



Use of social media in anatomy education: A narrative review of the literature[☆]

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ARTICLE INFO

Article history:

Received 11 June 2018

Received in revised form 22 August 2018

Accepted 4 October 2018

Keywords:

Social media

Anatomy

Medical education

Undergraduate

ABSTRACT

Purpose: Although anatomy is a significant part of medical education, there is controversy surrounding the appropriate method of anatomy teaching. Although social media is used in medical teaching, it has not been clarified if social platforms could significantly influence anatomy education. The purpose of this narrative review was to investigate to what extent the existing literature supports that social media could play a significant role in anatomy education.

Methods: PubMed, Scopus, Web of Science, Cochrane database of systematic reviews, ERIC and CINAHL plus were searched for studies with a purpose to investigate the correlation between social media and anatomy education. The following data were received from each paper: authors, year, country, level of outcome according to Kirkpatrick hierarchy, type of study, purpose, material, methods, conclusion and findings that supported each conclusion.

Results: Nine papers were eligible for analysis. Four of them focused on YouTube, three on Facebook and two on Twitter. Most studies were non-comparative, all the papers evaluated participants' reactions and no study investigated if students' attitude or anatomy knowledge was influenced by social media. It was generally shown that social platforms could positively affect anatomy education. However, concerns about the educational value of YouTube videos were expressed.

Conclusion: The research so far about the use of social media in anatomy education is limited and lacks comparative studies. It was generally demonstrated that social platforms could positively affect anatomy education. However, further research is needed to investigate if social media could influence students' attitude or anatomy knowledge.

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[☆] This paper belongs to the special issue Medical Education 2018.

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1. Introduction

The knowledge of anatomy, according to specialists, trainees and medical students, plays an important role in safe clinical practice (Ahmed et al., 2010). Although anatomy is considered as a significant part in a medical education curriculum, there is controversy surrounding the appropriate method of anatomy teaching (Papa and Vaccarezza, 2013). Blended learning, which combines face-to face and online teaching strategies (Graham, 2006), is an instructional approach, which, according to Estai and Bunt (2016), is promising and can comprise the use of social media. However, in this study, no further analysis about the possible efficacy of the use of social media in anatomy education was performed. Also, according to Guimaraes et al. (2017), technology-based teaching strategies have become a common practice in anatomy education, as complementary methods to traditional teaching tools, but, although the authors mentioned that social media could be beneficial to anatomy teaching, no adequate evidence was provided to support this argument.

In addition, the review by Sutherland and Jalali (2017) about the use of social media for medical teaching purposes included three papers that dealt with anatomy. However, it was not clarified if the use of social networks could play an important role in anatomy teaching and learning. Furthermore, El Bialy and Jalali (2015) demonstrated that social networks could positively influence medical education, but the authors dealt with the use of social networks in medical education generally, without focusing on anatomy. Others authors who performed reviews of the literature (Cheston et al., 2013; Roy et al., 2016; Sterling et al., 2017; Hollinderbaumer et al., 2013) also investigated the use of social platforms for medical teaching purposes and did not shed light on anatomy education. Generally, it was not clarified by all the aforementioned studies if the use of social media could help anatomy education.

In this context, the primary aim of the present study was the investigation of the use of social networking sites in anatomy education so far, via a review of the literature, by answering the question: “To what extent does the existing literature support the opinion that social media could play a significant role in anatomy education?” The secondary aim of the present review was the investigation of possible geographical factors that could affect the outcomes of the studies that were included.

2. Material and methods

2.1. Search strategy

A search was performed in the following databases: PubMed, Scopus, Web of Science, Cochrane database of systematic reviews, ERIC and CINAHL plus. The key words were: (“social media” OR “social networks” OR “social networking” OR “Facebook” OR “Twitter” OR “YouTube”) AND “anatomy” AND (“education” OR “teaching” OR “learning”). The use of the key words “Facebook”; “Twitter” and “YouTube” was based on the popularity of these social networking sites. More specifically; Facebook is the most popular social platform; followed by YouTube and Twitter (Ebizmba, 2017). Sutherland and Jalali (2017) demonstrated that Facebook; YouTube and Twitter were the social networks which were mainly used for medical education purposes. The three aforementioned social plat-

forms were also the most commonly used by medical students which were included in the study by El Bialy and Jalali (2015) and they were by far the most common social networks that were used for the education of health professionals; according to Curran et al. (2017). The search was completed on 4 February 2018. For the identification of relevant studies which were not found after the initial search; the reference lists of the papers which were included in the review were checked.

2.2. Inclusion criteria

The studies that were eligible for analysis were those whose purpose was to investigate the correlation between social media and undergraduate human anatomy education. The present analysis focused on topographic anatomy education and included only studies with a purpose to explore the use of social media for enhancing knowledge especially about topographic anatomy. Papers eligible for analysis were those which were published in peer-reviewed journals and written in English language.

2.3. Exclusion criteria

Papers which focused on disciplines that can be taught in conjunction with topographic anatomy, such as histology, pathology and embryology, were not eligible for analysis. Furthermore, studies which dealt with education regarding medical specialties, clinical reasoning skills and examination skills were excluded from the review. Duplicates, review articles, letters to the editor and published abstracts from conferences were also excluded.

2.4. Screening process

Screening was performed in three stages and included title, abstract and full text. If the title did not provide enough information for the inclusion or exclusion of the study, the abstract was also screened. Finally, if the abstract did not provide enough details again, the full text was screened.

2.5. Data extraction

In the present study, the following data were received from each paper: authors, year of publication, country, level of outcome according to Kirkpatrick hierarchy (Table 1, Kirkpatrick, 1967; Hammick, 2000), purpose and conclusion, along with the material and methods of each study and the findings that supported each conclusion. From the material and methods of each study, it was investigated if a qualitative or quantitative or mixed approach was used, if the study was comparative or not and what was the number of individuals who participated or videos which were screened. The data were analyzed with a narrative description and the studies were put into groups, according to the social network they dealt with. Ethical approval was not needed for the present study.

3. Results

The initial search in the six databases retrieved 92 papers. After the first screening, 61 irrelevant studies and two duplicates were excluded. One paper which focused on histology and eight papers about medical specialties education and clinical skills were also

Table 1
Kirkpatrick hierarchy (Kirkpatrick, 1967; Hammick, 2000).

Level 1	Reaction	Relates to participants' opinions on the learning experience.
Level 2a	Change of attitudes-perceptions	Relates to changes in the participants' attitudes or perceptions after the educational intervention.
Level 2b	Change of knowledge-skills	Relates to the acquisition of knowledge and skills after the educational intervention.
Level 3	Behavioral change	Relates to the change of behavior in the workplace due to the educational intervention.
Level 4a	Change in organizational practice	Significant changes in the delivery of care, due to an educational program.
Level 4b	Benefits to patients	Improvement of patients' health due to an educational program.

excluded. Finally, five letters to the editor, four review articles about the use of social media in medical education and two published abstracts from conferences were excluded and, thus, nine studies were eligible for analysis. No study was added after the search of the reference lists of the papers which were included.

From the nine studies that met the inclusion criteria, four focused on the use of YouTube in anatomy education, three on Facebook and two on Twitter. All the papers that were found were published after 2011. Three studies were performed in a University of the United Arab Emirates (Jaffar and Eladl, 2016; Jaffar, 2014; Jaffar, 2012) two studies were performed in Australia (Marsland and Lazarus, 2017; Raikos and Waidyasekara, 2014), two in the United Kingdom (Pickering and Bickerdike, 2017; Hennessy et al., 2016), one in Ireland (Barry et al., 2016) and one in Saudi Arabia (Azer, 2012). At all the studies, the educational intervention via social media had the minimum level of outcome, according to Kirkpatrick hierarchy (Kirkpatrick, 1967), and was restricted to the participants' reactions. As far as the main methods of the aforementioned studies are concerned, three papers were based on questionnaires that were answered by students (Jaffar, 2012; Barry et al., 2016; Pickering and Bickerdike, 2017), one study was based on questionnaires and insights tool (Jaffar, 2014), one study on engagement metrics (Jaffar and Eladl, 2016), one study on questionnaires and engagement metrics (Hennessy et al., 2016), two studies included assessment of the quality of YouTube videos (Azer, 2012; Raikos and Waidyasekara, 2014) and one paper included qualitative analysis of tweets (Marsland and Lazarus, 2017). A summary of the main findings from each paper is presented on Table 2.

3.1. Studies about the use of Facebook in anatomy education

The study by Jaffar (2014), which included 157 participants and used a quantitative approach, investigated the use of a Facebook page in anatomy education and demonstrated that Facebook had a positive impact as a teaching tool. The page was followed by the vast majority of the University of Sharjah students and, in addition, more than nine out of ten of these students expressed the opinion that the page was very good or excellent. Furthermore, approximately 90% of the students considered that it had a beneficial influence on their learning experience, by enhancing their interest and reinforcing their exam self-confidence. Also, the page gave to the students the opportunity for peer assessment and feedback. Moreover, the majority of students thought that the advantages of using Facebook for anatomy learning were more powerful than the disadvantages, such as distraction. More specifically, according to 84% of the students, Facebook could be an appropriate learning environment, although concerns were expressed about safety, privacy and distraction. However, according to 36% of students, the concern about distraction was so important, that the negative impact of Facebook outweighed the positive one (Jaffar, 2014).

Another study explored the relationship between the engagement of students in Facebook pages for anatomy education and their performance (Jaffar and Eladl, 2016). The authors concluded that students with high academic performance engaged in Facebook to a greater extent in comparison with low performers, so the opinion that Facebook could cause distraction was rejected. The correlation between engagement and performance was illustrated

by the fact that the high-performers not only demonstrated higher engagement than low-performers, but also contributed much more to discussions, which were considered as the more advanced form of engagement. However, the authors recognized their inability to distinguish if the students' high performance was the result or the cause of their Facebook engagement (Jaffar and Eladl, 2016).

The third study that dealt with the relationship between Facebook and anatomy education was performed in the United Kingdom (Pickering and Bickerdike, 2017). According to this study, almost half of the second-year medical students of the University of Leeds accessed the Facebook page about anatomy education and, from them, about 40% posted a comment. Generally, the students commented positively on this page in terms of helping their learning (85%), enhancing their confidence (73.2%) and limiting their anxiety (55.4%), while the majority of participants preferred the Facebook page to email as a means of asking questions. The authors noted that the students who posted comments were generally high-performers on the anatomy examinations of the preceding year. Also, those who engaged in the Facebook page about anatomy achieved generally higher scores in examinations of the module, in comparison with those who did not engage and, furthermore, those who posted more comments achieved generally higher scores. In addition, the authors wanted to find if the engagement with the Facebook page had a relationship with the students' gender and found that the proportion of male and female students who commented on the Facebook page did not differ significantly from the ratio between males and females of the program (Pickering and Bickerdike, 2017).

3.2. Studies about the use of Twitter in anatomy education

One of the two papers about the use of Twitter in anatomy education that were found after the literature search was published by Hennessy et al. (2016). The authors evaluated the use of Twitter in anatomy education via a mixed quantitative and qualitative approach and the participation of 150 students. It was noted that more than nine out of ten students used the Twitter hashtag of an anatomy course. This fact indicated their remarkable desire to gain knowledge from this social platform. Also, it was demonstrated that Twitter helped the students in terms of sharing ideas and worries, supporting each other and increasing their morale, while the communication with their teachers was strengthened. However, there was not a significantly positive influence of the use of Twitter on the students' grades on examinations. Furthermore, an important advantage of Twitter that was pointed out by the authors is that it offers to the students the opportunity to have academic accounts apart from their personal Twitter accounts, so they can protect their privacy. The character limit in Tweets probably had a negative impact on the students' contribution to activities, so they preferred to follow or observe the material of Twitter. The outcomes of this study showed a positive correlation between the teachers' contribution and students' engagement in this social networking site for educational purposes. This study also highlighted that students need moral support in terms of learning neuroanatomy, a support which seemed to be offered by Twitter. An important issue that was underlined is that Twitter offered to the students the opportunity to read each other's questions and obtain a quick feedback from

Table 2
The main characteristics of the studies of the review and their level in Kirkpatrick hierarchy.

Author(s).	Socialmedia	Material	Type of study	Approach	Purpose	Level	Variables looked at	Conclusion
Pickering and Bickerdike, 2017	Facebook	49 students	Non-comparative	Qualitative and quantitative	To explore if a Facebook Page helped preparation for anatomy assessments and reduced anxiety.	1	Students' perceptions on usage of a Facebook page, influence on assessment preparation and learning.	Facebook could play an important role in preparation for anatomy assessments.
Jaffar and Eladl, 2016	Facebook	Two groups of 10 students	Comparative	Quantitative	To examine the relationship between engagement in Facebook anatomy pages and students' academic performance.	1	Engagement of high and low performing students in a Facebook anatomy page.	High-performing students had stronger engagement in Facebook anatomy pages than low performers.
Jaffar, 2014	Facebook	157 students	Non-comparative	Quantitative	To explore if a Facebook page helped anatomy education beyond classroom.	1	Students' use of Facebook and their perceptions of a Facebook anatomy Page.	Facebook generally had a positive impact on anatomy education.
Marsland and Lazarus, 2017	Twitter	110 Twitter users	Non-comparative	Qualitative	To identify themes in the anatomy community, using a hashtag.	1	Trends and topics of Twitter chats.	The Twitter site led to a web-based community of practice.
Hennessy et al., 2016	Twitter	150 students	Non-comparative	Qualitative and quantitative	To evaluate how Twitter influenced students' engagement and anatomy learning experience.	1	Students' opinions on Twitter, correlation of engagement with examinations results.	Twitter could support students and have a positive impact on their learning experience.
Barry et al., 2016	YouTube	73 students	Non-comparative	Quantitative	To assess the students' attitudes to the use of social media in anatomy education.	1	Students' attitudes and prevalence of use of social networks for anatomy learning.	Social networks, especially YouTube, are becoming increasingly helpful in anatomy education.
Raikos and Waidyasekara, 2014	YouTube	294 videos	Non-comparative	Qualitative and quantitative	To perform a quantitative and qualitative analysis of heart anatomy videos on YouTube.	1	General data, general quality, anatomical quality and details of videos.	The educational value of most videos was limited. Faculty was encouraged to prepare videos.
Azer, 2012	YouTube	57 videos	Non-comparative	Qualitative and quantitative	To assess YouTube videos covering surface anatomy.	1	Content, technical, pedagogy and authority parameters of videos.	YouTube is inadequate for learning surface anatomy and teachers should add more useful videos.
Jaffar, 2012	YouTube	91 students	Non-comparative	Qualitative and quantitative	To evaluate students' perceptions and usage of YouTube videos for anatomy education and the effectiveness of these videos.	1	Students' usage of YouTube and experiences with the anatomy education YouTube channel.	YouTube could be a significant teaching tool with the help of the faculty.

teachers, although sometimes the limit of 140 characters in tweets did not allow detailed explanations. Therefore, despite the fact that Twitter was found to have advantages in comparison with emailing teachers, some students reported that email should remain an option. In addition, it was noted that the communication between students and teachers via Twitter made the latter more approachable in the classroom (Hennessy et al., 2016).

Another study about Twitter was performed by Marsland and Lazarus (2017). The authors investigated a Twitter platform, which was created in order to enhance public accessibility to anatomy content and knowledge and to encourage international anatomists to collaborate with each other and their students. It was found that the general public, although followed the discussions, did not engage extensively with the tweet chat. It was found that this Twitter platform led to the creation of a “community of practice”, which is a group of people who share a principal concern and try to ameliorate their practice of this concern via interaction (Wenger-Trayner and Wenger-Trayner, 2015). The anatomists and students who engaged in this platform had the opportunity to discuss about interesting topics, for example the difficulties which could be met regarding anatomy education (Marsland and Lazarus, 2017).

3.3. Studies about the use of YouTube in anatomy education

Four papers that were found after the literature search focused on the use of YouTube in anatomy education. More specifically, Azer (2012) evaluated, via a mixed quantitative and qualitative approach, the educational usefulness of 57 YouTube videos concerning surface anatomy. The author examined how anatomy education could be influenced by this popular social network, which can be easily and freely accessed and, therefore, could be considered as a notable means for sharing information. According to the author, only 27% of the total duration of YouTube videos concerning surface anatomy was useful for educational purposes. Also, the author noted a lack of video clips with high educational value and, furthermore, underlined the need of investigation of the proportion of students who can estimate the reliable electronic source of knowledge. Moreover, this study revealed that the YouTube videos covered inadequately the whole spectrum of surface anatomy. The author, by demonstrating the lack of educational power of YouTube, highlighted the need of the contribution of universities to the enhancement of the teaching potential of this social platform (Azer, 2012).

A study by Jaffar (2012), which focused on the use of YouTube as an anatomy teaching tool, included 91 participants and used a mixed qualitative and quantitative approach. The author demonstrated that almost all the students who participated used YouTube as an information resource. Furthermore, 86% of the students used the specific channel for anatomy education which was launched and, from them, 92% argued that they were helped in terms of learning anatomy by the use of this channel. Especially, this help was most commonly associated with the increase of their understanding and the creation of memorable visual images. Although 65% of the participants of the study were already using YouTube for educational purposes, a further 19% was encouraged to do so because of posting of suggested links. According to the author, if the quality of the YouTube videos about anatomy teaching was assessed by the faculty, this social platform could significantly enhance the students' learning experience (Jaffar, 2012).

Another study also focused on YouTube, a social networking site which offers easy and free access to knowledge and facilitates students, especially in the context of modern medical degree programs, which promote self-directed and problem-based learning (Raikos and Waidyasekara, 2014). The authors analyzed 294 videos and remarked that they covered inadequately the topographic anatomy of the heart and only about 25% of the videos

which were examined passed the authors' analysis. The paper demonstrated the general lack of high quality of the majority of YouTube videos regarding heart anatomy. It should be noted that less than 15% of the videos which were included in the study were endorsed by institutions. Moreover, it was clearly stated that YouTube videos could reinforce the students' anatomy learning experience, but the inferiority of videos to dissections, in terms of educational value, was underlined. Also, it was highlighted that ethical issues arise when students record videos from cadavers and upload them without receiving an approval by an authority (Raikos and Waidyasekara, 2014).

The study by Barry et al. (2016) evaluated the educational effectiveness of YouTube videos in terms of anatomy teaching. The authors performed a quantitative analysis of 73 multiple-choice, nine-item questionnaires. This study showed that approximately eight out of ten students used YouTube as the main source of anatomy video clips, while less than 25% of the participants preferred other sources. Also, 78% of the participants rated the videos as “extremely useful”, “very useful” or “useful” in facilitating their understanding of anatomy. There were no students who found these videos useless for their anatomy learning. Furthermore, in this study, the participants were asked how they would prefer to access an anatomy teacher if they had a question. Most of the students (59%) answered that they would like to access an instructor in person, while 29% of them answered that they would prefer to send an email. Finally, 12% of the participants said they would not access their teacher, so they would obviously choose to search information in the Internet or in the academic material they were provided with. The authors noted that the YouTube videos may involve patients, teachers, clinicians and surgeons, a fact that contributes to a more clinically oriented anatomy education. Nevertheless, the authors pointed out that it was not known if both students and teachers were comfortable with the use of social networks and, also, ethical considerations arise with the presentation of cadaveric dissections in videos and, generally, with filming of human tissues. In addition, it was argued that since students can communicate, via social platforms, out of scheduled contact hours, interaction among them is enhanced. The fact that there is a tendency of use of social media in anatomy education requires from the academics to adapt their teaching strategies to the new reality, but the cadaveric dissections should preserve, according to the authors, their important role in anatomy education. Since permission for online broadcasting may not always be obtained and given that students could ignore issues concerning copyright, care should be taken by academics for the projection of videos with respect to ethical issues (Barry et al., 2016).

4. Discussion

There is an increasing frequency of performance of studies about the correlation between social media and anatomy education, since five studies were published in the last two years (Table 2). Moreover, it can be seen that the studies about the use of social platforms in anatomy education were performed in universities of only five countries and four out of nine studies took place in the Middle East. Two studies which were performed in the United Arab Emirates and assessed the impact of Facebook and YouTube on anatomy education, strongly supported their use (Jaffar, 2012; Jaffar, 2014). Similarly, the two studies that took place in the United Kingdom, supported the use of Facebook and Twitter respectively, in terms of their usefulness as anatomy teaching tools (Pickering and Bickerdike, 2017; Hennessy et al., 2016). The remaining five studies were performed in the United Arab Emirates (Jaffar and Eladl, 2016), Saudi Arabia (Azer, 2012), Australia (Marsland and Lazarus,

2017; Raikos and Waidyasekara, 2014) and Ireland (Barry et al., 2016).

It is clear that the research about the use of social media in anatomy education has been performed in a limited range of regions and there was heterogeneity of the outcomes under investigation (Table 2). Two of the studies which assessed the students' reaction to the use of social platforms in anatomy education were performed in the United Arab Emirates and two in the United Kingdom. Although they showed that students reacted positively, the data are generally not enough to indicate that geographical factors affected the outcomes of the studies of the review. Probably, if there had been data from a wider spectrum of universities and countries, safer conclusions would have been extracted about the impact of social media on students who belong to different populations, with probably variable engagement in information and computer technologies, as well as with probably different curricula.

Also, there is a lack of comparative studies on how anatomy education is influenced by social platforms. It should be noted that the performance of randomized or comparative studies, regarding the possible advantages of the use of social media in medical education, is difficult (Arnbjörnsson, 2014). The reason is that, for the performance of such studies, there is a need for the comparison between two groups of students, one of which should refrain from the use of social media for a significant period of time (Arnbjörnsson, 2014). Since social networking sites are an integral part of students' everyday life, such a restriction is difficult to be imposed (Arnbjörnsson, 2014). Nevertheless, the performance of comparative studies, which should include users and non-users of social media, is necessary for the clarification of the extent to which social platforms could affect anatomy education.

4.1. Facebook in anatomy education

Two papers which were included in this review agreed that the use of Facebook as an anatomy teaching tool increased the students' confidence (Jaffar, 2014; Pickering and Bickerdike, 2017). The remark that high performers of the previous year generally engaged more in Facebook anatomy pages (Jaffar and Eladl, 2016) was supported by the study by Pickering and Bickerdike (2017) and confirmed the findings of the study by Michikyan et al. (2015), according to which the academic performance of a student could affect the use of this social platform. It should be noted that, although the percentage of students who agreed that Facebook could be an appropriate teaching tool was very high in the study by Jaffar (2014), in other studies that were found in the literature this percentage was significantly lower, from 25% to 62% (Smith and Caruso, 2010; Buzzetto-More, 2012; Stanciu et al., 2012). Moreover, two studies which were included in the review rejected the opinion that distraction is a major issue regarding Facebook (Jaffar, 2014; Jaffar and Eladl, 2016), although the opposite was reported in the literature (Wise et al., 2011).

In the study by Jaffar (2014), although the opinions which were expressed by the students were generally positive regarding the educational value of the Facebook anatomy page, it was noted that perhaps some answers were inaccurate. In addition, the impact of this page on students' examination performance was not investigated. An interesting result was that four out of five participants knew the privacy settings on Facebook, in contrast with the percentage of 63% which was found by MacDonald et al. (2010). Since privacy and safety issues arise with the use of Facebook for educational purposes, as it was previously mentioned, this result of the study by Jaffar (2014) could be considered as encouraging. Future research could demonstrate if the high interaction, which was found via the "insights" metrics, characterizes other pages (Jaffar, 2014). Moreover, in the study by Jaffar and Eladl (2016), although it was found that high performance was correlated with increased

engagement, it was not investigated if the high performance is the cause or result of increased engagement and, furthermore, the participants were relatively few.

Pickering and Bickerdike (2017) remarked that the number of students who posted a comment was limited, probably due to trepidation, because of anonymity and privacy issues (Aydin, 2012). Although Pickering and Bickerdike (2017) demonstrated that students reacted positively to a specific Facebook page, the opinions of students who did not engage with this page were not taken into account. Almost half of the students of the entire cohort did not engage, a fact which raises concerns about the implementation of this resource for teaching purposes. Also, this study could include a more reliable tool for the assessment of reduction of the students' anxiety, such as the State Trait Anxiety Inventory which was used by other authors (Spielberger, 1983; Schwartz et al., 2015). Finally, the relatively limited number of the participants of the study could be considered as a factor which impedes the extraction of safe conclusions.

The data of the present review suggest that, from the students' point of view, Facebook could have a positive impact on anatomy learning experience. However, there is a lack of evidence to support that this social network could essentially enrich anatomical knowledge.

4.2. Twitter in anatomy education

The study by Hennessy et al. (2016) confirmed the outcomes of previous studies regarding the help which was supplied via Twitter to students to collaborate (Kind et al., 2014) and communicate with their teachers (Junco et al., 2011; Junco et al., 2013; Ebner et al., 2010). Also, Hennessy et al. (2016) pointed out that the teachers' role in enhancing the students' engagement in Twitter is important as it had been previously reported (McArthur and Bostedo-Conway, 2012). However, a correlation between the use of Twitter and improved performance in examinations was not found, so the authors disagreed with the findings of other studies (Junco et al., 2011; Junco et al., 2013; Webb et al., 2015). However, it should be noted that the increased exam performance, which was demonstrated by Junco et al. (2011) and Junco et al. (2013), was probably correlated with the fact that students were asked to use Twitter in order to interact. Further research in the future could show if the method used by Junco et al. (2011), which comprised the mandatory use of Twitter by students, could be correlated with more effective anatomy learning.

The study by Marsland and Lazarus (2017) showed that Twitter led to the formation of an online community, as it has been reported in the literature (Dunlap and Lowenthal, 2009). Although geographical factors had previously impeded this formation, it seemed that such factors could stop playing a negative role (Marsland and Lazarus, 2017). However, the authors did not provide evidence that Twitter could be effectively used as an anatomy teaching tool. As it was also demonstrated by Hennessy et al. (2016), Twitter could be evaluated as a tool which reinforces students' collaboration and communication with teachers. Nevertheless, according to the two studies of the present review, it has not been proved that the use of this social platform could enhance anatomical knowledge.

4.3. YouTube in anatomy education

Raikos and Waidyasekara (2014) and Azer (2012) agreed on the limited educational usefulness of YouTube videos, if they are not controlled by the academic staff. The low educational value of YouTube videos was also demonstrated in the literature (Pant et al., 2012; Camm et al., 2013; Sutherland and Jalali, 2017) and the review by experts was also recommended (Assadi and Gasparyan, 2015). The fact that, in the study by Jaffar (2012), the vast major-

ity of participants commented positively on a faculty-led YouTube video for anatomy teaching, emphasized that YouTube videos launched by an institution could have a high educational effectiveness (Raikos and Waidyasekara, 2014). Via social platforms, this material can be shared with a large audience, a fact that gives to teachers the opportunity to receive feedback from students and educators worldwide and, therefore, to improve the quality of the material (Madanick, 2015; Walji and Stanbrook, 2015). In addition, the inferiority of YouTube videos to dissections in terms of teaching value that was remarked (Raikos and Waidyasekara, 2014), confirmed the findings of another study, which showed that three-dimensional virtual reality videos were inferior to dissections in terms of educational value (Pettersson et al., 2009).

Barry et al. (2016) showed that YouTube videos were generally considered as useful for anatomy education. This finding agrees with that of the study by Jaffar (2012). Nevertheless, a lack of evidence about the impact of YouTube on examination performance can be pointed out. Jaffar (2012) noted that videos related to examinations were added to the YouTube channel, according to the students' suggestions. However, the usefulness of these videos was not assessed. Regarding the content of videos, the students showed their preference to surface anatomy and model explanations and believed that these types of videos should continue to be shown. However, the educational effectiveness of specific types of videos was not investigated.

A similarity between the study by Raikos and Waidyasekara (2014) and that by Jaffar (2012) could be remarked, regarding the content of videos which was preferred by the students: they would like to view models more than cadavers. Furthermore, in the paper by Raikos and Waidyasekara (2014), there was a generally low cinematography and image quality of many videos, especially of those with cadaveric material, which could be explained by the fact that they were recorded by students with the use of portable mobile devices. Although this study showed that students clearly preferred specific types of videos, there was no assessment of the influence of these videos on students' examination performance.

Azer (2012) and Raikos and Waidyasekara (2014) found similar results regarding the percentage of educationally useful videos (27% and 25% respectively). Three assessors evaluated the quality of YouTube videos in each of these papers, a factor which increased their reliability. However, it should be pointed out that the criteria which were used for the assessment of the quality of videos in each of these studies had some differences. It should also be noticed that the generally low score of the videos of these studies was influenced by a variety of factors, including the quality of content, image and sound. It was not clarified to what extent each of these factors played a role in the low score that was generally achieved. Moreover, perhaps the key words that were used for search of YouTube videos in each of these studies could not be adequate to cover the whole spectrum of videos related to anatomy education. Also, it should be noted that the paper by Azer (2012) did not deal with the impact of the YouTube videos on the students' learning experience. Perhaps, if there were common, widely accepted criteria for the evaluation of the quality of YouTube videos, more reliable conclusions could be extracted. Further research in the future could clarify the relationship between the quality of YouTube videos and their impact on anatomy learning. It should also be noted that the aforementioned papers of the present review about YouTube did not provide details about the ethical approval of the recording and uploading of the videos, especially of those which included cadaveric material. Perhaps, studies which could assess the educational usefulness of faculty-led, ethically approved YouTube videos could provide interesting findings in the future.

Generally, the findings of the present review indicate that YouTube could play a positive role in anatomy learning experience, if the quality of the videos is appropriately evaluated by the

faculty. It seems that this quality is influenced not only by the content of videos, but also by their image and sound. However, there is no evidence that YouTube is an effective teaching tool in terms of improving students' anatomical knowledge.

This study has some limitations. Firstly, the search in six databases with the aforementioned key words, inclusion and exclusion criteria, may have been inadequate to detect all the papers that dealt with the correlation between social media and anatomy education. Particularly, three social networks were used as separate key words for the maximum possible inclusion of studies. The selection of these social platforms, as it was previously mentioned, was based on their popularity. Probably, the fact that other less popular social networking sites were not included in the key works could have led to the exclusion of some relevant papers. However, it was estimated that the key words which were used could be enough. Furthermore, if this review was systematic and not narrative and if it was performed by two or more independent researchers, the bias would be reduced and the strength of this study could be improved. Finally, if more than nine papers had been included in this review and if a statistical analysis had been performed, safer conclusions would have been extracted.

5. Conclusions

The research so far regarding the use of social media in anatomy education is limited and lacks comparative studies. The studies that were performed generally demonstrated that social platforms could have a beneficial impact on students' anatomy learning experience, under the appropriate guidance of their teachers and if the academic staff ensures the quality of the material which is taught. However, there was no study which investigated if the use of social media in anatomy education influenced students' attitude or anatomy knowledge. So, it could be noted that there is a lack of strong evidence that social networks are powerful anatomy teaching tools. Their positive impact seems to be constricted in students' reactions, but the papers which supported this argument are non-comparative. Further research in the future will probably shed more light on possible stronger benefits of the use of social media in anatomy education.

Acknowledgements

The author is grateful to Dr Peter Bazira and Dr Katherine Sanders, anatomy teachers of the University of Hull, for their precious help for the completion of this study.

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