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Videos in Anatomy Education: History, Present Usage and Future Prospects

Videos en la Educación de la Anatomía: Historia, Uso Actual y Perspectivas Futuras

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SUMMARY: Anatomy has a history as a critical area of study for medical and health professional programs. Over the last several decades the way in which anatomy is taught and the resources available to aid the delivery of material has evolved significantly. One of these resources has been videos, and their role in anatomy education has transformed over this time due to technological advancements and curricula reform. While there have been significant advances in video technology and their usage, there is still a scarcity of research supporting the various purposes of anatomy videos. Differences in the results of studies that have been published highlight the complexity of successfully integrated anatomy videos into curricula. However, they have been shown to be a potential supplement to reduced teaching time in anatomy, as a pre-conditioning tool prior to laboratory, and as a summary method for classes. Students perceive them as a highly important resource for revision and preparation for examinations. Further research is needed to identify the important components of anatomy videos that lead to their successful implementation. These factors seem to be important to define as many programs face reduced hours with cadaveric material and institutions utilise greater components of computer based instruction into their educational design.

KEY WORDS: Human anatomy; Anatomy education; Medical education; Videos.

INTRODUCTION

Teaching of anatomy has universally and historically underpinned medicine and health professional education. To develop a good understanding of function and pathophysiology the students first require a depth of understanding of structure of the human body. To deliver the large content of material associated with anatomy, didactic pedagogy was historically solely utilised. Lectures were used to present material, and cadaveric dissection to enhance 3-dimensional relationships of structures and tissues, as well as simulating a surgical environment (Chan & Pawlina, 2015). Dissection was the main method of teaching anatomy from the birth of modern anatomy education in the medieval and renaissance medical school (Aziz *et al*., 2002; Older, 2004). However, this started to change in the mid-twentieth century as anatomy started to be taught into a greater number of educational programs and the demand on resources and finances to fund these methods became increasingly influential to curricula. Anatomy education received additional pressure with declining hours dedicated to anatomy teaching within medical and health professional curricula as these programs expanded to integrate professional skills and imaging techniques that were not previously taught (Drake, 1998; McLachlan *et al*., 2004; Drake, 2007; Drake, 2014; Drake & Pawlina, 2014; Keim Janssen *et al*., 2014).

These pressures and research into teaching methodology and psychology, were a few catalysts for a surge in research into newer teaching methods, curriculum designs and innovations that could be adapted into anatomy education. The last several decades have seen transformations in anatomy education, with and without the evidence to support it (Drake, 1998; Drake *et al*., 2014). The efficacy of these changes has been called into question with common concerns amongst the health profession, and academic staff that the changes are impacting on students' amount and depth of anatomical knowledge (Prince *et al*., 2005; Bergman *et al*.; 2008, Brunk *et al*., 2016). Studies are seeking to validate or repute these concerns and measure the impact these changes and use of varied resources have

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had in anatomy education on students' anatomy knowledge and knowledge retention rates (Feigin *et al*., 2007; Granger & Calleson, 2007; Bryner *et al*., 2008; Ahmed *et al*., 2010; Bergman *et al*., 2011; Parmar & Rathinam, 2011; Keim Janssen *et al*.; Jurjus *et al*., 2016).

One addition to resources available in anatomy education that has strongly emerged through technological advancements in the last 40 years and has undergone evolution within that time, is anatomy videos. Technology has created the ability to view dissections or prosections without having to be physically present which has been viewed to be a valuable tool to anatomy education with the growing pressures affecting it (Ogunranti, 1987; Bacro *et al*., 2000; Trelease, 2016).

The way in which videos have been utilised in anatomy education, and what their purpose has been within educational programs has varied (Granger & Calleson; O'Brien *et al*., 2015). This paper will outline the historical development of anatomy videos and the utility in present and future anatomy education.

HISTORICAL DEVELOPMENTS

There are two major factors to consider when looking at the changes to anatomy videos over the past few decades. The first is the technological changes that have occurred, which have greatly changed the structure and accessibility of the videos. The second is the curricula format within which the videos occur and the changes to these curricula that have also occurred during the last several decades. Both the former and the later have greatly impacted upon the purpose of these videos and their utilisation within anatomy education (Jaffar, 2012; Trelease). With these two factors evolving greatly in recent years, research into anatomy videos has needed to evolve with it. However, there is a comparative scarcity of research into their value and utilisation relative to the scale of changes to their format and purpose (Saxena *et al*., 2008).

Video technology has a relatively long history in medical education as videos were used as an educational tool to record patient examinations to demonstrate communication skills in real clinical settings (Anderson *et al*., 1970). This especially became the case in the 1980s as advancements in technology changed their format and made them much more widely available in Video Home System (VHS). However, there were very few reports documenting its use in anatomy education, as most videos available at that time were commercially produced dissection videos (Ogunranti). Most resources available in anatomy, until the late twentieth century outside of the lecture and cadaver rooms, centred around printed materials such as textbooks and atlases (Trelease).

Ogunranti documented the use of videos in anatomy by locally producing videos that was specific to the material that was needed in the educational program that he was teaching. The aim of this study was to assess perceptions of the students of these videos regarding the quality, appropriateness as a resource, and their integration of information clinically. While the technology used is now deemed to be outdated, and more in-depth studies have been conducted on how videos can be utilised (Granger & Calleson; Topping, 2014; Collins *et al*., 2015; Lochner *et al*., 2016), there were two key discussion points that came out of this study that are currently relevant. The first, a highly topical point in modern anatomical education research, is that the author felt anatomy should be taught as a clinically orientated and integrated subject, and as such produced these anatomy videos to reflect this. And second, that locally produced anatomy videos, which can be tailored to the educational needs of the students in that program, have greatly underestimated value in anatomy education.

The next step in technology that changed the use of videos in anatomy education was the improvement of graphic displays on personal computers (PCs) and better affordability to have them in homes and classrooms. The real boom to multimedia learning applications came with the ability to use Compact Disc Read-Only Memory (CD-ROM) (Trelease).

In the 1990s, the next giant leap in the distribution and accessibility of videos came with the improvement of the internet and decreased band width limitations. This saw the identity of anatomy videos become greatly embedded within the new thread of education, computer assisted instruction/computer assisted learning (CAI/CAL) (Bacro *et al*.), which anatomy education has become considerably reliant on (McNulty *et al*., 2009a,b; Lochner *et al*.). Bacro *et al*. detailed the process by which anatomy videos could be filmed, and either stored on CD-ROM or uploaded to secure web based platforms. This ability for distribution of resources and access from home allowed students to be able to view anatomy videos to prepare for laboratory classes. With the authors adapting to the range of internet speeds by providing options of file sizes, the feedback from students for this extremely positive.

The last advancement to the distribution of anatomy videos came with the development of the video sharing website, YouTube, in 2005 (Jaffar). The ability to upload and freely share videos, or create protected groups of sharing

allowed students access to a resource without boundaries (Barry *et al*., 2016). YouTube has become such an established source of videos that by 2015 Barry *et al*. found that 78 % of their students who used web-based platforms to source information were using YouTube as their primary source of videos.

ROLE OF ANATOMY VIDEOS IN MODERN CURRICULA

As mentioned, one of the key factors to assess when looking at the evolving role of videos in anatomy education, is the changes that have occurred in anatomy curricula. Much of the research into anatomical videos has occurred in conjunction with the paradigm shift in anatomy education in health and medical curricula as educators seek to validate or justify teaching old and new methods or resources. Institutions are moving away from didactic teaching methods, towards active, student centred approaches to learning. A greater emphasis is on learning in clinical context with case based learning and vertical integration seeking to improve students' knowledge retention and ability to apply their knowledge (Parmar & Rathinam; Jurjus *et al*.). With this shift in teaching philosophies and methodologies there has been a decrease in face-to-face teaching and a change in how class time is utilised. Learning of content is being shifted to a home-self-directed format, and face-to-face time is used in a case-based format of learning in context (McBride & Drake, 2016). As such the ways in which videos are utilised in anatomy education vary and the research questions and results are different. This makes transferability of results very difficult. In an era where technology is advancing to virtualisation and augmented realities, the main research questions behind the studies are trying to determine their value and in what capacity they are used.

With a decline of time dedicated to anatomy (Drake, 1998; Drake *et al*.), especially for laboratory based activities and a decreased availability of resources such as bodies for dissection, videos are being explored as a possible solution to these newly created challenges (Granger & Calleson; Choi-Lundberg *et al*., 2016b). With dissection being such a time-consuming component of many anatomy courses, Granger & Calleson looked at the impact of alternating dissection with additional resources such as videos. The results showed a decrease in written examination scores when compared to the previous year cohort that performed all the dissections and did not alternate videos and dissection. However, there was no discernible difference in practical results, and no difference in a student's ability to identify a structure depending on whether they had dissected it or watched the video for that. Therefore, it is difficult to draw conclusions from these results regarding the successful use of videos as a substitute for dissection. With alternation of dissection and videos, and reviewing of other student's dissection work, students still received the benefits that are attributed to exposure to dissection (Aziz *et al*.). Mahmud *et al*. (2011), showed no difference to examination results between groups that dissected, and groups that had their learning supplemented with videos of dissection. However, accessibility to the videos in this study was limited and results were not correlated with usage. Neither Granger & Calleson nor Mahmud *et al*. showed any statistically significant improvement to examination results. The difference though, is that Granger & Calleson had partially substituted dissection time with videos, whereas Mahmud *et al*. supplemented dissection with videos. These mixed results demonstrate the complexity with considering the introduction of videos as a substitute or to supplement learning. However, they do suggest that there is value in using dissections videos as a partial substitute to dissection in response to curricula changes, if they are well integrated into the course.

Similar to this utilisation of dissection videos, Topping *et al*. integrated anatomy videos as a direct response to reduced curricula time. Unlike the other studies, which were dissection videos, these videos utilised prosected specimens and consisted of anatomical structures being demonstrated. Rather than being a direct substitute of class dissections time, they were supplementing the material already taught in the class time. This meant they were purely focused on demonstrating the anatomy that was already being taught in class, albeit in a reduced time frame, and contained no dissection techniques. The integration had a positive effect on examination results and demonstrated that anatomy videos can successfully be utilised to supplement material taught in class in response to reduced class hours. The difference in results between this study and Granger & Calleson and Mahmud *et al*. highlights the impact of the varying purpose, content, and surrounding curricula have on the results of the utilisation of videos in these studies. This complexity is representative of a common problem in educational research where results of studies often have little direct transferability to other population groups because the results are influenced by many factors. It takes deep exploration of these many factors, and their combinations, and thus many studies on the same area, to be able to extract transferable outcomes.

The results of the study by Topping *et al*. using prosection videos, when compared with others using dissection videos (Granger & Calleson; Mahmud *et al*.) highlights the necessity of more research on what are the components of anatomy videos that make them a successful or an unsuccessful resource.

UTILISATION OF ANATOMY VIDEOS

One of the major considerations when trying to measure the outcome of integrating videos into anatomy education has been with the purported usage of the videos by students. Studies have sought to answer the question whether students have performed better on examinations when they have had access to anatomy videos (Granger & Calleson; Saxena *et al*.; Mahmud *et al*.). These studies looking at the changes in examination scores with the introduction of videos to teaching have used previous cohorts that did not have access to the videos as controls for the results (Mahmud *et al*.). The results did not show a significant increase in examination outcomes after the videos had been introduced. However, with access to videos now completely online, and not compulsory to view, granting access to them is no guarantee they are being used, and therefore lacks control in measuring outcomes. When looking at results of the groups that have had access to the videos studies several authors (Saxena *et al*.; Choi-Lundberg *et al*., 2016a) have linked increased usage of dissection videos with increased examination scores on directly related anatomy content within the groups exposed to videos. The assumption is that the more times a student viewed the videos, the better they performed (Saxena *et al*.). However, with no baseline performance of these students, it is hard to link the better examination outcomes purely with the usage. While these results were positive they did not examine the obvious consideration that a student accessing more of the videos may also be employing other successful study behaviour, and not purely relying on the videos. This is a common criticism with educational research as most studies are reviewing the success of interventions in programs on students as they are studying rather than conducting controlled intervention trials. The consequence of this is that it is hard to show cause and effect, as there are many variables to consider (Colliver & Cianciolo, 2014).

Assessing the usage of videos also needs to include the pattern and intent of usage of the videos. Typically, this has been done via self-reporting methods such as surveys (Saxena *et al*.; Topping; O'Brien *et al*.), which has the potential to include inaccuracies. With most videos now being available online and in secure platforms that the students can access, studies are able to more accurately quantify the usage of videos by students, even down to an individual basis. Not only this, but the exploration of video usage can be expanded into the pattern of utilisation (Choi-Lundberg *et al*., 2016a). This information can then be combined with information from surveys from students on their perceptions of value and reasons for using videos. Once this information is combined it can provide better insight into how, when and why students are or are not using videos. This could potentially provide valuable insight on how best to maximise utilisation of videos to successfully integrate them as a resource in response to reduced teaching time. Just as importantly it could identify factors that need to be to make them a valuable resource.

One of the main reasons videos have been used as a resource in anatomy education is for the intention that they are used to prepare students for class. This is particularly the case with dissection videos as they teach students techniques as well as anatomical structures and sets expectations of progress stages that students should strive to achieve (Collins *et al*.). Studies measuring the use of videos prior to classes have shown mixed results. Numbers have varied between 39 % (DiLullo *et al*., 2009) to 70 % (Saxena *et al*.) of students using the videos to prepare for class. Choi-Lunberg *et al*. (2016a) found that while only 28 % of the students in their study accessed the video before their dissection class, 50 % of the students had watched all the videos by the end of semester, with the total viewings of videos jumping approximately 20 % in the last week before the exam. This is consistent with student feedback rating "traditional" learning methods and resources to learn anatomical structures as highly important, with videos serving as a highly useful adjunct resource and tool (Davis *et al*., 2014; Choi-Lundberg *et al*., 2016b). The pattern that has been identified is that students are using these online videos at home as resources to revise anatomy and helping them prepare for their exams as they can use it at their own pace as a substitute to lack of access to cadaver specimens at a time of revision (Topping; Choi-Lundberg *et al*., 2016a). This is an important finding to consider when assessing the intervention of videos as a resource. If they are designed as a substitution to class time and are intended to be viewed prior to face to face time, then important learning outcomes may be lost and therefore lead to poorer outcomes. Whereas if the videos are intended to be an adjunct to material taught by other methods, they might be utilised successfully as a resource for students to review the content at their own pace and revise prior to examinations.

With the research demonstrating students' patterns of use of videos as revision resources, the potential value of using videos as a preparatory tool should not be diminished and discounted. In a designed intervention trial, Collins *et al*. established that using short 6 min dissection videos prior to exposure to human tissue was a successful preconditioning tool (in reducing emotional stress before dissections) that led to significantly improved examination results in the intervention group. This study removes pattern of usage and demonstrates a direct cause and effect of videos on examination outcomes. The design of this study highlights the value of videos beyond delivery of content as

the video used was very short and did not cover all of the material taught in the unit. In addition to a statistically significant increase in correct answers on examination questions directly related to video content, an increase in scores for questions not directly related to video content was also observed. The number of these unrelated questions was not enough to make a full analysis and requires further investigation. However, the authors speculate, that by viewing the video prior to dissection it modified the students learning behaviours, encouraging them to apply themselves more due to better defined expectations.

THE FUTURE OF ANATOMY VIDEOS

The challenge now for educators, in a largely online learning platform, is how to change students' perceptions of videos to encourage them to view the videos and reap the benefits of that pre-conditioning prior to class. With the benefits from this pre-conditioning being demonstrated in such a short video, it reveals that the benefits are not all directly related to exposure to content. This being the case, length of video may be a factor to consider when designing videos as a preparatory tool. A short video would not significantly increase the students work load and therefore may entice the students to change their pattern of usage.

With the value being established of using videos as a preparatory tool, researchers should investigate what other factors could be utilised when developing and integrating videos. If these factors are identified and employed, then it could lead to a higher compliance rate of viewing by the students prior to class, and therefore better examination outcomes.

In addition to the use of anatomy videos for pre-conditioning and revision, Sarikcioglu *et al*. (2011) found them to be the most accepted and preferred lesson summary method by students. This was found to be the case regardless of which learning style (as defined by the Kolb's model) the student had preference to (Sarikcioglu *et al*.).

The complexity of factors influencing the successful utilisation of videos may account for why research into the effect of generic YouTube anatomy videos may not have significant impacts on students' examination results. A more successful utilisation of YouTube channels for independent learning may be for institutions to produce their own videos, tailored to the learning outcomes and needs of their programs, and use YouTube as a distribution platform. The additional problem with directing students to YouTube as a resource without specific links to certain videos, is the uncontrolled and potentially inaccurate content that may be available (Jaffar; Singh *et al*., 2012). Assadi & Gasparyan (2015) have questioned whether the future of anatomy videos in anatomy education needs to move towards an academic approach. This would involve a platform from which video creators can officially publish their work where it will be held accountable and its scholarly value can be tracked by measurable citations (Assadi & Gasparyan).

In an era of anatomy education that is being characterised by technological advancements and curricula evolutions, the future of anatomy videos is unclear. Virtual reality and 3D-visualisation technology is advancing and there is excitement for the potential for these technologies. The belief in some institutions is that these technologies are so advanced, that new medical schools can be built with no facilities for cadaveric materials for their programs (Sugand *et al.*, 2010). However, as is often the case with new innovations, the enthusiasm creates a replacement of old with the new, without the evidence to suggest benefit (Rogers, 2003).This is certainly the case in anatomy and medical educational reforms as research lags behind the changes (Colliver, 2002). With the evidence starting to explore the potential uses and benefits of anatomy videos, it would be an educational disservice for them to be deemed outdated. Especially currently, with equipment so advanced and highly accessible, it is very simple for institutions to produce high quality videos and share them easily. The time pressures and educational constraints in current curricula may mean that anatomy videos are needed more than ever.

CONCLUSION

Anatomy videos still have an ill-defined role in anatomy education. They have evolved with technological advancements from VHS, CD-ROMs to easily accessible online videos through institutional platforms and freely accessed video sharing sites such as YouTube. Their role in curricula has varied and as accessibility has changed so has their role in curricula. There is strong evidence to suggest they have value, but further research is needed on how to utilise them to their full potential.

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RESUMEN: La anatomía es una asignatura crítica en los programas médicos y profesionales de la salud. En las últimas décadas, la forma en que se enseña la anatomía y los recursos disponibles para ayudar a la entrega de material ha evolucionado significativamente. Uno de estos recursos han sido los videos, y su papel en la educación de la anatomía se ha transformado durante

este tiempo debido a los avances tecnológicos y la reforma curricular. Aunque existen avances significativos en la tecnología del video y su uso, todavía hay una escasez de investigación en relación a los diversos fines de los videos de anatomía. Las diferencias en los resultados de los estudios que se han publicado destacan la complejidad de integrar exitosamente videos de anatomía en la currícula. Sin embargo, se ha demostrado que son un suplemento potencial para reducir el tiempo de enseñanza en anatomía, como un instrumento de pre-acondicionamiento previo al laboratorio, y como un método de resumen para las clases. Los estudiantes los perciben como un recurso muy importante para la revisión y preparación de exámenes. Se necesitan más investigaciones para identificar los componentes importantes de los videos de anatomía que conducen a su implementación exitosa. Estos factores parecen ser importantes para definir cuántos programas enfrentan horas reducidas con material cadavérico y que instituciones utilizan componentes mayores para la instrucción computarizada en su diseño educativo.

PALABRAS CLAVE: Anatomía humana; Anatomía de la educación; Educación médica; Videos.

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