchsurgery.com>), designed and developed as a sophisticated virtual simulation tool, that claims to empower and connect the global surgical community by having users “Practice surgery anytime, anywhere”. This app is available in 226 countries with over 1 million users who can practice over 50 surgical procedures in over 10 surgical specialties. Moreover, it provides an assessment tool that evaluates knowledge and tracks progress, which is an important component for learning. In addition, it has the capacity to connect with physicians all over the world through discussion boards, and who are available to answer questions and share knowledge. Another example is the iLappSurgery app (<http://www.ilappsurgery.com>), created to target surgeons at all levels of training who wish to learn advanced techniques in the field of laparoscopic surgery. By using the iLappVIP app, surgeons navigate through modules using visual educational material including detailed medical illustrations, 3D-animations, and colorized video excerpts to demonstrate key concepts and reach out to experts from around the world who can comment and offer guidance for every procedure. This high tech tool offers a model of mentorship and communication amongst peers and guidance to surgeons learning new techniques. Learning a new surgical skill is already challenging as surgeons need to juggle their knowledge with their technical skills, perhaps with the help of another colleague, at most. With these new groundbreaking applications, surgeons have the opportunity to reach out to colleagues and experts in the field

who can provide feedback and technical pearls pertaining to a specific operation. In addition, training on these virtual simulators will likely boost confidence and ideally help improve surgical outcomes, given that surgeons will be better prepared when entering the operating room. Without the power of social media, this level of knowledge sharing would not be possible.

### **Is SoMe an effective educational tool? <H1>**

The use of SoMe in surgical education is still in its infancy but is starting to gain popularity as SoMe sites that offer tools for better communication and networking expand. There is still a paucity of evidence related to the use of SoMe as a viable arena for learning surgical techniques, however creative ways in which SoMe can complement surgical education are being explored and developed. Videos and virtual worlds play the most important roles in surgical skills training as they provide visual material that can be the basis for learning. For instance, a junior resident who is preparing for a first laparoscopic cholecystectomy can turn to YouTube or other video sharing sites and search for “how to perform a cholecystectomy” and be immediately presented with a multitude of narrated videos from which to choose. Trainees can use a step-by-step approach to learning and review. As described above, virtual worlds are the closest forms of simulation available using SoMe. Trainees immerse themselves into a virtual world and navigate through virtual reality scenarios where they have the freedom and ability to mistakes without any harm to the patient or liability. This safe environment allows trainees to push their limits without the real-life pressures of the operating room.

Although SoMe is still in its infancy in the world of surgical education, there is a significant amount of work describing its effectiveness in medical education. In order to increase the

effectiveness of SoMe sites in surgical education, educators must be consistent in integrating them into their teaching models such as creating closed groups or blogs where trainees are expected to participate or prepare a series of videos to review as part of a peer-reviewed library where trainees can confidently watch and learn. Moreover, having a moderator or a designated monitor to oversee the activity taking place of the SoMe site is the ideal situation as trainees can comment and get feedback for an optimal learning experience<sup>44</sup>. Since SoMe provides the opportunity for “anytime learning”, it can be used to fill in the educational gaps created by busy schedules and allows for self-regulation of knowledge to accommodate a variety of learning types. SoMe is easy to use and inexpensive, making it an attractive learning vessel. Specifically, the younger generation of trainees, who will be the surgeons of the future, are already well versed and immersed in the SoMe world and do not require any formal training on its use.

### **Does SoMe serve another role? <H1>**

Social media is here to stay. It has been incorporated into virtually every part of our lives and as we learn more about its potential use in medical and surgical education, we continue to unveil other applications for this sophisticated tool.

The idea of education through SoMe in low income countries is one to consider given that access to technology, equipment, and internet is growing throughout these parts of the world<sup>45</sup>. Low-income countries with medical schools can benefit from the use of SoMe to connect with the rest of the world, have access to conferences that they are unable to attend, as well as discuss cases with colleagues or experts in the field. For instance, a study of the use of mobile phones by resident physicians in Botswana, Africa showed that access to smartphones with email and web-

access were effectively used to engage self-directed learning at home<sup>46</sup>. Okrainec et al. created a telesimulation program using simulators, computers, webcams, and Skype™ software to teach the Fundamentals of Laparoscopic Skills (FLS) tasks to teach and proctor 16 surgeons in Botswana. They showed that remote telesimulation is an effective as well as cost-effective method for teaching laparoscopic skills<sup>47</sup>. There is still much progress needed to be made with regards to resources and infrastructure to support the use of SoMe in these parts of the world, however, the future is promising.

In addition to remote education, SoMe can also be a useful tool to provide feedback, which is an essential component to learning. Carter et al. looked at the effectiveness of providing online feedback to trainees regarding robotic simulator performance and technique. Fifty-three participants were randomized into a control group and an intervention group, where they used the “Google plus” social networking site to upload their recorded robotic simulator session. All intervention subjects gave blinded feedback regarding peer performance and received feedback on their own training session using open commentary and a structured skills assessment form. They found that those getting feedback were more comfortable with robotic surgery and, within the intervention group, 85% found peer feedback useful and 100% found it effective<sup>48</sup>. Another study used a mixed methods approach of qualitative methods and questionnaires to see whether Wiki and Facebook were effective platforms for peer feedback in a group of higher education students. Results showed that students benefited while engaging in the peer feedback process on both SoMe sites and incorporation of these tools as a peer feedback vessel improved critical thinking skills and materials produced<sup>49</sup>.



There is no doubt that feedback plays an important role in learning and skill acquisition. However, it is a step that is often overlooked in surgery. Reasons for this may include lack of time or unfamiliarity with best practices for giving feedback. Social media is an ideal platform since it is accessible at any time and allows for feedback providers (experts or peers) to immediately share “tips and tricks” through videos, articles, and other media, to help the learner. In a recent education article looking at the evolution of surgical training, Chand and Qureshi described the importance of “surgical replay”. This concept is based on the effectiveness of film study used by professional athletes who use video to breakdown and review their performances with a mentor, expert, or “coach” who provides ongoing feedback<sup>50</sup>. The act of reviewing a video and dissecting out areas of strength and weakness allows the learner to visualize their actions and learn from their mistakes. This tedious yet crucial process is often neglected in surgical training because of time constraints and availability. Social media can facilitate this exercise such that trainees can share their videos and practice “surgical replay” with other surgeons or experts in their field, using video sharing and live commentary. Although no specific program is currently created specifically for this purpose, program directors and teaching surgeons can arrange for this to take place at their own convenience, from the location of their choice. Perhaps eventually this practice will develop into a peer-reviewed exercise that is required in surgical training and incorporated into competency-based education.

## **Conclusion <H1>**

Given the many SoMe platforms and the rate at which sites are created, there will certainly be more exciting developments in the field of education. Social media developers continue to create and expand their SoMe sites providing an abundance of tools that can certainly be explored in

surgical education. As the influx of surgical trainees who grew up in the millennial generation enter surgical specialties, educators will have to turn to SoMe to cater to their learning needs and eventually incorporate these sites as an integral part of medical and surgical education. As technology becomes more sophisticated, so will surgical education.

## References

1. Center PR. Internet/Broadband Fact Sheet. 2017; <http://www.pewinternet.org/fact-sheet/internet-broadband/>. Accessed 12 February 2017.
2. Center PR. Mobile Fact Sheet. 2017; <http://www.pewinternet.org/fact-sheet/mobile/>. Accessed 10 February 2017.
3. Center PR. Social Media Update 2016. <http://www.pewinternet.org/2016/11/11/social-media-update-2016/>. Accessed 10 February 2017
4. Hillman T, Sherbino J. Social media in medical education: a new pedagogical paradigm? *Postgrad Med J*. 2015;91(1080):544-545.
5. Cognitivism. <https://www.learning-theories.com/cognitivism.html>. Accessed 10 February 2017.
6. Ertmer PAaN, T.J. . Behaviorism, Cognitivism, Constructivism: Comparing Critical Features From an Instructional Design Perspectiv. *Performance Improvement Quarterly*. 1993;6(4):50-72.
7. Evgeniou E, Loizou P. The theoretical base of e-learning and its role in surgical education. *J Surg Educ*. 2012;69(5):665-669.
8. Tedman RAaT, D.K. Introduction to the Evolution of Teaching and Learning Paradigms. *Studies in Computational Intelligence (SCI)*. 2007;62:1-6.
9. Siemens G. Connectivism: A learning theory for the digital age. . *International Journal of Instructional Technology and Distance Learning*. 2005;2(1):3-10.
10. Downes S. New technology supporting informal learning. *Technologies in Web Intelligence*. 2010;2(1):27-33.
11. Schlitzkus LL, Schenarts KD, Schenarts PJ. Is your residency program ready for Generation Y? *J Surg Educ*. 2010;67(2):108-111.
12. Mattar SG, Alseidi AA, Jones DB, et al. General surgery residency inadequately prepares trainees for fellowship: results of a survey of fellowship program directors. *Ann Surg*. 2013;258(3):440-449.
13. Cheston CC, Flickinger TE, Chisolm MS. Social media use in medical education: a systematic review. *Acad Med*. 2013;88(6):893-901.
14. Evans CH, Schenarts KD. Evolving Educational Techniques in Surgical Training. *Surg Clin North Am*. 2016;96(1):71-88.
15. Ventola CL. Social media and health care professionals: benefits, risks, and best practices. *P T*. 2014;39(7):491-520.
16. Topf JM, Hiremath S. Social media, medicine and the modern journal club. *Int Rev Psychiatry*. 2015;27(2):147-154.
17. Sauer IM, Bialek D, Efimova E, Schwartlander R, Pless G, Neuhaus P. "Blogs" and "wikis" are valuable software tools for communication within research groups. *Artif Organs*. 2005;29(1):82-83.
18. Wexner SD, Petrucci AM, Brady RR, Ennis-O'Connor M, Fitzgerald E, Mayol J. Social media in colorectal surgery. *Colorectal Dis*. 2016.
19. Ferrada P, Suliburk JW, Bryczkowski SB, et al. The surgeon and social media: Twitter as a tool for practicing surgeons. *Bull Am Coll Surg*. 2016;101(6):19-24.
20. Chapman SJ, Mayol J, Brady RR. Twitter can enhance the medical conference experience. *BMJ*. 2016;354:i3973.

21. Logghe HJ, Pellino G, Brady R, McCoubrey AS, Atallah S. How Twitter has connected the colorectal community. *Tech Coloproctol*. 2016;20(12):805-809.
22. Branford OA, Kamali P, Rohrich RJ, et al. #PlasticSurgery. *Plast Reconstr Surg*. 2016;138(6):1354-1365.
23. YouTube statistics. <https://www.youtube.com/yt/press/statistics.html>. Accessed 6 February 2017.
24. Rapp AK, Healy MG, Charlton ME, Keith JN, Rosenbaum ME, Kapadia MR. YouTube is the Most Frequently Used Educational Video Source for Surgical Preparation. *J Surg Educ*. 2016;73(6):1072-1076.
25. Clifton A, Mann C. Can YouTube enhance student nurse learning? *Nurse Educ Today*. 2011;31(4):311-313.
26. Al-Khatib TA. Surgical education on YouTube. *Saudi Med J*. 2014;35(3):221-223.
27. Jaffar AA. YouTube: An emerging tool in anatomy education. *Anat Sci Educ*. 2012;5(3):158-164.
28. Podcast. . <https://www.merriam-webster.com/dictionary/podcast>. Accessed 1 February 2017.
29. Wikipedias. Lo. [https://en.wikipedia.org/wiki/List\\_of\\_Wikipedias](https://en.wikipedia.org/wiki/List_of_Wikipedias), Accessed 24 January 2017.
30. Rasmussen A, Lewis M, White J. The application of wiki technology in medical education. *Med Teach*. 2013;35(2):109-114.
31. Thompson CL, Schulz WL, Terrence A. A student authored online medical education textbook: editing patterns and content evaluation of a medical student wiki. *AMIA Annu Symp Proc*. 2011;2011:1392-1401.
32. Varga-Atkins T, Dangerfield P, Brigden D. Developing professionalism through the use of wikis: A study with first-year undergraduate medical students. *Med Teach*. 2010;32(10):824-829.
33. Choi-Lundberg DL, Low TF, Patman P, Turner P, Sinha SN. Medical student preferences for self-directed study resources in gross anatomy. *Anat Sci Educ*. 2016;9(2):150-160.
34. Boulos MN, Hetherington L, Wheeler S. Second Life: an overview of the potential of 3-D virtual worlds in medical and health education. *Health Info Libr J*. 2007;24(4):233-245.
35. Patel V, Aggarwal R, Osinibi E, Taylor D, Arora S, Darzi A. Operating room introduction for the novice. *Am J Surg*. 2012;203(2):266-275.
36. Cohen D, Sevdalis N, Taylor D, et al. Emergency preparedness in the 21st century: training and preparation modules in virtual environments. *Resuscitation*. 2013;84(1):78-84.
37. Patel V, Aggarwal R, Cohen D, Taylor D, Darzi A. Implementation of an interactive virtual-world simulation for structured surgeon assessment of clinical scenarios. *J Am Coll Surg*. 2013;217(2):270-279.
38. Flowers MG, Aggarwal R. Second Life: a novel simulation platform for the training of surgical residents. *Expert Rev Med Devices*. 2014;11(2):101-103.
39. Madanick RD. Education Becomes Social: The Intersection of Social Media and Medical Education. *Gastroenterology*. 2015;149(4):844-847.
40. Pearson D, Bond MC, Kegg J, et al. Evaluation of Social Media Use by Emergency Medicine Residents and Faculty. *West J Emerg Med*. 2015;16(5):715-720.

41. Yamout SZ, Glick ZA, Lind DS, Monson RA, Glick PL. Using social media to enhance surgeon and patient education and communication. *Bull Am Coll Surg*. 2011;96(7):7-15.
42. Jacob B. Revolutionizing Surgery Through Worldwide Collaboration. 2016; <http://www.facebookstories.com/stories/99818/international-hernia-collaboration>. Accessed 10 January 2017.
43. ResearchGate. <https://www.researchgate.net/about>. Accessed 14 February 2017.
44. Blackmur JP, Clement RG, Brady RR, Oliver CW. Surgical training 2.0: How contemporary developments in information technology can augment surgical training. *Surgeon*. 2013;11(2):105-112.
45. Aronson B. Improving online access to medical information for low-income countries. *N Engl J Med*. 2004;350(10):966-968.
46. Chang AY, Ghose S, Littman-Quinn R, et al. Use of mobile learning by resident physicians in Botswana. *Telemed J E Health*. 2012;18(1):11-13.
47. Okrainec A, Henao O, Azzie G. Telesimulation: an effective method for teaching the fundamentals of laparoscopic surgery in resource-restricted countries. *Surg Endosc*. 2010;24(2):417-422.
48. Carter SC, Chiang A, Shah G, et al. Video-based peer feedback through social networking for robotic surgery simulation: a multicenter randomized controlled trial. *Ann Surg*. 2015;261(5):870-875.
49. Demirbilek M. Social media and peer feedback: What do students really think about using Wiki and Facebook as platforms for peer feedback? *Active Learning in Higher Education*. 2015;16(3):211-224.
50. Chand M, Qureshi T. Evolution in surgical training: what can we learn from professional coaches and elite athletes? *J R Soc Med*. 2014;107(7):290-292.