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Letter to the Editor

Teaching a blind student anatomy during the Covid-19 pandemic.

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To the Editor, Anatomical Sciences Education:

With great interest I read the article titled *'Human Anatomy: Teaching-Learning Experience of a Support Teacher and a Student with Low Vision and Blindness'* by Mendonça and colleagues (2021) and I would like to commend all the staff involved for their commitment in delivering accessible anatomical education. This article describes techniques employed by a highly qualified support teacher to assist a student with low vision and blindness in learning anatomy, in addition to the learning experiences of this student. Further publications have also discussed techniques employed to teach anatomy to students with visual impairments (Diniz and Sita, 2019; Muchlinski et al., 2020, Hospitál, 2020). Only through the dissemination of innovative pedagogies and the sharing of teaching-learning experiences through publication, conferences, and even social media will anatomy educators develop a community of practice that can benefit these students. Furthermore, listening to the experiences of students with disabilities should be a central tenet of successfully understanding their needs, and as such, they should be proactively consulted and empowered to advocate their views (Hurst, 1999).

It is encouraging to hear that the number of students with disabilities enrolled in Brazilian universities is increasing. This positive trajectory mirrors figures in the United Kingdom (UK) and is directly correlated to the introduction of the Equality Act (2010). This act reformed, harmonized and strengthened discrimination law to support progress on equality (Equality Challenge Unit, 2012). It states that institutions must 'make reasonable adjustment in relation to student, staff and services' to ensure that disabled people are not placed at a substantial disadvantage in comparison to non-disabled colleagues (Equality Act 2010). In 2019/2020 there were 332,300 disabled students enrolled in higher education institutes across the United Kingdom, of these 3190 were blind or had a serious visual impairment (Hubble and Bolton, 2021).

While it is promising that the numbers of students with disabilities are increasing there persists gaps in their experiences and outcomes. Unfortunately, these students are more likely to drop out of their degrees, receive lower degree qualifications and experience lower employment outcomes than

students without disabilities (Hubble and Bolton, 2021). Therefore, it is not surprising that the challenges faced by disabled students were exacerbated as a result of the switch to online learning during the Covid-19 pandemic (Office for Students, 2020).

Students of 2019/2020 experienced a drastic, yet necessary transformation to their education due to the threat of the Covid-19 pandemic (UNESCO, 2020). Globally, universities closed their doors and educators worked tirelessly to deliver educational content and assessments in a new online format. Modern technology and the internet were instrumental in this process, however, access to these resources was not universal, with connectivity, technological skills, and financial cost all contributing factors (Adedoyin and Soykan, 2020). Students had to quickly learn to navigate this new learning environment in order to succeed. For disabled students the switch to online learning presented unique challenges due to the diverse nature of their educational needs. For example, neurodiverse students reported that they struggled to participate in interactive synchronous sessions due to the high volume of multitasking necessary, while inaccurate and/or automatic word capturing was a significant barrier to students with hearing impairments (Wilson et al., 2020). Students with mental health concerns reported elevated levels of anxiety due the lockdown impacted their ability to study (Son et al., 2020). Unfortunately, in some cases, students with sensory disabilities were asked to suspend their studies due to the lack of accessible online resources (Wilson et al., 2020).

The online delivery of anatomy education specially also presented unique challenges due to the tactile and three-dimensional (3D) nature of the subject (Longhurst et al., 2020; Dulohery et al., 2021). Despite this, the anatomy learning environment demonstrated a resilience and capacity to adapt to the threat of a global pandemic (Baptiste, 2021). This was driven by innovative educators who responded by using technology to maintain high standards of anatomical education globally (Evans et al., 2020). Students benefited from 3D models, and digitized cadaveric resources (Longhurst et al., 2020; Flynn et al.,2021). However, students struggled with lack of access to physical resources in order to fully appreciate anatomical variations and pathologies (Böckers et al, 2020 ; Cheng et al., 2020; Evans and Pawlina, 2021; Naidoo et al., 2021). While challenges for

anatomy education have been discussed (Longhurst et al., 2020) there is a paucity in the literature regarding the unique experiences of disabled students. Despite this, Pacheco and colleagues (2020) describe the technological challenges of teaching anatomy to students with intellectual disabilities during the Covid-19 pandemic, including the lack of practical classes. In addition, Mendonça and colleagues (2021) acknowledge that understanding the challenges of learning for students with low vision and blindness during the pandemic should be recognized in order to develop new teaching and learning strategies (Meleo-Erwin et al., 2021). Therefore, this letter aims to describe the experiences of teaching an allied healthcare student with blindness during the Covid-19 pandemic and the strategies used to accommodate them, in conjunction with the challenges faced. This is important as many universities are considering delivering anatomical education through a blended approach in the future (Longhurst et al., 2020; Böckers et al., 2021; Onigbinde et al., 2021; Shahrvini et al., 2021). Consequently, adjustment and accommodation in order to deliver accessible online education may be necessary.

The student with blindness was enrolled in an interprofessional module comprising of first year undergraduate students from medicine, diagnostic radiography, occupational therapy, physiotherapy and health care science. Anatomy was taught over seven weeks, with a preliminary lecture and a subsequent practical session in the dissection room (DR). With the advent of the Covid-19 pandemic, all in-person teaching shifted to an online format. Lectures were delivered through Panopto video platform (Panopto Inc., Seattle, WA) and practical sessions were replaced with a 'virtual online workbook' (VOW) that students worked through asynchronously on Canvas learning management system (Instructure, Inc., Salt Lake City, UT) and interactive question and answer sessions that were delivered synchronously through an open source web conferencing system, the Big Blue Button (Big Blue Button Inc., Ottawa, Canada). The VOW replaced the traditional DR handbook and consisted of webpages embedded with multimedia. This included joint photographic experts group (JPEG) images and graphics interchange format (GIF) animations of cadaveric specimens, illustrations and diagrams; three-dimensional (3D) anatomical models; hyperlinks to Acland's Video Atlas of Human Anatomy (Acland, 2013) and other educational websites, including

YouTube(TM) (YouTube, San Bruno, CA); and bespoke videos. The bespoke videos were created in the DR with bones, cadaveric prosections, plastinated specimens, plastic models, and included tutorials using the 3D software Complete Anatomy (3D4Medical/Elsevier, Dublin, Republic of Ireland). The VOW received positive feedback and all students passed the written multiple-choice summative assessment.

Regrettably, the VOW proved to be an inaccessible resource for the student with blindness for a number of reasons, and as such, they were unable to sit the summative written assessment (which has been re-arranged for summer 2021). Firstly, due to the large volume of media embedded within Canvas learning management system, the screen reader did not work efficiently. Secondly, the student's support worker had no previous training in anatomy [unlike the support worker in Mendonça and colleague's report (2021)]. While they could read the text to the student, they had no comprehension of how best to describe the structures within the visual media. Consequently, the student had no context to base their understanding of anatomy. Therefore, online learning of anatomy for this student was unfeasible during the initial Covid-19 lockdown.

Once government restrictions were relaxed, alternative face-to-face sessions in the DR were essential to facilitate anatomical understanding. The anatomical position, basic terminology and joint and muscular function were demonstrated using the student's own body. Palpation of resources (both cadaveric and non-cadaveric) and surface landmarks, while the lecturer didactyly described the anatomy, was vital to ensure that the student could build up a 3D representation (proprioceptive/tactile map) of the structures. To this end, ensuring the student understood the orientation of resources in relation to its position in their own body (i.e., what surface was anterior/posterior) helped facilitate understanding. Analogies were also used to help the student understand certain concepts, for example, describing the chambers of the heart like the rooms in a house. A support worker was present during these sessions, however they could not facilitate the teaching as they lacked anatomical training. Their main responsibility was to help the student access the university facilities and audio record the sessions.

Other authors have described the benefits of using 3D printed models to teach anatomy to visually impaired students (Stangl et al., 2015; Jo et al., 2016; Kolitsky, 2016; Witowski, 2016), however these were not available at the said initiation. Alternative creative techniques have also been employed, for example using hot-melt adhesive, pins and fabrics to produce tactile resources (Diniz and Sita, 2019). Other low-cost arts and crafts materials can be utilized, such as puffy paint to create tactile diagrams, while playdough, pipe cleaners and string can be used to create tactile representations of structures, such as blood vessels and nerves. For students with low vision, simple accommodations in the DR can be beneficial, including using additional light sources and magnifying glasses.

Upon reflection, it may have been possible to teach this student remotely using teleconferencing software, if they had access to tactile anatomical resources. For example, the student could have borrowed plastic/3D printed models from the DR, and/or creative resources could have been sent to their home. A support worker would need to be present to help orientate the resources, while the anatomy teacher could describe the content through a video call. Further investigation into the feasibility of this method is necessary.

Lack of time to prepare accessible resources for this student was the main barrier to learning during the unprecedented Covid-19 pandemic. All faculty had to adapt swiftly to remote working and the delivery of high-quality online educational content and assessment, and as such, this was a challenging period for staff as workloads suddenly increased (Longhurst et al., 2020; Pather et al., 2020, Smith and Pawlina, 2021). This particular experience echoes a report that states that math's teachers of students with low vision and blindness generally do not feel prepared to teach students with this type of disability (McBride, 2020), indicating this issue is not unique to anatomical education.

Accounting for the steady increase in the number of disabled students enrolled in university, anatomists should consider designing and delivering accessible curricula. One method grounded in

cognitive neuroscience is the Universal Design for Learning framework, that aims to improve teaching and learning for all (CAST, 2018). These guidelines recommend providing multiple options for engagement, representation, action and expression to allow students with varying abilities to optimize their learning. The implementation of these guidelines in anatomical education have been specifically described recently by Balta and colleagues (2021).

For online learning specifically, digital content, including teaching resources, should meet the internationally recognized set of guidelines for improving accessibility recommended by the Web Content Accessibility Guidelines (WCAG,2018). For example, text alternatives ('alt text') for all non-text content should be provided in addition to transcripts for all audio and video media, while text and images should have the capability to be enlarged to support students with visual impairments. It is also beneficial to ensure there is a significant contract in color between the text and background color and it is imperative that color should not be used as the only visual means on conveying information. All videos (including lecture recordings) should contain accurate captions to benefit all students including those with auditory impairments. For color blind students, there should be a significant contrast between the text and background color, while using different

There is no doubt that the Covid-19 pandemic was a pivotal moment in the history of education. We stand on the frontier; a turning point for the future of anatomical education. Important decisions surrounding the trajectory of anatomical delivery will be made by faculty. Will the global anatomical community decide to continue with online education or take a blended approach in the future? Only time will tell and empirical data will be essential to formulate rationale behind these important decisions. While it is clear that technology allowed most students and educators to prevail during the pandemic, it must not be overlooked that this form of education was suboptimal for many students, as they were disadvantaged by closure of anatomy laboratories. For instance, this one case study demonstrated that online learning of anatomy was impossible for a blind student. This was impart due to the sudden imposition of lockdown regulations and the lack of preparation for this unique circumstance. However, there are ways that learning online can be designed to ensure accessibility. While it can be time consuming to adapt resources and practice, it is our responsibility

as educators to ensure that the learning environment, be it physical or digital, is accessible and inclusive to all students (Shea and Sandoval, 2020; Smith and Pawlina, 2021). Importantly, these changes have the potential to benefit all future students of anatomy, not just those with disabilities.

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