

#Anatomynotes: A temporal content analysis of anatomy education posts on Instagram

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Abstract

Social media platforms such as Instagram are becoming increasingly popular sources for students to access anatomy educational resources. This review used content analysis to examine posts under the hashtag #anatomynotes and is the first to map the characteristics of anatomy education posts on Instagram and determine any temporal changes. Sample posts were gathered from April 2019 and April 2021 and categorized according to the technical format, purpose and author credentials. Engagement was recorded in the form of likes and comments. Overall, posts depicting illustrations remained the most popular format within both time periods. Three-dimensional models saw an increase in popularity with a 62.5% rise. Students remained the most common author type throughout and increased further in 2021 by 25%. Clinician authors and posts focusing on clinical education also increased in 2021 by 17.9% and 227%, respectively. Humor-based posts saw the greatest increase among the post purposes, with 1000% more recorded in 2021. Engagement overall saw a decline with notably significant reductions in average likes per post among all text-based posts (-72%, $p < 0.0001$), all illustrative posts (-51%, $p = 0.0013$), and a decline in the presence of comments among all text-based posts (-65.1%, $p = 0.0158$). These findings highlight that Instagram is a popular platform for facilitating near-peer teaching while increasingly providing a space where students and clinicians can interact. Additionally, it highlights the benefits of the platform for visually focused learners. However, future research should seek to determine whether Instagram can facilitate deeper learning and have an impact on academic and clinical performance.

KEYWORDS

anatomical sciences/medical education, anatomy and medical education, anatomy education, E-learning, medical student, undergraduate medical education

INTRODUCTION

Anatomy education has been revolutionized in the age of social media (Hennessy & Smith, 2020). Social media consists of platforms that enable users to create and share educational content or

participate in networking remotely without the restrictions of temporal or geographic boundaries, an ever-relevant advantage following the Covid-19 pandemic (D'souza et al., 2021).

As digital media and access to internet technologies has evolved over the turn of the century, online anatomical content began to be

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created and shared on platforms including Facebook, X (formerly known as Twitter), Instagram, and YouTube. This has allowed students to easily, cheaply, and quickly access digital anatomical photographs, images and virtual reconstructions that can complement more traditional laboratory and lecture theatre-based anatomy teaching (Hennessy & Smith, 2020). A blended learning approach combining face-to-face traditional anatomical teaching with online resources has been found to successfully increase student engagement, motivation, and examination self-confidence (Jaffar, 2014).

The Covid-19 pandemic saw unprecedented disruption to the delivery of face-to-face anatomy teaching, potentially further encouraging students to source additional anatomy learning material from online sources including social media. Data collected from the first wave of the pandemic in the United Kingdom demonstrated that experiences from anatomy laboratories were changed largely from in-person sessions with cadaveric materials to remote virtual sessions utilizing digital teaching resources (Longhurst et al., 2020). Simultaneously, lectures transitioned from predominantly in-person to various remote mediums including an increased incorporation of video conferencing sites to provide synchronous teaching or pre-recorded material for asynchronous review (Nguyen et al., 2020; McWatt, 2021). Similar changes to education were echoed in studies assessing changes to anatomy education during the pandemic internationally (Brassett et al., 2020; Pather et al., 2020; Singal et al., 2020; Cheng et al., 2021; Attardi et al., 2022). Disruption caused to anatomy teaching during the Covid-19 pandemic may have been an additional catalyst for students looking to try alternative learning approaches such as incorporating online and social media in order to supplement their learning (Gulati et al., 2020).

Instagram is a social media platform primarily utilized to share image- and video-based content (Liu & Sharma, 2021). Studies highlighting student and learner perspectives have determined that Instagram's format is particularly effective for visual learning as the platform is tailor made for sharing, collating, and curating images on various topics (Shafer et al., 2018; Border et al., 2019; Courneya & Cox, 2020; Essig et al., 2020; Nguyen et al., 2021). Instagram as an online education community has also been suggested as a useful supplement to classroom teaching to help aid revision as the site has been found to support and promote learning theories which are well established to the development of sound pedagogy including micro-learning and social learning theory (Douglas et al., 2019; Yücel et al., 2020). As interest in social media and education grows, and student engagement on sites such as Instagram rises, anatomy educators are increasingly acknowledging and beginning to integrate social media within a more formal curriculum and are providing guidance aimed at educational Instagram accounts on how to ensure productive conversation online and how to promote digital professionalism between educators and students (Rashid et al., 2020; Nguyen et al., 2021).

Instagram's platform has grown rapidly in the past decade reaching over 2 billion active monthly users in 2023 with 61.1% of its users aged 18–34 (Statista, 2023). This growth has coincided with a decline in engagement with educational content on similar sites such as X and Facebook with students shifting to Instagram as their

preferred social media platform for learning (Border et al., 2019; Douglas et al., 2019; Perifanou et al., 2021).

Facebook allows users to create personal identifiable profiles allowing members to share text, image-, and video-based content as well as view and interact with other members profiles (Jaffar, 2014). In a retrospective analysis, looking at the effectiveness of a preclinical medical education Facebook discussion group, students determined that the platform was effective in helping to build learner–teacher relationships which subsequently facilitated improved content learning (Henry et al., 2020). These findings corroborate with a similar study conducted by Jaffar, 2014 who also surveyed second year medical students interacting with a human anatomy education page created on Facebook. Students reported that they found anatomy learning more stimulating and that it additionally helped to increase their understanding of anatomy (Jaffar, 2014). However, as the platform facilitates direct communication between learners and educators, privacy on the site has been a concern for students who wish to keep their Facebook accounts a personal and private space. Unlike Instagram, Facebook does not allow users to hold separate private and academic or professional accounts (Szwelnik, 2008).

X is a platform which allows people to communicate through short lengths of text of 140 characters or less, also known as “Posts” (formerly known as Tweets) (Skiba, 2008). In a qualitative study assessing medical students' views on using X to deliver undergraduate medical education, students stated that they found X particularly effective in helping them consolidate their course teaching through micro-learning. Additionally, engaging with users of their choice allowed each medical student to tailor their learning on X to their own personal needs (Mysko & Delgaty, 2015). While X allows learners to hold separate academic and professional accounts, there are significant limitations of using X for educational purposes, particular the challenge of sharing complex information within character limited “Posts” and the unsuitability of the format of a “Post” for a visually focused subject such as anatomy (Bista, 2015).

The emerging literature examining the use of Instagram has confirmed its growing popularity in anatomy education. In two U.S. university, students felt more engaged with course content when class instructors posted weekly content to Instagram (Ganjoo et al., 2021), and felt more confident when answering examination questions after studying dedicated educational content from an Instagram account (Essig et al., 2020). In two U.S. dental schools, students found two anatomy professors' Instagram pages to be helpful for anatomy study, deeming them “convenient, engaging, and professional” (Yoachim & Nguyen, 2021). Other studies have highlighted that the students engaging with anatomy education on Instagram used it for social interactions as well as study (Brown, 2020), and that mnemonics and humor help to bring about an online community of practice (Courneya & Cox, 2020). In the more clinical field of academic radiology, a review found that anatomy posts were one of the key areas of use (Yu & Sharma, 2022).

While the literature currently describes how Instagram is being increasingly utilized within education and the potential benefits of this, there are currently no studies which look to examine the content

of these posts in further depth nor are these studies examining content trends over time. The main aim of this article, therefore, is to provide a descriptive commentary on the uses of Instagram for anatomy learning by determining the trends and changes between 2019 and 2021 in who is posting anatomy educational content on Instagram, the purpose of these posts, the format in which educational content is presented, and how students engage with this content.

MATERIALS AND METHODS

This study was deemed exempt by the University College London Research Ethics Committee under provision "Research involving information freely available in the public domain" and, therefore, did not require ethical approval from the board prior to the conduction of the research.

Posts relevant to anatomy education can be found by utilizing the "hashtags" feature on Instagram. As hyperlinks cross-referencing concepts across all types of webpages, posts, images and videos, hashtags (e.g., #anatomynotes) provide a thematic historical log of a single concept on one webpage. As this has allowed students to explore the material topic by topic, it allowed the post analyzing team to snapshot this specific topic over a specific time period.

This study analyzed the content from the Instagram hashtag "#anatomynotes" alone. As of July 18, 2023, this hashtag has approximately 22, 300 posts. An assessment of the top 10 hashtags with the greatest number of posts related to anatomy was undertaken by searching for the keyword "Anatomy" into Instagram's search bar in the early stages of the study in order to determine which hashtag would be most suitable for this study. This revealed the following hashtags: #anatomy, #anatomydrawing, #anatomyart, #anatomystudy, #anatomyandphysiology, #anatomytrains, #anatomypractice, #anatomysketch, #greysanatomy, #anatomynotes. Two authors (IH and CD) assessed the first nine posts under each of these hashtags. #Anatomynotes was determined as the most relevant for the learning and teaching of human anatomy while simultaneously attracting a continuously high level of engagement and posts. Hashtags were eliminated following this initial assessment for either having too many posts that fell within the exclusion criteria detailed below, too many posts entirely unrelated to human anatomy, hashtags targeting other elements of the medical curriculum, such as "#anatomyandphysiology" or hashtags targeting a specific themed characteristic such as "#anatomydrawing" which predominantly collated illustrations and could therefore not allow for deeper analysis of the breadth of post characteristics found within posts on Instagram.

On April 1, 2022, two members of the team (IH and CD) together selected and saved the first 175 Instagram posts available under #anatomynotes from the very first post uploaded on April 1, 2019 and the first 175 posts from the first post uploaded on April 1, 2021. The full search was carried out within 1 day by both researchers due to daily fluctuations in the content available under the hashtag. This volume of posts was chosen to provide an overview

of the content during these periods as per the methodology of previous content analysis literature on other topic-specific hashtags (Heineman et al., 2021; Parker et al., 2021). These posts were compiled on Microsoft Excel.

Our exclusion criteria included "reels," or videos longer than 60s as these were not discoverable under hashtags in a chronological fashion, and therefore, such posts were not included within this analysis, as they are not organized in the same manner. Posts purely related to veterinary medicine and animal anatomy were also excluded. All other posts were considered for analysis to help determine the breadth of the educational content available under the hashtag.

A conventional content analysis approach was used for this study, a qualitative data assessment process, whereby data, or in this study, Instagram posts were organized into categories and themes based on the authors assessments (Elo & Kyngäs, 2008). This process utilizes inductive reasoning, whereby the categories and codes used in this study were derived directly from the data through the authors examining each post and continuously comparing posts within each category (Burnard, 1991). "Coding" involves authors identifying common themes within the posts and attaching labels (codes) in order to index posts accordingly (Maguire & Delahunt, 2017). This allowed for quantitative assessment of the various post characteristics, particularly allowing the authors to determine any trends over the two time periods. Two authors (IH and CD) reviewed the posts and then came together to generate the final codebook (Table 1) and definitions through the method of "open coding," whereby a first review of all of the posts allowed for the generation and grouping of relevant categories and sub-characteristics. The full set of posts was then systematically re-reviewed and analyzed again using the final codebook. Any instances of coding disagreement were resolved between the two authors.

This coding classified posts based on their purpose including commercial posts, humor posts, public interest or awareness posts, inspirational, clinical education posts, and basic sciences education posts. The data were then further categorized according to the technical format it was presented in including whether the posts content was primarily an illustration, a three dimensional (3D) physical model or a text-based post. Videos were further broken down according to whether the content primarily depicted text, an illustration or 3D model. Finally, posts were classified according to the author type of each post, including student authors, clinicians, university affiliated authors, non-clinician educators, the general public, and unknown authors. The full definitions of each of these categories are provided within the codebook (Table 1). Examples of coded images have been provided with the written permission of each post author (Figure 1).

These details were collected through a combination of assessing each post, the authors Instagram username and biography, and the details within the captions annotating each post. Total numbers of likes and comments generated by each post were recorded and served as a proxy for learners' physical engagement with the content.

TABLE 1 Codebook demonstrating the categories each post was assessed for and the definitions of each allocated code.

Codebook		
Category	Code	Definition
Purpose of post	Commercial posts	Posts that clearly sold, advertised, or recommended products, or services
	Humor posts	Posts that discussed anatomy content or the study of anatomy in a comical or entertaining way
	Public interest or awareness posts	Posts determined to target, inform or disseminate anatomy knowledge relevant to the general public or posts which applied anatomy to scenarios outside of medical or dental education
	Inspirational posts	Posts primarily directed to be motivational or those which provided learners with advice on studying or productivity
	Clinical education	Posts that demonstrated how anatomy content could be applied to clinical scenarios, conditions, or practical procedures
	Basic sciences education	Posts that taught learners how to identify anatomical body structures without further clinical context
Technical format	Illustration	A still image with the content primarily focused on a hand-produced or digitally created drawing or graphic illustration
	Text	A still post containing primarily text
	3D model	A still image with the content primarily focused on a three dimensional (3D) physical model related to anatomy including plastic anatomical models, skeletal structures, cadaveric prosection/ dissection, and human subjects/participants
	Video	Content provided in an entirely videographic format. Videos were further broken down according to whether the content primarily depicted text, an illustration or 3D model as per the definitions above
Author type	Students	Author identified as a student currently enrolled in a university course according to the authors biography, username, post or the details within the captions annotating each post
	Clinicians	Author identified as a qualified medical doctor or surgeon according to the authors biography, username, post or the details within the captions annotating each post
	University affiliated	Post produced by an account associated with a particular university or university affiliated organization according to the biography of the account, the account username, post, or the details within the captions annotating each post
	Non-clinician educator	Author identified as an anatomy teacher or educator but not a qualified medical doctor or surgeon (for example a university lecturer posting from a personal account) according to the authors biography, username, post, or the details within the captions annotating each post
	General public	Author is an identifiable member of the general public not associating with any of the author types above. The authors name appeared within either the authors biography, username, post, or the details within the captions annotating each post
	Unknown	The authors biography, username, post or the details within the captions annotating each post provided no details to allow for the author to be recognized as any of the above

RStudio Team (2020, Integrated Development for R. RStudio, PBC, Boston, MA URL) was used for statistical analysis. To investigate the difference in the number of posts by format/author/purpose between 2019 and 2021, Chi-Square tests were used. Multivariate logistic regression was used to estimate the odds ratios produced. Multivariate linear regression was used to estimate the increased average likes by post category between the years. A p -value <0.05 was considered statistically significant. All analyses and p values are adjusted for the fact that a post's type was simultaneously categorized by authorship, purpose, and format.

RESULTS

With regards to the range of post formats, overall, illustrative posts remained the most popular across both time periods. Posts depicting

3D models overall saw a large increase in 62.5% from 2019 to 2021, whereas text-based posts saw a decline of -28.8%. Analyses have determined a significant difference in the distribution of posts by format across 2019 and 2021 ($p=0.0324$) (Table 2). Statistically significant changes were seen in engagement as determined by the average number of users likes per post among the different post formats. A significant reduction of -72% was seen among all text-based posts ($p<0.0001$) and all illustrative posts at -51% ($p=0.0013$) in 2021. Average number of likes among all posts depicting 3D models, however, remained stable with no significant change ($p=0.0747$) (Table 3).

Posts aiming to provide basic sciences education continued to be the most frequently assessed form of post purpose between 2019 and 2021. The number of posts with content focusing on clinical education and humor saw a great increase of 227% and 1000% respectively in 2021. This change in distribution of posts by purpose


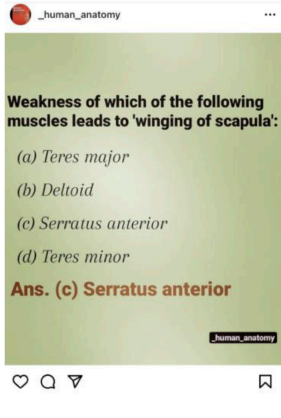

Post				
		Full image content credit to creator @katielam.hl on Instagram®	Full image content credit to creator @_human_anatomy on Instagram®	Full image content credit to creator @aspiringanatomist on Instagram®
Categories	Post Format	Non-video, 3D Model	Non-video, text-based	Non-video, illustration
	Post Purpose	Basic Sciences Education	Clinical Education	Basic Sciences Education
	Post Author	Student	Unknown	Non-clinician Educator

FIGURE 1 Example posts under the hashtag “#anatomynotes” and the associated codes for each post.

across 2019 and 2021 was determined to be significantly different ($p=0.0001$) (Table 2).

The average number of likes per post remained steady with no significant change across the different post purposes except basic sciences education which saw a significant drop in average likes (-61.9%, $p < 0.0001$) (Table 3).

Of the identifiable author types, student authors remained as the most common author type among the posts analyzed between both time periods. Numbers of student authors only continued to grow in 2021 with a rise in 25%, with an increase in popularity at the highest rate of all of the coded author types. Number of clinicians as post authors was the only additional coded author type where an increase was noted with a 17.9% rise seen in 2021. For a large proportion of the authors, their credentials remained unknown. In 2019, this made up to 34.3% of the posts and 33.7% of posts in 2021. This change in distribution of posts by author type across 2019 and 2021 was determined to be significantly different ($p < 0.0001$) (Table 2). Significant decreases in the average number of likes was seen per post authored by clinicians and non-clinician educators of -60.9% ($p = 0.0117$) and -97.8% ($p < 0.0001$), respectively, between 2019 and 2021, all other author types showed no significant change (Table 3).

The estimated change in the presence of comments per post type determined that overall user interaction through this form of engagement remained steady with no significant change in the number of comments between any post purpose or author type. Among the different post formats, the only significant change was seen among overall text-based posts, with a decline noted of -65.1% ($p = 0.0158$) (Table 4).

DISCUSSION

The temporal trends and changes noted within the post characteristics across 2019 and 2021 and changes in engagement may be

reflective of how learners prefer to utilize Instagram for the purpose of anatomy learning, the potential benefits of this platform within anatomy education, and how Instagram can adapt to learner needs over time.

As a platform built to share images and short videos, Instagram is an ideal social media platform for sharing educational resources suited to visually oriented subjects, such as the teaching of anatomy, and this is reflected in the data demonstrating that content containing illustrations remained the highest proportion of posts across both time periods (Hennessy & Smith, 2020). Previous research has determined that revision strategies associated with actively drawing and viewing drawings increases retention of knowledge surrounding anatomical structures and this correlated with improved examination results (Naug et al., 2016; Courneya & Cox, 2020). The larger proportion of posts depicting illustrations in this study may therefore be authors providing content that best suit users' educational needs. As Instagram continues to grow in popularity worldwide, the decline in the number of text-based posts noted over time may also correlate with authors aiming to capture the attention of students internationally without language barriers. Compared to other image-based resources commonly used within anatomy education, for example, atlases and computer models, Instagram is a free-to-use social media platform which allows users to informally interact with educational resources, thus more likely to be accessed in a learner's spare time and in a non-institutional setting.

Students that produce and interact with 3D physical models and develop 3D visuospatial abilities through kinesthetic learning have been found to be able to better identify anatomical structures and understand the spatial relationships between different structures (Michalski & Ross, 2014; Yamine & Violato, 2015; Smith et al., 2017, Hernandez et al., 2020). Kinesthetic learning refers to an educational approach requiring students to engage with content through the physical manipulation of learning materials, ultimately promoting deep learning through multi-sensory engagement (Kharb

TABLE 2 Comparison of the number of posts coded for each post characteristic type across the categories “post format,” “post purpose,” and “post author” in 2019 and 2021.

Category	Characteristic	Number of posts by each post characteristic type across 2019 and 2021		p-Value ^a
		Year		
		2019 n (%)	2021 n (%)	
Post format	Non-videos			p=0.0002
	Illustrations	84 (48.0)	73 (41.7)	
	3D models	20 (11.4)	23 (13.1)	
	Text-based	64 (36.6)	46 (26.3)	
	Videos			
	Illustrations	1 (0.6)	16 (9.1)	
	3D models	4 (2.3)	16 (9.1)	
	Text-based	2 (1.1)	1 (0.6)	
	Overall			
	Illustrations	85 (48.6)	89 (50.9)	
3D models	24 (13.7)	39 (22.3)		
Text-based	66 (37.7)	47 (26.9)		
Post purpose	Basic sciences education	129 (73.7)	97 (55.4)	p=0.0001
	Clinical education	11 (6.3)	36 (20.6)	
	Inspirational	27 (15.4)	10 (5.7)	
	Humor	2 (1.1)	22 (12.6)	
	Public interest or awareness	5 (2.9)	6 (3.4)	
	Commercial advertising	1 (0.6)	4 (2.3)	
Post author	Students	56 (32.0)	70 (40.0)	p<0.0001
	Clinicians	28 (16.0)	33 (18.9)	
	University affiliated	0 (0.0)	2 (1.1)	
	Non-clinician educator	10 (5.7)	5 (2.9)	
	General public	21 (12.0)	6 (3.4)	
	Unknown	60 (34.3)	59 (33.7)	

Note: Illustrations refer to posts with hand-drawn/digital illustrations and compositions.

^aUsing Chi-Square test.

et al., 2013). Within anatomy education, this has historically been achieved through a variety of physical resources including plastic models, bones, and cadaveric dissection (Preece et al., 2013). With laboratory closures during the Covid-19 pandemic and reduced hands-on learning opportunities for students, the overall increase in posts depicting 3D models in 2021 may suggest that educators may have utilized social media to provide students with supplementary learning experiences and resources (Longhurst et al., 2020). However, whether these posts depicting 3D models are able to stimulate deep learning to the same extent as in-person interaction remains unknown. This dynamic change in the content format between 2019 and 2021 does however demonstrate Instagram's versatility as a platform to adapt and respond to emerging needs within education.

Humor-based posts utilizing jokes and “memes,” often humorous digital content shared rapidly by users, have historically been popular within educational spaces on social media sites such as X due to their

ability to educate in a relatable and light-hearted manner (Hennessy et al., 2016; Lonnberg et al., 2020; Bageshwar, 2021). The popularity of this content is also seen on Instagram as data within this study has demonstrated the number of these posts only increasing over time. Common themes within these posts included the difficulties students were facing with learning anatomy content and study aids to help students remember anatomy content. Research has previously established the importance of humor and its ability to engage students, attract students' attention and improve fact recall particularly in online learning environments (Erdođdu & Çakırođlu, 2021; Antón-Sancho et al., 2022). The rising number of humor-based posts seen between 2019 and 2021 may additionally be revealing of the demand for more positive morale boosting posts over the course of the pandemic perhaps due to increasing concerns medical students had over interrupted studies (Alsoufi et al., 2020).

Instagram appears to be an increasingly popular platform for student run study pages as demonstrated by the increasing number of

TABLE 3 Change in engagement determined by the estimated change in average number of likes per post among each post characteristic across the categories “post format,” “post purpose,” and “post author” in 2019 and 2021.

Category	Characteristic	Estimated change in average likes per post among each post characteristic across 2019 and 2021					
		Mean by year			Estimated increase ^a	95% Confidence interval ^a	p-Value ^{a,b}
		2019	2021				
Post format	Non-videos						
	Illustrations	635.2	324.0	-48.8%	[-67.9, -18.4]	p=0.0050	
	3D models	68.2	790.7	85.0%	[-25.5, 359.5]	p=0.1843	
	Text-based	160.7	74.4	-70.7%	[-83.0, -49.5]	p<0.0001	
	Videos						
	Illustrations	41.0	78.4	-48.8%	[-92.5, 2049.6]	p=0.8666	
	3D models	42.0	739.2	127.9%	[-50.2, 942.1]	p=0.2872	
	Text-based	192.0	19.0	-91.4%	[-99.7, 145.6]	p=0.1522	
	Overall						
	Illustrations	628.2	279.9	-51.0	[-68.3, -24.4]	p=0.0013	
3D models	63.8	769.6	101.3	[-6.8, 334.4]	p=0.0747		
Text-based	161.6	73.2	-72.0	[-83.5, 52.3]	p<0.0001		
Post purpose	Basic sciences education	426.3	102.9	-61.9%	[-74.5, -43.2]	p<0.0001	
	Clinical education	682.5	439.1	-52.9%	[-81.9, 22.8]	p=0.1234	
	Inspirational	99.4	387.6	49.1%	[-47.4, 322.7]	p=0.4510	
	Humor	34.5	1194.5	752.5%	[4.4, 6861.8]	p=0.0455	
	Public interest or awareness	52.4	358.2	-2.3%	[-75.4, 586.3]	p=0.7573	
	Commercial advertising	88.0	68.3	-2.3%	[-95.3, 1935.4]	p=0.9878	
Post author	Students	76.5	562.5	29.2%	[-23.7, 118.9]	p=0.3399	
	Clinicians	445.9	94.7	-60.9%	[-81.1, -18.9]	p=0.0117	
	University affiliated	-	72.5	-	-	-	
	Non-clinician educator	3381.1	57.0	-97.8	[-99.5, -90.7]	p<0.0001	
	General public	60.3	37.0	-9.2%	[-75.5, 237.1]	p=0.8849	
	Unknown	229.2	257.8	-78.3%	[-87.0, -63.6]	p<0.0001	

Note: Illustrations refer to posts with hand-drawn/digital illustrations and compositions.

^aAdjusted for format and purpose.

^bUsing Wald test.

student authors seen in 2021. In a study, analyzing the impact of an Instagram page set-up by medical students, peers commented on the benefits of supplementing and consolidating their learning with resources, such as multiple-choice questions (Gulati et al., 2020). This peer-to-peer approach in teaching has also been shown to bring additional benefits to student authors as the research required to produce educational material for posts stimulated their own learning (Healey et al., 2016). Producing educational content additionally promoted reflective practice among student authors who used learner feedback to improve the content or format of their posts (Courneya & Cox, 2020). Student content creators also felt that producing educational posts helped to develop additional “soft skills” such as creativity and team working skills (Gulati et al., 2020).

Furthermore, as Instagram does not require the “real-time” extended synchronous interaction that is essential to peer-teaching

in-person or through video conferencing, students from around the world can contribute to and interact with educational content during any convenient periods of time (Tsarapkina et al., 2020). This form of opportunistic bite-sized learning, or micro-learning, is credited to be a significant benefit of being able to access educational content on social media sites (Tennyson & Smallheer, 2021).

Peer educators may also be able to utilize Instagram to create an environment that allows students to explore difficult subjects without the fear of failure or judgment (Zijdenbos, Fick, & Cate, 2010; Hall et al., 2014). This is especially an advantage of a publicly visible social media, such as Instagram as the platform can allow students to build international communities through dedicated pages. These students can then share their ideas, experiences, and understanding of topics by interacting with posts to enhance the learning experiences of the whole group (Mnkandla & Minnaar, 2017). These communities may

TABLE 4 Change in engagement determined by the estimated change in presence of comments among posts of each post characteristic across the categories “post format,” “post purpose,” and “post author” in 2019 and 2021.

Category	Characteristic	Estimated change in the presence of comments among each post characteristic across 2019 and 2021					
		Posts with comments by year			Estimated odds ratio ^a	95% Confidence interval ^a	p-Value ^{a,b}
		2019	2021				
Post format	Non-videos						
	Illustrations	49 (58%)	41 (56%)	0.95	[0.47, 1.94]	<i>p</i> = 0.8944	
	3D models	9 (45%)	12 (52%)	0.61	[0.14, 2.61]	<i>p</i> = 0.5074	
	Text-based	41 (64%)	15 (33%)	0.41	[0.17, 0.95]	<i>p</i> = 0.0407	
	Videos						
	Illustrations	1 (100%)	4 (25%)	-	-	-	
	3D models	3 (75%)	12 (75%)	0.74	[0.03, 8.44]	<i>p</i> = 0.8209	
	Text-based	2 (0%)	0 (0%)	-	-	-	
	Overall						
	Illustrations	50 (59%)	45 (51%)	0.76	[0.39, 1.47]	<i>p</i> = 0.4122	
3D models	12 (50%)	24 (62%)	0.89	[0.27, 2.95]	<i>p</i> = 0.8534		
Text-based	43 (65%)	15 (32%)	0.35	[0.15, 0.81]	<i>p</i> = 0.0158		
Post purpose	Basic sciences education	69 (53%)	39 (40%)	0.74	[0.41, 1.35]	<i>p</i> = 0.3311	
	Clinical education	7 (64%)	16 (44%)	0.40	[0.08, 1.71]	<i>p</i> = 0.2257	
	Inspirational	24 (89%)	6 (60%)	0.19	[0.03, 1.19]	<i>p</i> = 0.0780	
	Humor	1 (50%)	18 (82%)	6.43	[0.19, 222.5]	<i>p</i> = 0.2540	
	Public interest or awareness	3 (60%)	2 (33%)	0.29	[0.02, 3.58]	<i>p</i> = 0.3434	
	Commercial advertising	1 (100%)	3 (75%)	-	-	-	
Post author	Students	31 (55%)	39 (56%)	-	-	-	
	Clinicians	21 (75%)	16 (48%)	0.31	[0.09, 1.01]	<i>p</i> = 0.0583	
	University affiliated	-	2 (100%)	-	-	-	
	Non-clinician educator	10 (100%)	0 (0%)	-	-	-	
	General public	15 (71%)	3 (50%)	0.35	[0.03, 3.07]	<i>p</i> = 0.3474	
	Unknown	28 (47%)	24 (41%)	0.67	[0.30, 1.48]	<i>p</i> = 0.3221	

Note: Illustrations refer to posts with hand-drawn/digital illustrations and compositions.

^aAdjusted for format and purpose.

^bUsing Wald test.

therefore prefer to remain as a leaner only space in order to allow students to comfortably identify gaps in their knowledge and ask questions. This may help to explain why, despite clinical education post numbers drastically increasing, engagement with these posts and those authored by clinicians failed to see an increase. Previous studies have demonstrated that students expressed an unease with interacting with lecturers and educational professionals on social media with a preference for peer-to-peer interaction for not just social but academic purposes (Smith & Caruso, 2010).

A disadvantage of peer-led teaching on social media, however, can be the lack of integration between factual anatomy content and the clinical application of this knowledge due to the relative inexperience of peer tutors (Zijdenbos, de Haan, et al., 2010). Additionally,

a lack of quality control of posts is a major concern as any member of the public with an account may post on Instagram within their terms and conditions, which could lead to erroneous or misleading information being shared (Azer et al., 2022; Katz & Nandi, 2021). The educational space on Instagram increasingly becoming a collaborative effort between peer-teachers, clinicians, and other medical professionals in the future will allow for the platform to deliver a more comprehensive anatomy learning experience by providing students greater access to the expertise of professional educators worldwide and potentially more reliable factual content (El Bialy & Jalali, 2015; Nouri et al., 2022).

Another significant limitation of using Instagram posts as a tool for education is that it provides students with passive learning

resources and has limited ways in which users are able to interact with authors and their posts. Our results demonstrated a shift in how learners interacted with posts, particularly highlighting an overall significant reduction in likes from 2019 to 2021 and no significant change in overall presence of comments. The concept of “lurkers” or learners who choose to passively observe information in this manner as opposed to actively participating has been well studied to be a disadvantage of teaching on social media platforms (Bozkurt et al., 2020). Social media sites have previously been credited with being able to promote social learning theory which proposes that learning occurs when people with a common interest come together to collaborate and share ideas (Flynn et al., 2015). However, with a decline noted in engagement within this study it cannot be determined whether current levels of interaction on the site are truly educationally beneficial for learners.

Incorporating social media within education also introduces concerns regarding the ethical and legal policies of posting of sensitive content, particularly issues surrounding sharing and disseminating digital images or videos containing copyrighted illustrations, cadaveric specimens, identifiable patient information, and otherwise inappropriate content (Lottering et al., 2022). On sites, such as Instagram, the post author remains responsible for seeking permission to upload content, safeguarding personal information, and preventing the dissemination of hate speech or dangerous misinformation (Pater et al., 2016). Though Instagram provides some safeguards through the terms of use, such as banning unlawful and confidential content, the site relies on users reporting inappropriate content, by which time the content may already be disseminated (Cornwall, 2016; Lottering et al., 2022). Incorporation of sites, such as Instagram into an educational program should therefore be carried out alongside a discussion with content creators and learners on how to utilize the social media appropriately and the importance of maintaining patient privacy and confidentiality. (Douglas et al., 2019; Wanner et al., 2019; Instagram, 2022).

The strengths of this study include a large number of analyzed posts, spanning two periods approximately 2 years apart to appreciate the change in trends before and after the pandemic. This study acknowledges the prior experiences of the student researchers may impact data collection, as both are active users of Instagram with an interest in medical education and anatomy. Ultimately, this allowed the research team to effectively navigate Instagram during data collection and understand the nuances of student and author interactions in order to categorize posts into a range of its purpose such as humor and inspiration.

LIMITATIONS OF THE STUDY

There are limitations identified within this study, such as the subjective nature of categorizing the posts into themes. Measures were put in place in order to ensure consistency within our analysis. Two authors reviewed each post independently before coming to a consensus on the most suitable category. However, this cannot completely

eliminate the variation of results that different perspectives may produce. Future studies may employ stricter and more explicit criteria to allow for more objective and non-biased organization of data.

Additionally, the authorship for individual posts was determined according to the public Instagram biographies given, and this information was not corroborated with other sources of information, hence has the potential to be false or inaccurate. Verification of all credentials that authors claim to possess on their pages will therefore be important to confirm as our findings suggest an increase particularly in clinician engagement. It is therefore crucial to determine if this is a true increase or instead false claims made by authors as a way of falsely reassuring users of the reliability of the content as it has been previously determined that the public trust clinician authors to be a more credible source of information (Ventola, 2014). Authors of posts may therefore mimic clinicians in order to popularize their accounts or to appear more trustworthy. Additionally, a large proportion of authors were unknown across both assessed time periods making it difficult to determine the true extent to which the proportion or the significance of author type increasing or decreasing may be.

Furthermore, within this study, only English language posts were coded and assessed. Given the global audience on social media sites it is vital that any further analyses of educational content on Instagram also assesses the content of posts in several other languages to determine if the trends noted in this study are reflective for students and learners internationally.

FUTURE DIRECTIONS

Though Instagram appears to be an increasingly popular source for anatomy learning the evidence base regarding the impact of educational resources available remains limited. Previous studies have determined that students who consistently engaged with relevant educational material on Instagram felt more confident when approaching examination questions (Galiatsatos et al., 2016; Essig et al., 2020). However, there is currently no evidence demonstrating that engagement with anatomy educational resources on Instagram directly improves students' knowledge or assessment results (Cheston et al., 2013). More work is therefore required to determine the impact of social media in a more objective manner, such as analyzing the assessment performance of students using Instagram as an additional revision tool compared to a controlled cohort.

Moreover, the trends that we have noted need to be tracked prospectively to analyze whether the shifts we have identified have been sustained or have altered further. This is especially important given the rapidly evolving nature of social media and the emergence of new platforms and features in 2022 and 2023. On Instagram, for example, “stories” are an increasingly common feature. Instagram stories are images, text, or video-based posts available on a users' homepage for only 24h and can contain more interactive features, such as multiple-choice questions and real-time reactions. The

multiple-choice question feature in particular allows for more anonymous engagement with only the original author of the post being able to see who has answered a question. This may allow students to feel more comfortable with interacting with the content (Roberts & Rajah-Kanagasabai, 2013). Including “stories” in a future analysis would enable a comparison to traditional posts and could help determine whether this feature truly can provide more engaging anatomy education.

CONCLUSIONS AND IMPLICATIONS

This study analyzing Instagram posts on anatomy education under the hashtag “#anatomynotes” in 2019 and 2021 is the first to begin to describe the anatomy education content available on Instagram as well as highlight the temporal changes and trends within these posts, and how these changes may impact on anatomy learning. These posts extend beyond basic sciences education and provide humor and inspiration to engage students outside of the classroom, as well as enhance opportunities for both near-peer and clinician led teaching. Instagram posts have been shifted toward image and 3D-interactive formats from text-based posts, as educators and students from a variety of specialties point out its utility as a visually engaging anatomy revision tool. It remains to be seen whether engagement with these Instagram posts will objectively improve students' performance at medical school, and if so, what the conditions of interaction are for students to maximize the benefits of Instagram as an educational platform.

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