Review Article

Teaching through social media

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Abstract: Timely and widely available, social media (SM) platforms and tools offer new and exciting learning opportunities in medical education. Despite scarce, we sought for a body of consistent evidence allowing us to substantially approach the concept of SM and how physicians as learners and medical educators can use SM based-education to benefit their clinical practice and their patients' outcomes. We correlate education theories with the progression of world-wide web phases and how this influences the process of teaching and learning. We mention some examples of SM tools already in use in healthcare education. Potential advantages and effectiveness SM in medical education, as well as limitations of SM and pre-requisites for its use are discussed. Our concluding remarks underline the good practices in effectively utilizing SM in healthcare education.

Keywords: Medical education; continuing professional development (CPD); continuing medical education (CME); social media (SM); self-determined learning; heutagogy

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Introduction

The use of social media (SM) in medical education and clinical practice is rapidly evolving. In the current educational landscape, we describe the incorporation of SM applications in medical education. Recognizing its increasing relevance albeit scarce robust evidence, we sought to consistently approach the concept of SM and how physicians as learners and medical educators can use these tools to benefit their clinical practice and their patients' outcomes. We correlate education theories with the progression of the web phases and describe how this influences medical educators, curriculum design and learner skills. We discuss categories of tools with examples in current practice, expected benefits and effectiveness of SM in medical education, potential downsides, and requirements for effectively incorporating SM in medical education. Our concluding remarks underline the good practices in effectively utilizing SM in healthcare education. Although we consider the continuum of medical education, we place greater emphasis on continuing professional development (CPD) as this is the largest audience of learners and covers many years of professional practice.

Complex learning environments and the role of the internet

The healthcare workforce moves in complex systems and learning environments characterized by heavy and ever changing information load, fast-paced delivery, increasing duty hours with less time for formal classroom-based learning, and increasing scrutiny of cost/benefit of "classical" continuing education in venues as conferences and congresses, usually delivered by experts in content often with little or no background in educational strategies (1).

Internet-based technologies have wide reach and offer

the potential to deliver cost-effective, personalized medical education. SM refers to internet-based tools that allow individuals and communities to gather and communicate (2). Also designated as "Web 2.0" or "social networking" these internet-based tools facilitate networking to search, share and store knowledge through online collaboration, interaction, and discussion, sometimes in real time. Overall in 2019 there are 3.5 billion active SM users, and 93% of these are mobile SM users, accessing SM using smart phones (3). Facebook is the most popular social network worldwide and in April 2019 had 2.32 billion monthly active users. Instagram allows users to share images, audio and video, and in April 2019 had 1 billion monthly active accounts (4). Although SM is considered a phenomenon of the millennial generation or Generation Y (born 1980–2000), more than 35% of "Facebookers" are older than 35 years old (5), and users older than 65 years are the fastest growing cohort (3).

SM in medical education

SM use has been rapidly adopted by medical professionals (6). Estimates are that 45–90% of medical students, residents and fellows use SM for several purposes, 67% of practicing physicians use Twitter and 48% of them use Facebook (7). The vast majority of academic physicians are predominantly "digital immigrants" who were born before the digital technology era. On the other hand, postgraduate trainees, the most junior members of the medical profession, and medical students, the soon-to-be members, are Millennial, Gen X and Gen Y "digital natives" who have grown up using SM integrated in their lives (8,9).

SM, including mobile learning, has also been adopted as a tool for CPD (10-12). Wang and associates surveyed a population of practicing physicians who had attended a continuing medical education (CME) course. Their positive attitudes on using SM in CME led the authors to conclude that CME course directors should guide SM strategies towards youthful, technology-savvy CME participants as they increasingly enter into their professional healthcare lives (7).

SM tools in medical education may be grouped by function (*Table 1*) and include social networking (Facebook, Google Plus, Twitter), professional networking (LinkedIn), media sharing (YouTube, Vimeo, Instagram), microblogs (Twitter), knowledge aggregation [wikis, free open access medical education (FOAM)], and gaming environments. Each of the SM tools has advantages and disadvantages (28).

Some authors also consider learning management systems or virtual learning environments such as Blackboard and Moodle, and collaborative document writing such as Google Docs, to be categorized under the broad category of SM, but these are omitted from our review. Preferred sites can change rapidly (e.g., the demise of Myspace) and vary between age groups; for example, younger people are thought to favor Instagram and Snapchat, whilst older users prefer Facebook (2).

Education theory and development of the internet

An interesting correlation between the progression of the web in response to the users' needs and educational theories can be drawn (29).

Education 1.0 and Web 1.0: a cognitivist and pedagogical approach to learning. One size fits all

Education 1.0 is based on three "Learners Rs": they receive by listening, respond by taking notes and regurgitate by taking the same assessments of their cohort (30). All alike, learners are receptacles, and educators provide information. This is a one way, didactic, teacher-directed (Pedagogy) educational format transferred to the student by the teacher (instructivism, cognitivism, behaviorism) aiming at instilling all learners with essential or basic academic knowledge and skills (essentialism). Similarly, Web 1.0 is the "read-only" web, a one-way source of information (31).

Education 2.0 and Web 2.0: knowledge builders and a constructivist and andragogical approach to learning

Education 2.0 focuses on three Cs—communicating, contributing, and collaborating (32). Learners are encouraged to interact with the content by commenting, remixing, sharing via social networks and re using in different contexts and additional purposes. Its foundations lie in humanistic roots (33) and emphasizes the human element and the social context (32,34) in the process of learning and teaching.

Web 2.0 or "read-write web" fosters interactivity among learners, and between learners, educators and content (31). Education 2.0 uses Web 2.0 technologies and tools to enhance project-based and inquiry learning, collaborative learning, global learning projects, Skype in the classroom, and shared wikis, blogs and other social networking in the

Table 1 Current social media tools used in medical education grouped by function, with specific examples

Function	Current social media tools	Examples
Social networking (13)	Facebook	Facebook communities (e.g., medical quizzes of the New England Journal of Medicine, Radiology signs and Radiopaedia), including medical quizzes with extraction and identification of users' responses (14)
	WhatsApp (15)	Google+ circles are subgroups within the users' SM community
	Google Plus	Massive open online courses (www.mooc.org/) on-line learning communities (16)
	Twitter	Evidence-based tweeting: tweeting peer-reviewed publications' references by including the URL links to PubMed articles (17)
Professional networking	LinkedIn	Professional profile site
		Allows professional networking
Media sharing	YouTube	Eyetube collection of categorized surgical videos, podcasts of latest trend in eye surgery and interviews with key opinion leaders (https://eyetube.net)
	Vimeo	
	Instagram	
Blogs, microblogs (indexed using hashtags)	Twitter (18,19)	Share clinical teaching points
		Disseminate evidence-based medicine
		Disseminate daily curriculum (20)
		Live retweeting during conferences
		Moderated twitter chats (e.g., #meded weekly chat)
		Journal clubs (21)
		Blogs associated with journals (e.g., http://journalsblog.gastro.org)
Knowledge aggregation (edited by anyone with access)	Wikis	Free open access medical education [FOAM (22)]
		EyeWiki hosted by the American Academy of Ophthalmology (https://eyewiki.aao.org/Main_Page)
Gaming environments	Second Life	Users interact through virtual representations of themselves [avatars (23)]
	Serious games in health care (24,25)	Gamification as a method of teaching new skills (26,27)

SM, social media.

classroom. These platforms and tools suit the rationale of Education 2.0.

While facilitating learning, the educator still develops learning activities and remains the learning orchestrator. Learning experiences should comply with principles of adult learning (Andragogy) such as active, experiential, authentic, relevant learning providing procedures and resources to learn how to learn (Constructivism). The educator should create engaging learning environments allowing shared planning upon learning needs diagnosed to formulate directed goals and objectives aligned with content, and evaluate outcomes (35). Learning experiences provide multiple representations of reality to reflect the complexity of the real world and prize knowledge building over knowledge reproduction. Learners experience authentic tasks in meaningful contexts and are encouraged to collaborate among themselves, to activate their prior knowledge, to reflect and accommodate new learning within their personal unique knowledge structure (35).

Education 3.0 and Web 3.0: self-determined learners, heutagogy, and connectivism

The central three Cs of Education 3.0 are connecting,

creating and constructing. Education 3.0 differs from Education 2.0 by emphasizing self-determined learning, rather than learning facilitated by the educator (32). Learners create their knowledge by driving, authoring and assessing their own learning experiences. Self-determined learners develop a "free-agent learner" profile to create personalized learning environments and experiences. Being already skillful in informal learning by interacting with the web they adapt daily used tools to meet their personal learning needs independent of the educational venue, content, source and process (de-institutionalized learning). Learners become mentors, educators, and role models among themselves and share effective learning strategies. The role of educators shifts to that of mentors. Educational, social, technological and legal components influence the process of learning and teaching in Education 3.0 (29).

Education 3.0 embodies a heutagogical (36,37) and connectivist approach in the process of teaching and learning. Particularly for adult learners, heutagogy recognizes learners as autonomous, capable and self-efficacious, in summary, self-determined. Open, multifaceted, learner-centered, widely familiar and ready to use Web 2.0 tools and resources scaffold the heutagogical and connectivist learning environment, nurturing self-driven learning. Self-determined learners master their learning pathway and generate content with added value to the field of study.

Web 3.0 is the "read-write-execute" web (31). It makes use of semantic markup (data interchange formats) that enables software applications to understand information, speak to each other and to interpret information for humans (34). Based on self-browsing history, each individual has a unique Internet profile, which can be used by Web 3.0 to tailor future browsing experiences (31) by providing free, relevant, ready to use, interactive and networked personalized content based on individual interests.

This new approach to learning puts emphasis on creating deep, broad, and global connections, which has been described as connectivism (38). Learners enhance their capacity to know more using their ability to nurture connections and to devise links between fields, ideas and concepts. Decision making in what to learn is itself a learning experience.

Evolving role of educators

To take full advantage of SM in medical education, the role of educators must evolve. Education 1.0 educators assume a central role in the process of teaching and learning, delivering the essentials in the same manner to all the students regardless of their interests or previous experiences. Learning is dictated and occurs in classical classroom venues. Learners are dependent and have few resources of their own to learn sequentially.

In Education 2.0 learning environments, educators become facilitators. Educators are no longer required to control all variables and can adapt methods and choose tools and resources to better meet learners' needs. Teaching is social, progressively constructed (educator to learner and learner to learner) and uses digital social applications. Learning venues can be in a building or on-line.

In Education 3.0 educators, learners, SM tools, resources, processes and connections become one entity potentially capable of meeting individual learners', educators', and societal needs. Teaching occurs in a co-constructivist system embracing the multiple bidirectional relations among educators, learners, ideas and technology. The role of educators is to develop learners' capability in learning and to develop and apply their competencies in novel situations. Learners choose their educators, manage their own learning, decide and lead their own learning path. The educator is challenged to innovate and should become a connected learner with the responsibility to be a connected educator, which is the first step towards learner-driven learning (39).

Learners' skills in Education 3.0

Learners in the new environment need to develop: (I) critical thinking and problem-solving skills; (II) collaboration across networks and leading by influence; (III) agility and adaptability; (IV) initiative and entrepreneurialism; (V) effective oral and written communication; (VI) accessing and analyzing information abilities; (VII) curiosity and imagination (40). Gerstein further adds grit, resilience, hope and optimistic vision, self-regulation, empathy and global stewardship as necessary skills (30).

Incorporating SM into medical education

Whyte and Hennessy developed a systematic review on how to effectively use SM in medical education. Their literature search informed the construction of a validated questionnaire on three factors: (I) most effective platforms and their purposes; (II) SM benefits to teaching, and (III)

students' understanding on the benefits/disadvantages of academic SM platforms. The review acknowledges the value of SM, with an emphasis for Facebook and Twitter, if used appropriately. SM has shown the potential to enable virtual learning communities and personal learning environments, to assist educators in expanding learning environments beyond the classroom, nurture a culture of continuous learning and promote learners' autonomy and self-efficacy (41). Similarly, to incorporate SM into medical education, Kind and Patel recommend to: (I) define your goals; (II) match with appropriate tools; (III) know your community; (IV) share interaction guidelines; (V) keep patient information confidential, and (VI) share evidence-based information (42). To do this, educators need to understand the strengths and weaknesses of the various SM tools, and the use of SM tools in specific situations such as small group learning. Throughout, educators must be role models for appropriate use of SM (discussed below).

Advantages of SM in medical education

The strengths of SM tools include familiarity, accessibility, the ability to personalize user profiles, interactivity between individuals (formation of learning communities), extending the educational moments beyond in-person learning events to incidental learning, and reaching geographically remote and underserved communities.

Proposed advantages of SM in medical education include reflective writing, knowledge sharing, shared problem solving and peer-to-peer teaching (43,44). Learners may also generate new content to demonstrate their new learning. SM may also preferentially engage the millennial learner.

Effectiveness of SM in medical education

SM is becoming integral to evolving educational methods, however evidence of its effectiveness in medical education is weak, with at best outcomes expressed at a satisfaction level, and limited data on learner performance (43,45-47). Limited data supports incorporation of SM into medical education to foster interactivity (44).

There is also limited evidence on the role of individual SM tools. Twitter is the most frequently used platform to promote conference themes (via hashtags) and research content. Sterling *et al.* found the majority of studies on twitter were exploratory and used hashtags to analyze the frequency with which conference attendees accessed the platform and not its effect on learning (45). A systematic review of Twitter-based journal clubs concluded that these are free, time-efficient and publicly accessible means to facilitate international discussions regarding clinically important evidence-based research, but was not able to review the effect on learning (21).

Regarding SM in CPD, Flynn *et al.* concluded that SM has a modest impact on driving traffic to evidence-based CME options. Compared to other SM platforms and email, Facebook showed the best result on driving physician web traffic to evidence-based CME (48). McGowan *et al.* showed SM applications to be an efficient and effective method for physicians to keep up-to-date and to share newly acquired medical knowledge with other physicians within the medical community and concluded that further studies are necessary to examine the impact SM on physicians' knowledge, attitudes, skills, and behaviors in practice (49).

Risks and barriers to using in SM in medical education

Many risks in use of SM in medical education have been described. These are detailed in *Table 2* and include poor quality of information, damage to professional image, breaches of patient privacy, violation of the doctor-patient boundary, breach of regulatory standards and legal issues. These risks can be lessened by following codes of good conduct (recommendations follow).

It is important to note that although educators are aware of the advantages of incorporating SM into medical education, there is a lag in uptake. Barriers to uptake of SM in medical education are shown in *Table 3*, and include concerns regarding the educational value of material, professionalism, educator barriers, learner barriers, technological limitations and organizational barriers (11,53). Many of these barriers are similar to those occurring in self-directed CPD (54).

Potential negative health impacts are described for SM usage, with an association between increased use of SM and increased levels of anxiety and depression in young adults (55,56).

The significant risks and barriers associated with SM in medical education clearly indicate that training of learners and educators is needed to effectively incorporate SM into medical education.

Good practice guidelines

Many health care organizations and professional societies

Table 2 Risks associated with using social media in medical education (2,50,51)

Category	Comments, examples
Poor quality of information	Authorship may not be identified
	Date of writing may not be specified
	Hierarchy of evidence is not applied
	Information may not have been peer-reviewed
	No mechanism to refute incorrect information
	Declarations of interest may not be declared
Damage to professional image	Damage to image of learners, educators and institutions
	Posts are searchable by peers, patients and potential employers (into the indefinite future)
	Users self-report posting unprofessional content (52)
Breaches of patient privacy	All jurisdictions have relevant privacy laws that apply to SM
	Users need to be aware of privacy settings in SM tools
Violation of doctor-patient boundary	"Friending" patients on SM is inappropriate
Breach of regulatory standards	Medical regulators have relevant standards applying to SM use
Legal issues	Jurisdictional Freedom of Speech laws may apply
	All posted material is discoverable in legal cases
	Responses on-line may constitute medical advice for which the poster is deemed to take professional responsibility

SM, social media.

develop guidelines for appropriate use, for example the Australian Health Practitioner Regulation Agency (57).

Learning and role modeling good SM conduct should happen across the medical education continuum (58). SM guidelines can embed "offline" in-person settings useful models and should recognize platforms learning opportunities and challenges as more research substantially informs the idea of heutagogy as a theory of online and distance education (59,60). In its essence, heutagogy encapsulates self-determined learning and acknowledges CPD educators with competencies going beyond the cognitive component or medical knowledge to embrace others as learner centeredness, interpersonal and communication skills, professionalism and role model, reflective practice and system-based practice. Program design and implementation, program evaluation, leadership and mentorship/coaching are relevant competencies to develop by those also involved in curriculum development (61,62).

Guidelines for appropriate use are shown in *Table 4*.

Conclusions

Undergraduate, postgraduate and CPD programs and systems across specialties are increasingly using SM platforms for education, choosing online tools according to their specific applications. Incorporating SM tools and methods in medical education is thought to facilitate interactivity and engage learners in their own lifelong learning. Strengths of SM include wide accessibility and personalized user profiles that allow targeting specific audiences, encourage self-determined learning and self-efficacy, improve learning effectiveness, cost-benefit and bring the sense of accomplishment and satisfaction to the community of learning. On the other hand, SM platforms are associated with potential risks including particularly professionalism and breaches of the patient-physician relationship and patient confidentiality. SM sites and platforms offer very interesting and useful opportunities to promote individual and public health, and advance professional development as long as good practices are observed.

Table 3 Barriers to use of social media in medical education (11,42)

Category	Comments, examples
Educational value	Educational value in teaching has not yet been fully established
	Content quality is variable and may not have a reliable source
	Lack of feedback provided to learners
Professionalism	Users consider that SM use may be viewed as unprofessional by peers, patients, institutions and regulators
Educator barriers	Lack of knowledge and experience in SM use
	Lack of enthusiasm for SM use
Learner usage	Learners may prefer face-to-face instruction
	Lack of knowledge in SM use
	Learners may have preferences for specific SM tools
	Time constraints
Technological	Websites may not work with mobile devices
	Slow internet access
	Cost of apps can be high
	Organizational policies may prohibit accessing SM or downloading internet material at work
Organizational	May not have appropriate policies in SM use
	Culture may not value SM
	Lack of resources dedicated to IT and SM

IT, information technology; SM, social media.

Table 4 Common guidelines for the use of social media in medical education, with reflective questions to promote guideline usage [adapted from (2,59,63)]

Context	Guidelines	Reflective questions
Content credibility	Share only information from credible sources	Is user generated content valid?
	Include PubMed links to reference material	
	Post only to credible and/or curated websites	
	Refute any inaccurate information you encounter	
	Use a respectful tone when discussing patients	
	Avoid negative posts and personal conversation	
Legal concerns	Remember that the content you author may be discoverable	Which freedom of speech legislations applies to me?
	Appropriately cite your sources	What are the SM platforms capabilities in use?
	Comply with relevant privacy laws	
	Comply with current copyright laws, which may be rapidly evolving	
Medical Licensing concerns	Comply with requirements of medical license regulators, for example the use of patient testimonials	What are the guidelines and professional by-laws in my jurisdiction applying to interact online with the public?

Table 1 (*continued*)

Table 1 (*continued*)

Context	Guidelines	Reflective questions
Networking practices	Do not contact patients with requests to join your network	Is professionalism an identity or a persona?
	Direct patients who want to join your personal network to your website or a more secure means of communication	How much self-disclosure is the right amount?
	"Self-audit" to assess the accuracy of information available on physician-ranking Web sites and other sources online	Is it possible to keep your professional and social selves "separate" online?
	Be aware that online postings may have future harmful or beneficial implications for your professional life	How to balance online networking impact?
	Control privacy settings on your SM tools	Should one delete one's "former versions" self-representation online?
		Will we become more accepting of personal growth and change online?
Patient privacy	De-identify all patient data with respect to person, place and time	How to maintain confidentiality?
	De-identify patient images	
	Obtain patient consent when required	
Personal privacy	Use the most secure privacy settings possible	What is the plan when patients request to connect on social media?
	Keep personal and professional profiles separate and behave professionally in both	What is the plan when asked medical questions online?
Professional ethics	Disclose any in-kind or financial compensation received	How accurate can online self-identification be?
	Do not make false or misleading claims	How far can we trust in a doctor-patient relationship developed on line?
	Preserve the relationship, confidentiality, privacy, and respect for persons	
Self-identification	Identify yourself on professional sites	Am I prepared to clearly identify myself?
	Make sure your credentials are correctly stated	Have I disclosed any possible conflicts of interest?
	Specify whether or not you are representing an employer	

SM, social media.

This is an interesting and emerging field of research in medical education and especially in CPD as there are few and modest quality studies pertaining SM in medical education that offer mixed results concerning learners' satisfaction and knowledge attainment. Further research is necessary to optimize the use of SM in medical education.

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