Viewership footprint for a low-resource, student-centred collaborative video platform to teach orthopaedics in southern Africa

G S Wever,[1] MB ChB; **I Elliott,**[2] MB ChB; **J McCaul,**[1] MB ChB, FC Orth (SA), MMed (Orth); **M Workman,**[1] MB ChB, FC Orth (SA), MMed (Orth), BSc (Physio); **M Laubscher,**[1] MB ChB, Dip Pec (SA), MMed (Orth), FC Orth (SA); **R N Dunn,**[1] FC Orth (SA), MMed (Orth); **M Held,**[1] MD, PhD, FC Orth (SA), MMed (Orth)

[1] *Orthopaedic Research Unit, Department of Orthopaedic Surgery, Groote Schuur Hospital, Red Cross War Memorial Children's Hospital and Faculty of Health Sciences, University of Cape Town, South Africa*

[2] *Visiting orthopaedic trainee, Department of Orthopaedic Surgery, Groote Schuur Hospital, University of Cape Town, South Africa; and University of Utah, Salt Lake City, USA*

Corresponding author: *M Held (michael.held@uct.ac.za)*

Background. Institutions are increasingly using technology to augment the class learning experience of medical students. Especially in Africa, local content is key to allow insights and knowledge to emerge and build transformative capacity for students and patients. There is currently no peer-reviewed video content produced by students with the aim of providing education on orthopaedic topics for medical students and patients in this region.

Objectives. To evaluate the demographic and geographical viewership as well as video-specific statistics of orthopaedic teaching videos for medical students on a YouTube channel, with the expressed aim of informing future content production.

Methods. Videos were produced by South African (SA) medical students as a problem-based collaborative project. Student-owned smartphones and various types of free video editing software were used to produce these videos, which were then assessed by a group of orthopaedic specialists and uploaded onto a YouTube channel (UCTeach). The analytical reports of this channel generated by Google and YouTube were analysed regarding watch time per day (minutes), average view duration (minutes), most watched videos, top geographies, age and gender.

Results. A total of 83 videos were uploaded to the UCTeach Ortho channel during a 2-year period, with a total watch time of 857 062 minutes and 337 983 views. The majority of viewers were between the ages of 18 and 34 years (85%). India had the most views (*n*=69 089), followed by the USA (*n*=66 257) and SA (*n*=21 882). Most of the videos were watched on mobile phones (*n*=183 299) and computers (*n*=128 228). The most watched video, produced in April 2016, was on physiological and pathological gait, with 51 314 views.

Conclusions. Our study provides proof of concept for a new educational material creation and dissemination strategy. A low-cost local collaborative orthopaedic video project by medical students for medical students can lead to high view counts and watch time on YouTube. It is accessible to audiences in low-, middle- and high-income countries. The students' educational videos also reached a global audience consistently over a 3-year period.

S Afr Med J 2020;110(6):532-536. https://doi.org/10.7196/SAMJ.2020.v110i6.14348

The use of technology has disrupted the historical pedagogical approach in classrooms and continuously creates new forms of teaching practice. Over the past several years, orthopaedic learning has expanded to include online videos of topics ranging from surgical techniques to physical exam manoeuvres.[1] These videos reach a broad audience, from orthopaedic faculty to medical students. Student-led creation of media such as educational videos can connect students with external experts, create novel educational content, and stimulate ongoing discussions after formal lessons.[2] Open-source videos in the classroom, and especially the generation of such videos, can therefore improve participation when used as a learning tool.[3] Involving students actively in the content creation of this medium creates a student-centred learning process. Here, students become teachers and obtain greater benefit than students who only learn for their own benefit – this is also known as the 'protégé effect'.[4,5] As a result, an online student-centred multimedia learning process can reach a diverse global audience, and allow the video creators to understand the content more deeply.[6,7]

These processes could be used in southern Africa, where access to surgical programmes is not uniformly available, which may contribute to one of the lowest surgeon-to-inhabitant densities in the world, 0.05 - 1.3 per 100 000.[8] Large distances make it cumbersome to connect students to educators, patients to surgeons and surgeons to each other, which limits training and educational opportunities. This situation is aggravated by severe resource restrictions. Multimedia teaching content is therefore an attractive option to reach a broader audience, but historically it has been hampered by production costs.

The growing availably of internet and smartphone devices in southern Africa is resulting in increased use of online teaching platforms, which allow unique opportunities to overcome some of these challenges.[9-11] Yet, owing to significant resource restrictions, there is limited local experience in the role and feasibility of technology and augmented learning for medical students in the form of videos.[12]

Objectives

To evaluate the viewership statistics of the orthopaedic teaching videos on YouTube created by South African (SA) medical students for their peers, and to assess the demographic and geographical make-up of the viewers and the most popular types of videos. The

purpose of understanding these data is to inform targets for future videos and to make improvements to the format of the videos.

Methods

Videos

The Department of Orthopaedic Surgery at the University of Cape Town initiated an assessment task for 5th-year medical students. Groups of three were given relevant orthopaedic topics, ranging from examination techniques to common orthopaedic problems, with guidelines on how to create an audiovisual presentation no longer than 7 minutes. The videos were graded as part of their final mark for the rotation with regard to content, graphics, technical production, ability to work in a team, and delivery. The videos were reviewed by orthopaedic specialists, and once the content was approved, they were uploaded to the UCTeach Ortho YouTube channel created in 2016.

Watch time in minutes for each day and average view duration, top 10 watched videos, top geographies, gender, and playback devices were analysed.

Statistics, data types and validation

A convenience sample of the standard analytical reports from the YouTube Studio channel analytics, made available by Google and YouTube (as its subsidiary), was downloaded at a single time point in March 2019 and included data for all UCTeach Ortho videos uploaded since inception in February 2016. This online analysis is live and ongoing (e.g. statistics update continuously as viewers worldwide access the videos), and new student videos are added every 2 months.

Standard analytical reports can be viewed for the entire channel or per selected video. They include subsections such as overview, engagement, audience and reach. Overview includes categories such as top videos (by views), number of views, total watch time and subscribers. Engagement includes total watch time and average view duration. The audience subsection provides data on number of unique viewers, average views per viewer, and demographic information (gender, age and the country viewed from). The 'reach' subsection provides data on how viewers came to the channel – e.g. from a Google search, WhatsApp or Facebook link, or by following a 'suggested videos' link from another video. This subsection was not included in the study analysis, but may provide opportunity for further study.

Google/YouTube Studio analytics has built-in systems of algorithmic validation of statistical reports. For example, during viewership count, only valid views are counted and low-quality playbacks that are assessed as views by a computer program instead of a human are discarded. Similarly, subscriber count is validated by verifying the legitimacy of accounts and removing subscribers that are in fact spam subscriptions.

Descriptive statistics were used to evaluate the analytics. Means were compared for each category in each subsection. The raw data provided by Google/YouTube did not allow for the granularity necessary to calculate the confidence interval (CI) or standard deviation for most metrics, although for those metrics that were reported in means, mean and 95% CI were calculated.

Ethics clearance

Ethics clearance was obtained from the Faculty of Health Sciences Human Research Ethics Committee, University of Cape Town (ref. no. 185/2018).

Results

A total of 83 videos were uploaded during the 2-year period, with a total watch time of 857 062 minutes and 337 983 views. Data for unique viewers were not available before August 2017, but viewership data after that showed an average of 1.3 views per viewer, implying ~259 986 unique viewers. The average watch time per video was 2.16 minutes (95% CI 2.00 - 2.32), although the average length of each video was 6.71 minutes (95% CI 6.30 - 7.12). Average video viewing time also decreased from ~6 minutes in 2016 to 2 - 3 minutes in the following years.

The top 10 videos regarding watch time (Fig. 1) used predominantly Khan-style tablet drawings and pictures rather than face recording of a person talking. The most watched video was on physiological and pathological gait, with a total of 51 314 views (Fig. 1). Although the video was 7.48 minutes in duration, the average viewing time was only 2.9 minutes. The most watched video in the USA was 'How to do a Bier's block', and in India, 'Management of tuberculosis of the spine'. Videos specifically made for patient education had very low view counts of <100 per video.

Among the top 50 most-viewed videos, there were 11 procedural videos with 105 040 views. 'How to do a digital block' was most viewed at 49 800. Other procedural videos were on how to do a Bier's block, Thomas traction splint application, knee aspiration, intra-articular injections, application of plaster of Paris, reduction of shoulder dislocation (two videos), Cone's calliper application, below-elbow plaster application and below-knee plaster application. Ten videos were on the topic of clinical examination (21 410 views). Most popular was hand examination at 5 322 views; others included three hip exam videos, another two hand exam videos, a knee exam video, two shoulder exam videos and one video on elbow anatomy and examination. Seven videos with 65 508 views addressed X-ray interpretation. Most viewed was 'How to look at cervical spine X-rays' (26 219 views), followed by 'Approach to orthopaedic radiography' and videos on how to look at cervical spine X-rays, how to assess a shoulder X-ray, X-ray of supracondylar fractures, diagnosing cervical spine fractures, and X-ray of ankle fractures. The rest of the top 50 videos were general educational videos on conditions or concepts such as gait, osteomyelitis, American Spinal Injury Association (ASIA) score, etc. and received 126 669 views as a category. 'How to make a medical educational video' featured at number 45 most popular as the only non-medical educational video, with 1 263 views.

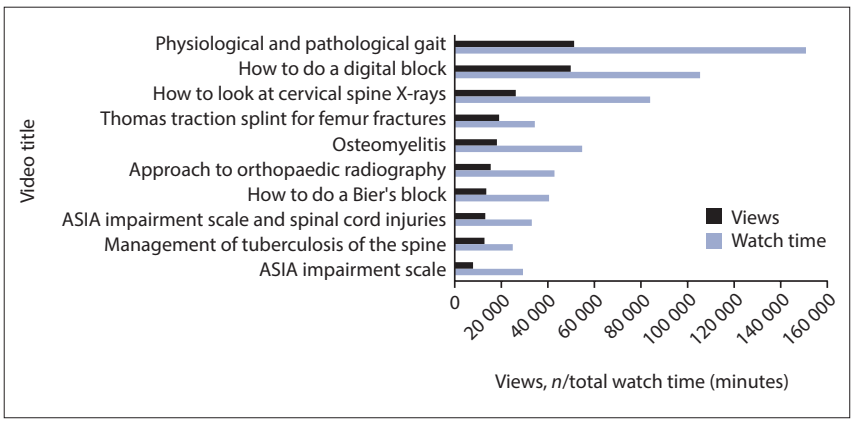

Fig. 1. Number of views per video title. (ASIA = American Spinal Injury Association.)

Most viewers were between 18 and 34 years of age (85%), most were male (61%), and the largest number were aged 25 - 34 years (48%) (Table 1).

Most views were from India (*n*=69 089; 32%) followed by the USA (*n*=66 257; 31%) and SA (*n*=21 882; 10%) (Fig. 2). Videos were watched by 892 viewers in low-income countries, for a total watch time of 1 792 minutes. The majority of these viewers were from Nepal (*n*=602), although eight different low-income countries in Asia and Africa were represented (Fig. 3); 922 viewers from 16 different African countries (15 outside SA) watched the videos (Fig. 4). Low-income and lower-middle-income countries accounted for 10% of the viewership (Table 2).[13]

Most of the videos where watched on mobile devices (*n*=183 299; 54%) and computers (*n*=128 228; 38%) (Fig. 5).

Discussion

Our study showed that a low-cost, student-centred, collaborative production of orthopaedics teaching videos specific to southern Africa led to high viewing counts and watch time on an open-source platform. At the time of data collection, the channel had 2 900 subscribers and 83 videos, with the top video (on gait) having been watched 51 314 times. No other YouTube channels consisting of orthopaedic teaching videos made *by* medical students could be identified for a frame of reference. Cairo University OrthoTube channel has 1 140 subscribers, with 38 videos. Their most watched video was on fracture healing, with 1 100 views. The Young Orthopod is an Indian channel for medical students, with 13 600 subscribers and 43 videos, with the most watched videos being on fracture healing (266 000 views) and club foot (61 000 views).

Interestingly, the majority of views originated outside of the targeted audience of SA. This study does show that videos produced in a middle-income country can and do reach audiences in both low- and high-income countries at relatively high view rates. It should be noted that the content was created using basic equipment such as smartphone cameras and free video editing software. The production of the videos was therefore not restricted by a lack of resources.

Table 1. Viewer age groups

Viewer age (years)	Viewers, %
18 - 24	37.2
25 - 34	48.3
35 - 44	13.1
45 - 54	1.4

Table 2. Viewership representation according to income status

Income status	Viewing countries (*N*=79), *n* (%)
High income	34 (43.0)
Middle income	37 (46.8)
Low income	8 (10.1)

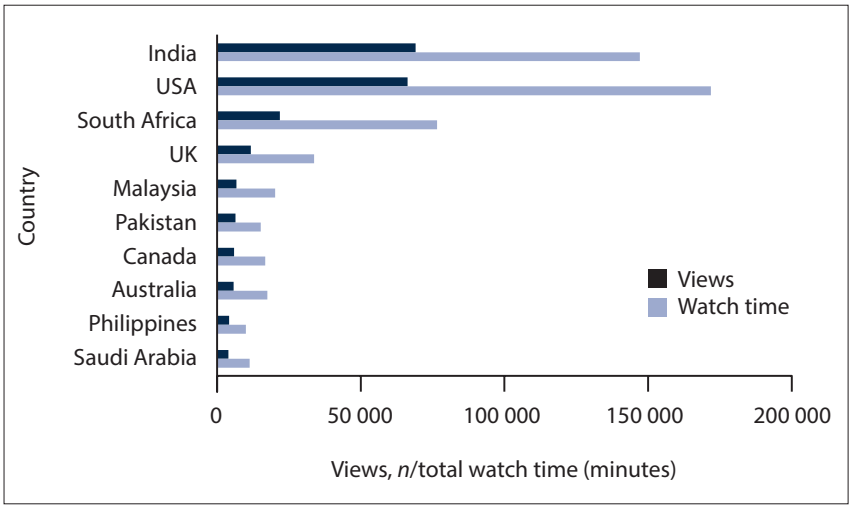

Fig. 2. Countries with most views.

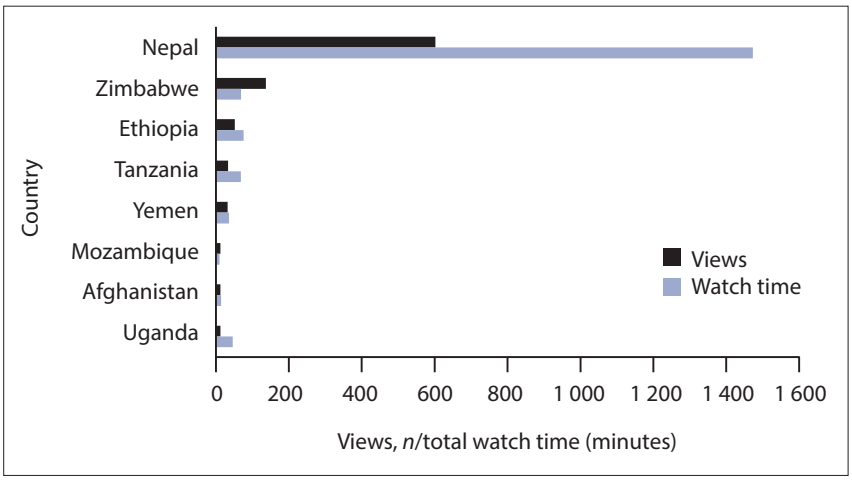

Fig. 3. Low-income countries by number of views.

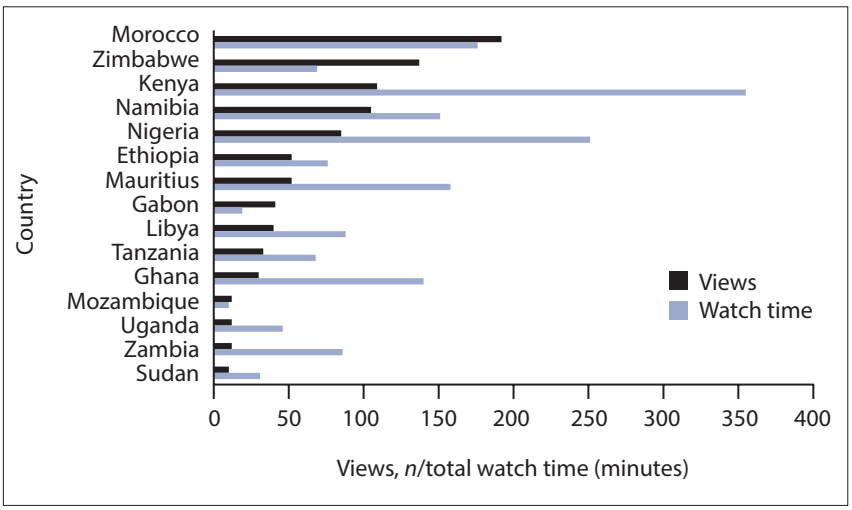

Fig. 4. African countries by number of views.

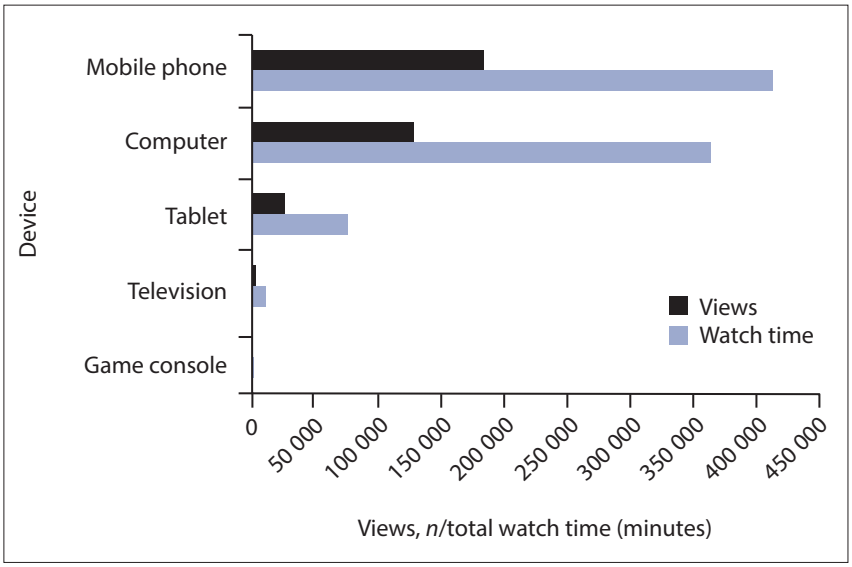

Fig. 5. Device type by number of views.

Most viewers in SA were around the age of medical students in the country (18 - 24 years) and slightly younger than viewers from India or the USA. A possible reason for this finding could be that the students producing the videos in SA discussed the existence of the videos with their peers. The average age of viewers in the USA falls into the age range typical for resident trainees, as US medical students' average age as first-years is 23, and 26 by senior year (i.e. when they graduate to enter residency).[14] The average age of viewers in India still falls into the age expected of their medical students, as the average age of medical students in India is ~20.[15] We assume that most viewers are in some stage of medical training, though this cannot be known for certain based on the data collected.

We also found that the viewing time per video was much shorter than its duration. In a study of student-video engagement in e-learning environments, Guo *et al.*[16] found that video duration >6 minutes decreased student engagement with the material, and that engagement dropped off precipitously, with only 50% engagement with videos between 9 and 12 minutes long. There could be many reasons for the short viewing time of these videos. Viewing time could be indicative of attention span, or of the time it took to convey the major point of the video. Either way, the actual watched duration could be used as a guide for future videos.

The most successful videos in terms of viewership used Khan-style tablet drawings, named after the Khan Academy style of educational video that employs sketching out the lesson with audio – similar to drawing on a whiteboard or chalkboard. It focuses on a live drawing rather than a teacher's face during explaining.[17] This finding is in keeping with previous evidence showing that short videos, Khan-style drawings and informal talking-head videos are more engaging than pre-recorded high-quality classroom videos.[16]

The most popular videos were those that reached a broad training audience, such as ones on general orthopaedic topics/pathologies and clinical examinations. These videos appealed to audiences both in southern Africa and in places like the USA. The video 'Management of tuberculosis of the spine' was viewed 12 756 times. Of these views, 27% originated from India, and it was also watched in the Philippines, both countries with a high TB and drug-resistant TB burden.[18]

Some of the videos were specifically produced for patient education – to be viewed by patients. These had low view counts and viewing time. The low numbers of views for these videos may indicate that patients fail to search for them successfully, or that patients access sources of information other than videos on the internet. To increase access, videos could therefore be shown in hospital and clinic facilities, much like patient-focused educational programmes in the USA targeting arthroplasty patients.[19,20]

Study limitations

There are several limitations to this study. It was a retrospective study using analytics from a third-party website regarding viewership, so data interpretation is entirely based upon the quality of data collection by Google. For the purpose of this study, it was assumed that this is done in a rigorous manner.

There was limited scope of available data, which limited the types of inferences the authors could draw about the users, as well as whether they gained knowledge from the videos, or how the videos were applied. The field of work or study of the viewers is unknown, so it is unclear what percentage of viewers are in the medical field, and if they are, at what stage of training.

The videos were produced for a specific audience in southern Africa, although they obviously have some appeal to a broader audience. The country of origin of viewership is also inferred from the IP address of the viewer, while some viewers from more restrictive countries may use VPN (virtual private network) or other methods to access YouTube, resulting in a false impression of their actual location.

There is little direct feedback on what subjects to explore or how to improve the video presentations. Some suggestions do appear in the 'comments' section, and this may be an opportunity for further study.

Conclusions

Our study has provided proof of concept for a new educational material creation and dissemination strategy: a strategy that is online, low cost, easy to use, scaleable and student driven. It has highlighted that a problem-based, collaborative video project can lead to high viewing counts and watch time on YouTube in SA, also reach Indian and American viewers, and be enjoyed by countries across all income groups.

The average age of our viewers and that of medical students matched, especially in SA. Videos using Khan-style drawings and informal talking-head videos had high view counts. The average watch time was <3 minutes, indicating the target for acceptable video duration for viewers.

The local student-based production of educational videos was accomplished without the use of costly equipment, software or specialised media staff. Lack of access to resources is often a barrier, but did not prove problematic in our case. Across the 4 years it has been viable and successful in terms of continuous production of videos, reach and viewership.

Further targeted assessment, both quantitative and qualitative, would be required to better understand the needs and use patterns of end users. This would inform creation of future material. The platform of education is changing, and educators and students need to change with it. This study provides an example of a student-led online initiative. The viewership results can help to

inform both local and international cohorts of educators in how to better create material and utilise this platform in the future.

Declaration. None.

Acknowledgements. None.

Author contributions. GSW wrote the protocol, analysed the data and wrote the initial manuscript. IE analysed the data and critically reviewed the final manuscript. JM contributed to the concept and design of the video project, and addressed editorial comments to complete the final published manuscript. MW contributed to the original protocol, literature review and reviewed manuscripts. ML and RND contributed to the design of the project and critically reviewed the final manuscript. MH conceptualised and designed the study, contributed to the analysis and interpretation of data, and oversaw the writing of the manuscript.

Funding. Support was received from the Harry Crossley Foundation in the form of funding that covered publication costs.

Conflicts of interest. None.

1. VuMedi. https://www.vumedi.com/accounts/login/ (accessed 15 March 2019).
2. George DR, Dellasega C. Use of social media in graduate-level medical humanities education: Two pilot studies from Penn State College of Medicine. MedTeach 2011;33(8):e429-e434. https://doi.org/10.3109/0142159x.2011.586749
3. Buzzetto-More N. Student attitudes towards the integration of YouTube in online, hybrid, and web-assisted courses: An examination of the impact of course modality on perception. J Online Learn Teach 2015;11(1):55-73.
4. Kristensen P, Bjerkedal T. Explaining the relation between birth order and intelligence. Science 2007;316(5832):1717. https://doi.org/10.1126/science.1141493
5. Chase CC, Chin DB, Oppezzo MA, Schwartz DL. Teachable agents and the protégé effect: Increasing the effort towards learning. J Sci Educ Technol 2009;18(4):334-352. https://doi.org/10.1007/s10956-009-9180-4
6. Eick CJ, King DT Jr. Nonscience majors' perceptions on the use of YouTube video to support learning in an integrated science lecture. J Coll Sci Teach 2012;42(1):26-30.
7. Duffy P. Engaging the YouTube Google-eyed generation: Strategies for using Web 2.0 in teaching and learning. Electron J E-Learn 2008;6(2):119-130.
8. Dell AJ, Gray S, Fraser R, Held M, Dunn R. Orthopaedic surgeon density in South Africa. World J Surg 2018;42(12):3849-3855. https://doi.org/10.1007/s00268-018-4709-4
9. Poushter J. Smartphone ownership and internet usage continues to climb in emerging economies. Pew Res Cent 2016;22:1-44.
10. Romanov K, Nevgi A. Do medical students watch video clips in eLearning and do these facilitate learning? Med Teach 2007;29(5):490-494. https://doi.org/10.1080/01421590701542119
11. Nicole A. An examination of undergraduate student's perceptions and predilections of the use of YouTube in the teaching and learning process. Interdiscip J E-Ski Lifelong Learn 2014;10:017-032. https://doi.org/10.28945/1965
12. Frehywot S, Vovides Y, Talib Z, et al. E-learning in medical education in resource constrained low- and middle-income countries. Hum Resour Health 2013;11(1):4. https://doi.org/10.1186/1478-4491-11-4
13. World Bank. DataHelpDesk. https://datahelpdesk.worldbank.org/knowledgebase/articles/906519 (accessed 6 January 2020).
14. Frank E, Carrera J, Elon L, Hertzberg V. Basic demographics, health practices, and health status of U.S. medical students. Am J Prev Med 2006;31(6):499-505. https://doi.org/10.1016/j.amepre.2006.08.009
15. Iqbal S, Gupta S, Venkatarao E. Stress, anxiety & depression among medical undergraduate students & their socio-demographic correlates. Indian J Med Res 2015;141(3):354-357. https://doi.org/10.4103/0971-5916.156571
16. Guo PJ, Kim J, Rubin R. How video production affects student engagement: An empirical study of MOOC videos. Proceedings of the first ACM conference on Learning @ scale conference, March 2014. https://doi.org/10.1145/2556325.2566239
17. Khan Academy. http://www.khanacademy.org (accessed 15 March 2019).
18. Sharma A, Hill A, Kurbatova E, et al. Estimating the future burden of multidrug-resistant and extensively drug-resistant tuberculosis in India, the Philippines, Russia, and South Africa: A mathematical modelling study. Lancet Infect Dis 2017;17(7):707-715. https://doi.org/10.1016/j.ijtb.2017.08.020
19. Yoon RS, Nellans KW, Geller JA, Kim AD, Jacobs MR, Macaulay W. Patient education before hip or knee arthroplasty lowers length of stay. J Arthroplasty 2010;25(4):547-551. https://doi.org/10.1016/j.arth.2009.03.012
20. Lin PC, Lin LC, Lin JJ. Comparing the effectiveness of different educational programs for patients with total knee arthroplasty. Orthop Nurs 1997;16(5):43-49. https://doi.org/10.1097/00006416-199709000-00013

Accepted 3 March 2020.