

**PRECLINICAL MEDICAL STUDENTS'
PERCEPTIONS OF ANATOMY EDUCATION
ENVIRONMENT IN UNIVERSITI SAINS MALAYSIA
BEFORE AND DURING
THE COVID-19 PANDEMIC**

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UNIVERSITI SAINS MALAYSIA

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by
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LIST OF ABBREVIATIONS

3D	Three-dimensional
AAPOR	American Association for Public Opinion Research
AEEMI	Anatomy Education Environment Measurement Inventory
CAL	Computer-assisted learning
COVID-19	Coronavirus disease 2019
DePAN	Dasar e-Pembelajaran Negara
e-learning	Electronic learning
e-mail	Electronic mail
HEIs	Higher educational institutions
IT	Information technology
JEPeM	Human Research Ethics Committee of USM
MD	Doctor of Medicine
Moodle	Modular Object-Oriented Dynamic Learning Environment
MSc	Master of Science
MUET	Malaysian University English Test
OSPE	Objective Structured Practical Examination
PBL	Problem-based learning
PDF	Portable Document Format
QR	Quick response
SD	Standard deviation
SPICES	Student-centred, Problem-based, Integrated, Community-based, Electives, and Systematic
SPSS	Statistical Package for Social Sciences
TBL	Team-based learning
UNESCO	United Nations Educational, Scientific and Cultural Organization
USM	Universiti Sains Malaysia
WFME	World Federation of Medical Education
WHO	World Health Organization

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**PERSEPSI PELAJAR PERUBATAN PRAKLINIKAL TERHADAP
PERSEKITARAN PENDIDIKAN ANATOMI DI UNIVERSITI SAINS
MALAYSIA SEBELUM DAN SEMASA PANDEMIK COVID-19**

ABSTRAK

Pengenalan: Menyediakan persekitaran pendidikan yang positif adalah penting untuk pembelajaran pelajar dan untuk mencapai pencapaian akademik yang baik. Walau bagaimanapun, pandemik penyakit Coronavirus 2019 (COVID-19) telah mengganggu pembelajaran pelajar kerana pembelajaran bersemuka telah ditukar kepada pembelajaran jarak jauh sepenuhnya dalam masa yang singkat. Oleh itu, pelajar telah kehilangan sumber pembelajaran secara fizikal, yang merupakan modaliti penting bagi pembelajaran subjek anatomi.

Objektif: Tujuan kajian ini adalah untuk menilai persepsi pelajar perubatan prakilinikal Universiti Sains Malaysia (USM) terhadap persekitaran pendidikan anatomi sebelum dan semasa pandemik COVID-19.

Metodologi: Kaedah campuran yang menggunakan pendekatan kuantitatif dan kualitatif telah diaplikasikan dalam kajian ini. Seramai 156 pelajar tahun satu dan dua sesi akademik 2020/2021, Program Ijazah Doktor Perubatan, USM menyertai kajian ini. Inventori Pengukuran Persekitaran Pendidikan Anatomi, 26 item (AEEMI-26), borang sosiodemografik dan soalan subjektif tentang pengalaman dan cabaran semasa wabak COVID-19 telah diedarkan kepada pelajar yang bersetuju menyertai kajian dalam bentuk elektronik. Pendekatan kuantitatif yang menggunakan reka bentuk keratan rentas digunakan untuk membandingkan data dari AEEMI-26 di antara kohort COVID-19 dengan kohort pra-COVID-19 yang diperolehi daripada kajian terdahulu. Kohort pra-COVID-19 melibatkan 136 pelajar daripada pelajar tahun satu

dan dua dari sesi akademik 2018/2019 dalam Program Ijazah Doktor Perubatan, USM. Sementara itu, pendekatan kualitatif menggunakan reka bentuk penyelidikan fenomenologi telah dilaksanakan menggunakan analisis tematik ke atas maklumbalas kohort COVID-19 mengenai pengalaman dan cabaran dalam pembelajaran anatomi semasa COVID-19 bagi mengimbuhkan penemuan analisis kuantitatif.

Keputusan: Kadar tindak balas kajian ini adalah 75% dan kadar keciciran adalah sebanyak 4%. Majoriti peserta adalah perempuan, Melayu, warganegara Malaysia, 21 tahun, dan pelajar tahun satu. Domain perkaitan pengetahuan anatomi dan persepsi positif dan negatif terhadap guru-guru anatomi dilihat sebagai positif oleh kohort pra-COVID-19 dan COVID-19. Walau bagaimanapun, kedua-dua kohort mengaggap domain penguasaan subjek anatomi dan sumber pembelajaran anatomi sebagai memerlukan penambahbaikan. Perbandingan skor domain pra-COVID-19 dan COVID-19 kebanyakannya menunjukkan skor yang lebih tinggi secara ketara bagi kohort COVID-19, kecuali untuk domain penguasaan subjek anatomi yang menunjukkan skor yang lebih rendah, dan tidak ketara bagi kohort COVID-19. Enam tema telah dilaporkan bagi pengalaman dan cabaran kohort COVID-19 dalam pembelajaran anatomi semasa pandemik COVID-19.

Konklusi: Persekitaran pendidikan anatomi di USM dari segi perkaitan pengetahuan anatomi dan guru-guru anatomi adalah positif. Namun begitu, sumber pembelajaran anatomi dan penguasaan subjek anatomi di USM memerlukan sedikit penambahbaikan. Tambahan pula, pelajar menghadapi pengalaman dan cabaran dalam pembelajaran anatomi semasa COVID-19 sama seperti pelajar-pelajar dari institusi lain di seluruh dunia. Kajian pada masa hadapan harus menyiasat hubungan antara faktor yang mempengaruhi persekitaran pendidikan anatomi dan prestasi akademik pelajar selepas pandemik COVID-19.

**PRECLINICAL MEDICAL STUDENTS' PERCEPTIONS OF
ANATOMY EDUCATION ENVIRONMENT IN UNIVERSITI SAINS
MALAYSIA BEFORE AND DURING THE COVID-19 PANDEMIC**

ABSTRACT

Background: Providing a positive education environment is important for students' learning and to attain good academic achievements. However, the Coronavirus disease 2019 (COVID-19) pandemic had disrupted students' learning as face-to-face learning was rapidly converted to fully remote learning. Hence, students were deprived of physical learning resources which are important modalities for anatomy learning.

Objective: This study aims to evaluate the USM's preclinical medical students' perceptions of the anatomy education environment before and during the COVID-19 pandemic.

Methodology: A mixed method study that utilises quantitative and qualitative approaches were applied in this study. A total of 156 first-and second-year students of academic session 2020/2021 in the Doctor of Medicine Degree Programme, USM participated in this study. The Anatomy Education Environment Measurement Inventory, 26 items (AEEMI-26), a sociodemographic form, and a subjective question on experiences and challenges during the COVID-19 pandemic were distributed to consented students in an electronic form. A quantitative approach that applied a cross-sectional design was used to compare data from AEEMI-26 between the COVID-19 cohort and pre-COVID-19 cohort obtained from a previous study. The pre-COVID-19 cohort involved 136 first-and second-year students of academic session 2018/2019 in the Doctor of Medicine Degree Programme, USM. Meanwhile, a qualitative approach using phenomenology research design was implemented by applying thematic analysis

to COVID-19 cohort's responses regarding experiences and challenges in learning anatomy during COVID-19 to supplement the findings of the quantitative analysis.

Results: The response rate of this study was 75% and the dropout rate was 4%. The majority of the participants were female, Malay, Malaysians, 21 years old, and first-year students. Anatomy knowledge relevance and positive and negative perceptions of anatomy teachers domains were perceived as positive areas for both pre-COVID-19 and COVID-19 cohorts. However, anatomy subject mastery and learning resources domains were perceived as areas of improvement for both cohorts. Comparison of pre-COVID-19 and COVID-19 domains' scores mainly revealed significantly higher scores in the COVID-19 cohort, except for the anatomy subject mastery domain which showed a not significantly lesser score in the COVID-19 cohort. Six themes were reported for the COVID-19 cohort experiences and challenges in anatomy learning during the COVID-19 pandemic.

Conclusions: The anatomy education environment in USM in terms of anatomy knowledge relevance and anatomy teachers was positive. However, the anatomy learning resources and anatomy subject mastery in USM require some improvements. Furthermore, the students faced experiences and challenges in anatomy learning during COVID-19 similar to students in other institutions globally. Future studies should investigate the relationship between factors affecting the anatomy education environment and students' academic performance after the COVID-19 pandemic.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Anatomy is one of the core subjects in medical education (Guimarães *et al.*, 2017), as it plays an important role in preparing medical students to become safe medical practitioners (Papa *et al.*, 2019). However, learning anatomy can be challenging as there is much information to learn, difficult terminologies, and complex anatomical structures that require three-dimensional (3D) visualisation (Azer and Azer, 2016; Hadie *et al.*, 2018). This could lead to the compromise of the medical students' anatomical knowledge and the institution's integrity (Bergman *et al.*, 2011). Thus, students may not sufficiently be prepared for rigorous clinical practices (Kowalczyk and Majewski, 2021). The decline in anatomical knowledge among medical students has been discussed in the literature within the last few decades (Bergman *et al.*, 2011; Hołda *et al.*, 2019). This situation could have resulted in unsafe clinical practices (Hołda *et al.*, 2019), whereby surgical errors associated with poor anatomical knowledge have been reported to result in medicolegal litigation (Ellis, 2002; Fileni *et al.*, 2013; Mukherjee *et al.*, 2014; Polistena *et al.*, 2016). Several factors had been identified that may have been responsible for the decrease in anatomical knowledge including the deficiency in the number of qualified anatomy instructors, the nonexistence of a core anatomy curriculum, decreased usage of cadaveric dissection, insufficient clinical relevance, and lack of assessment instruments (Bergman *et al.*, 2011; Fillmore *et al.*, 2016; Hołda *et al.*, 2019). This scenario has given a significant impact on medical practitioners, especially junior doctors, and surgical interns as they claimed to not receive enough fundamental anatomy knowledge in medical schools (Ahmad *et al.*, 2021).

The Coronavirus disease 2019 (COVID-19) infection that was first discovered in China in December 2019, has inflicted significant changes in the education environment in educational institutions all over the world (Elengoe, 2020). In March 2020, the World Health Organization [WHO] (2020), had declared the infectious disease a pandemic. The Malaysian government has taken the action to restrict the in-person teaching and learning activities in all educational institutions in response to the movement control order, to curb the infection (Shah *et al.*, 2020). Before the pandemic, anatomy teaching and learning in public and private medical institutions in Malaysia were held mainly via face-to-face approach, namely didactic lectures, practical sessions using cadaveric specimens and anatomical models, problem-based learning (PBL), team-based learning (TBL), computer-assisted learning (CAL), clinical simulations, and peer teaching (Losco *et al.*, 2017; Muda *et al.*, 2021). To align with the blooming technology around the world, higher education institutions (HEIs) in Malaysia have followed the trend to implement e-learning in blended learning (DePAN, 2010), and USM has an established e-learning website since 2011 (Johari *et al.*, 2011). Nevertheless, e-learning was underutilised, and blended learning was not implemented in USM medical school including in the anatomy curriculum, as most of the teaching methods were conducted through a face-to-face approach.

Contrastingly, the pandemic had enforced partial or complete closure of campuses, which resulted in the abrupt conversion of face-to-face teaching and learning into the online digitised method (Evans *et al.*, 2020; Franchi, 2020; Pather *et al.*, 2020). Moreover, anatomy departments are reportedly facing great challenges in adapting to the unfamiliar education environment such as challenges in remote education, obtaining and maintaining cadaveric specimens, risk of exposure to COVID-19 infection, or uneven workload distribution (Longhurst *et al.*, 2020). HEIs

were obligated to deal with time limitations in coping with changes in anatomy learning during COVID-19, the decline in cadaveric access, and changes in assessment practice (Longhurst *et al.*, 2020). Since anatomy subject requires an in-depth understanding of anatomical structures and their relations that could be obtained mainly from attending practical classes, therefore, institutions worldwide must diversify their educational resources to keep up with the different education environments, as the students are unable to access various conventional and laboratory learning modalities (Evans *et al.*, 2020; Pather *et al.*, 2020; Longhurst *et al.*, 2020). To ensure continuity of educational provision, the use of e-learning and web-based learning is being empowered, thus enforcing reliance on technology and demand for internet service (Franchi, 2020; Longhurst *et al.*, 2020). Hence, educators and students alike are expected to adapt to online education (Pather *et al.*, 2020).

USM predominantly adheres to synchronous teaching and learning during the pandemic. Apart from being feasible, the synchronous method also allows active learning in large groups by applying small group activities (Flynn *et al.*, 2021). Additionally, the synchronous method may improve students' learning by providing immediate feedback that can help the students to solve their problems and queries in learning (Perveen, 2016). Besides, synchronous learning also creates engagement between the students and lecturers, making this approach a preferable method among medical students (Czerniewicz *et al.*, 2020). However, online learning has some disadvantages. The drawbacks of online education are loss of haptic feedback, challenges with technology and internet accessibility (Carswell *et al.*, 2002; Pather *et al.*, 2020), and the implications on students' communication, engagement, motivation, and cognition (Singal *et al.*, 2021; Evans and Pawlina, 2021). Besides, there is difficulty in explaining the relationship, surfaces, and organ structures, size

visualisation restriction, making size and shape comparison between different anatomical parts difficult (Muda *et al.*, 2021). Furthermore, during the pandemic, the students had limited opportunity to attend in-person laboratory sessions, which hindered them from getting enough exposure to the hands-on activities. As a consequence, they are unable to appreciate kinaesthetic learning experiences that are associated with the use of human anatomy models, cadavers, plastinated specimens (Evans and Pawlina, 2021), and microscopic glass slides (Naidoo *et al.*, 2021).

A study in Malaysia reported that 70% of internet users are from the urban area, which means that there is a discrepancy between the usage of the internet in urban and rural areas (Choong, 2020). This situation puts the underprivileged, and marginalised students who have difficulties in obtaining resources and experience poor online education accessibility, in a vulnerable state (Selvanathan *et al.*, 2020). Furthermore, in large groups of students, sudden internet complications such as compatibility issues or software updates can interfere with education (Darici *et al.*, 2021). Apart from losing the opportunity to develop effective communication skills in the lab or practical sessions, students who gave non-verbal feedback during online lessons, such as nodding or frowning, can indicate their understanding of the subject can be hampered from the lecturers' view. Hence, students are more prone to feel disengaged or isolated while learning (Evans and Pawlina, 2021). Subsequently, students may perceive their education environment as negative during online lessons. This condition consequently influences students' engagement, motivation, and educational experience (Singal *et al.*, 2021). Remote education also obtrudes students at home as their home conditions can either be non-conducive or too conducive for them to stay focused during the classes (Singal *et al.*, 2021). Moreover, the students may struggle with problems in network accessibility, logistics, and time zones hurdle

(Carswell *et al.*, 2002; Pather *et al.*, 2020). Lastly, students may feel more relaxed during online classes, or they may become overwhelmed with anatomical input especially when the learning devices used during classes are not suitable (i.e., small screen devices, and inefficient devices) (Selvanathan *et al.*, 2020; Kosgallana *et al.*, 2021). Hence, understanding the factors in the education environment is important to ensure effective learning.

Educational environment indicates the factors that are involved in any educational event, which play a role in learners' motivation and responses (i.e., behaviour, attitude, and value) towards an educational task (Roff and McAleer, 2001; Hutchinson, 2003). The elements of an education environment include the students, curricula, and institutional resources, which are the staff, teachers, and facilities (Roff and McAleer, 2001). Fulfilling the needs of students based on Maslow's Hierarchy can boost their education and academic achievements (Burleson and Thoron, 2017). An education environment that provides students with the sense of being welcomed, engaged, supported, and challenged, can lead to good academic achievement, whereas an exclusionary, unsupportive, or abusive education environment, usually leads to high levels of depression, burnout, and marginalisation or exhaustion (Gruppen *et al.*, 2019). As anatomy educators, they have an important role in shaping the anatomy education environment (Roff and McAleer, 2001; Genn, 2012) by enhancing the students' educational experience and engagement via classroom activities (Patera, 2021), and influencing the students' cognitive and affective disposition (Murray, 2007), students' performance and motivation (Mahler *et al.*, 2017). The curriculum controls the behaviour of all components of the education environment, any advancements in the education environment and curriculum can be done by identifying weaknesses and strengths in both (Rahman *et al.*, 2015). The facilities are also an

important element of the education environment as they can create an environment for students to challenge their depth of knowledge, skill, and attitude toward problem-solving exercises (Ganguly, 2010).

The impacts of the education environment are on students' welfare, educational accomplishments, and behaviour (Hutchinson, 2003). Educational environment influences students' selection of educational approaches, which are correlated with their academic achievement (Pimparyon *et al.*, 2000). Anatomy subject has been related to encouraging professionalism and good moral values in medical students (Sbayeh *et al.*, 2016; Longhurst *et al.*, 2020; Huynh *et al.*, 2021; McDaniel *et al.*, 2021). It has been shown that an effective education environment allows this professional development to happen (Shochet *et al.*, 2013; Dunham *et al.*, 2017; Yoo and Kim, 2019). Apart from professionalism, Gruppen *et al.* (2018) stated that a good education environment should also allow the students to understand their educational goals, obtain purposeful and significant knowledge, and encourage autonomy over their education. Therefore, the education environment needs to be assessed from time to time especially when there is an abrupt change in methods of lesson delivery so that an effective education environment can be achieved (Genn, 2001). This study will be conducted using the Anatomy Education Environment Measurement Inventory (AEEMI), which is a universal, validated, and reliable tool that was designed to measure the anatomy education environment in Malaysian medical schools (Hadie *et al.*, 2021).

1.2 Justification of the study

This study attempts to investigate the USM anatomy education environment from the perspective of medical students before and during the COVID-19 pandemic, with regards to anatomy knowledge relevance, anatomy teachers, anatomy subject mastery, and anatomy learning resources.

The Department of Anatomy at USM encounters challenges in delivering the best instructional method during the COVID-19 pandemic. Currently, there is inadequate evidence that portrays the students' perceptions of the anatomy educational environment at USM during COVID-19. In an effort toward the betterment of anatomy education, it has been suggested that the curriculum, quality of teaching delivery methods, and educational resources should be investigated (Papa and Vaccarezza, 2013). Besides, the evaluation of the education environment has been acknowledged and recommended by the World Federation of Medical Education (WFME) (Akbar *et al.*, 2019). According to Genn (2001), the medical institutions' environment and curriculum are constantly changing and evolving because of the evaluation of the education environment. It has been proven that investigating education environments can avail the strength and weaknesses of the factors in the education environment, which influence students' performance and the success of an institution (Rahman *et al.*, 2015; Akbar *et al.*, 2019). The education environment can be evaluated by assessing students' perceptions of the environment by asking students to answer a set of questionnaires or items about how they perceive their educational environment, with each question or item grouped into a specific scale or dimension of environment, and the entire complementary items make up for any probable feature for that environment (Genn, 2001). This study could diagnose factors that affect students' education environment. Hence, exploring the room for improvement based on students'

perceptions is a very influential instrument to grasp the content and conveyance of virtual anatomy classes (Singal *et al.*, 2021).

Anatomists play a role in designing and shaping the anatomy education environment (Evans and Pawlina, 2021). Hence, it is crucial to identify the problems in the anatomy education environment in USM during the COVID-19 pandemic. For this reason, students' perceptions of their education environment are essential. Further, this effort would provide important information on the desirable factors of the online anatomy education environment, which are perceived beneficial by the students. Applying a well-designed online education environment that is well received by the students is a pertinent move in stimulating deeper learning (Evans and Pawlina, 2021). Besides, it has been stated that a good education environment could enhance students' expectations to achieve educational outcomes such as academic achievement, and positive behaviour in learning (Lizzio *et al.*, 2002; De Könings *et al.*, 2005; Al-qahtani and Ed, 2015; Dunham *et al.*, 2017; Ahmed *et al.*, 2018).

Meanwhile, comparing students' perspectives before and during the COVID-19 pandemic can provide us with evidence of how different or similar the students perceived their education environment in different situations. Comparing the perceptions is important to anticipate and explained the current or upcoming situations, based on the depiction of the past event (Bukhari, 2012). Besides, comparing the perspective can provide evidence if the changes in the anatomy education solely pertaining to the COVID-19, or if the shift indicates an abiding change in how anatomy education is delivered (Harmon *et al.*, 2021).

1.3 Benefits of the study

Principally, this study can bring forth anatomy education environment refinement by using the students' perceptions that provide relevant information for the anatomy educators to improve the anatomy education environment (Roff and McAleer, 2001; Genn, 2001). This study can also stimulate students' self-awareness on ways to improve social learning factors such as peer support or internal motivation, which are the components of the education environment, provided that the results are discussed with the students (Hattie and Timperley, 2007). Optimising the education environment could eventually enhance the students' performance (Ahmed *et al.*, 2018). Also, this study may aid institutions in reshaping the curriculum design and finding resources (Smith *et al.*, 2014), so that the education environment would be in the students' best interest in their journey to become competent medical practitioners.

1.4 Study objectives

1.4.1 General objective

To evaluate the USM preclinical medical students' perceptions of anatomy education environment before and during the COVID-19 pandemic.

1.4.2 Specific objectives

- 1) To determine the scores of the five domains of AEEMI-26 in pre-COVID-19 and COVID-19 cohorts.
- 2) To compare the anatomy knowledge relevance score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts.

- 3) To compare the positive perceptions of anatomy teachers score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts.
- 4) To compare the negative perceptions of anatomy teachers score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts.
- 5) To compare the anatomy subject mastery score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts.
- 6) To compare the anatomy learning resources score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts.
- 7) To explore the USM's preclinical medical students' experiences and challenges in learning anatomy during COVID-19 pandemic.

1.5 Research questions

- 1) What are the scores of the five domains of AEEMI-26 in pre-COVID-19 and COVID-19 cohorts?
- 2) Is there any significant difference in the anatomy knowledge relevance score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts?
- 3) Is there any significant difference in the positive perceptions of anatomy teachers score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts?
- 4) Is there any significant difference in the negative perceptions of anatomy teachers score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts?

- 5) Is there any significant difference in the perceptions of anatomy subject mastery score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts?
- 6) Is there any significant difference in the anatomy learning resources score among USM's preclinical medical students between pre-COVID-19 and COVID-19 cohorts?
- 7) What are the USM's preclinical medical students' experiences and challenges in learning anatomy during COVID-19 pandemic?

1.6 Research hypotheses

There are no research hypotheses for specific objectives one and seven because the first objective is analysed descriptively whereas the seventh objective is analysed using qualitative analysis. The hypotheses for the second to sixth objectives are as follows:

- 1) Hypotheses for the second specific objective:
 Null hypothesis: There is no significant difference in the anatomy knowledge relevance score between the pre-COVID-19 cohort and COVID-19 cohort.
 Alternative hypothesis: The anatomy knowledge relevance score of the pre-COVID-19 cohort is higher than that of the COVID-19 cohort.
- 2) Hypotheses for the third specific objective:
 Null hypothesis: There is no significant difference in the positive perceptions of anatomy teachers score between the pre-COVID-19 cohort and COVID-19 cohort.

Alternate hypothesis: The positive perceptions of anatomy teachers score of the pre-COVID-19 cohort is higher than that of the COVID-19 cohort.

3) Hypotheses for the fourth specific objective:

Null hypothesis: There is no significant difference in the negative perceptions of anatomy teachers score between the pre-COVID-19 cohort and COVID-19 cohort.

Alternative hypothesis: The negative perceptions of anatomy teachers score of the pre-COVID-19 cohort is lower than COVID-19 cohort.

4) Hypotheses for the fifth specific objective:

Null hypothesis: There is no significant difference in the anatomy subject mastery score between the pre-COVID-19 cohort and COVID-19 cohort.

Alternative hypothesis: The anatomy subject mastery score of the pre-COVID-19 cohort is higher than COVID-19 cohort.

5) Hypotheses for the sixth specific objective:

Null hypothesis: There is no significant difference in the anatomy learning resources score between the pre-COVID-19 cohort and COVID-19 cohort.

Alternative hypothesis: The anatomy learning resources score of the pre-COVID-19 cohort is higher than COVID-19 cohort.

In general, it is hypothesised that the USM's preclinical medical students' perceptions of the anatomy education environment during COVID-19 pandemic is less positive than before COVID-19 pandemic.

1.7 Operational definitions

- 1) **Education environment:** Elements that are involved in the learning event which play a role in learners' motivation and responses, namely behaviour, attitude, and value, towards an educational task (Hutchinson, 2003; Roff and McAleer, 2009)
- 2) **E-learning:** It is a form of electronic or web-based learning, referring to the educational activities that run using the internet via electronic modalities (Poon *et al.*, 2004)
- 3) **Remote education:** Refers to an educational environment where the students and educators are virtually present, in which information transfer and communications occur via technology (Scholes, 2021).
- 4) **Synchronous learning:** Synchronous learning means that students and teachers are both presents at the same time in an online learning environment when the lesson takes place (Perveen, 2016).
- 5) **Blended learning:** Blended learning is a teaching and learning concept that involves traditional face-to-face teaching in a classroom setting with learning that is supported by information, communication, and technology (ICT) (Dangwal, 2017).
- 6) **Anatomy knowledge relevance:** Anatomy knowledge relevance indicates how the students view an anatomy topic in terms of its' relation to clinical importance (Moxham and Plaisant, 2007; Gorgich *et al.*, 2017; Moxham *et al.*, 2017; Naz *et al.*, 2017).
- 7) **Positive perception of anatomy teachers:** This is defined as how the students discern their anatomy educator from a good point of view (Hattie and Timperley, 2007).

- 8) **Negative perception of anatomy teachers:** This term is defined as the students' insight into the unfavourable qualities of their anatomy educator (Hattie and Timperley, 2007).
- 9) **Anatomy subject mastery:** This term refers to students' understanding of a particular content of anatomy topic (Gebhardt, 2018; Zhang *et al.*, 2020).
- 10) **Anatomy learning resources:** Anatomy learning resources are the tools and infrastructure used for teaching and learning anatomy (Balogun, 2019).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will delineate the Anatomy Educational environment, pertaining to its components, concepts, and changes, before and during the COVID-19 pandemic. Likewise, this chapter will also probe into the delivery of lessons and the challenges in online learning.

2.2 Educational environment

2.2.1 Educational environment—its components and importance

The educational environment involves a physical, social, and psychological context that allows lessons to transpire and promotes effective communications among students, faculty members, support staffs, and stakeholders for professional growth to occur (Genn, 2001; Shochet *et al.*, 2013; Gruppen *et al.*, 2019). In general, physical factors of the educational environment such as background noise, number of students in a classroom, classroom lighting, and classroom facilities can impact students' wellbeing and learning (Che Ahmad and Amirul, 2017; Naude and Meier, 2019). While the social context of the educational environment extrapolates how students engage with peers, faculty members, staffs, and other stakeholders (Gruppen *et al.*, 2018). A study by Brouwer *et al.* (2019) proved that community-based learning promotes the development of a sense of belonging, and the peer interaction component of PBL contributes directly to academic success. Meanwhile, the psychological context of the educational environment refers to the students' urge toward motivation,

resilience, and well-being (e.g., when students' basic psychological needs are fulfilled, they would develop a sense of well-being) (Neufeld and Malin, 2019).

Further, a positive educational environment is one of the important factors that contributes to optimal learning (Akbar *et al.*, 2019). For example, a favourable clinical educational environment exerts a positive impact on medical students' learning during their clinical years, whereby students will gain more confidence to learn and pass the course (Pai *et al.*, 2014). Therefore, all educational environment factors that could nurture intellectual activities, attainment of learning outcomes, and development of lifelong learning skills should be embraced and emphasised during curriculum evaluation and development (Dunne *et al.*, 2006).

2.2.2 The need to evaluate the educational environment

Effective learning occurs when the educational environment is optimised (Yusoff *et al.*, 2013; Liaison Committee on Medical Education, 2015). Furthermore, students' subjective experience of the educational environment influences their adaptation and reaction to learning activities and eventually their performance (Roff and McAleer, 2001; Ahmed, 2018). Hence, evaluating the educational environment is a pertinent move prior to any program or curriculum evaluation and change. This form of evaluation can be performed by measuring the students' perceptions of their educational environment.

Evaluating the education environment is important to improve students' performance, increase students' motivation and provide quality teaching (Dent *et al.*, 2013). The positive and negative points of the educational environment provide relevant feedback to the educational providers on the current curriculum or

programmes (Rahman *et al.*, 2015; Hongkan *et al.*, 2018; Akbar *et al.*, 2019). Feedback regarding the education environment is crucial to maintaining a positive medical school environment as it influences students' progress to becoming doctors (Dent *et al.*, 2013). Students are responsible persons of interest to give perceptions regarding the education environment as their experiences are related to their achievements, satisfaction, and success (Genn, 2001). Therefore, investigating students' perceptions of the educational environment may ensure the delivery of high-quality education (Pimparyon *et al.*, 2000).

Additionally, changes made in the educational environment are possible through a good feedback mechanism (Genn, 2001; Evans and Pawlina, 2021). This is proven in a study by Lin (2018), that anonymous feedback may shed some light on a particular assessed matter as the assessor can obtain critical, unguarded, and sincere comments. Previous studies had evaluated the educational environment by requesting students to answer a questionnaire containing items that evaluate their perceptions of the educational environment. A good educational environment questionnaire should contain adequate numbers of items that could be grouped into a specific construct or domain, which are reflective of the educational environment (Roff *et al.*, 1997).

In keeping with the shift from face-to-face to online anatomy teaching and learning during the COVID-19 pandemic, a detailed inspection of the change to online education and its environment would not only elucidate the online learning experiences to the faculty but can provide a firm understanding of the students' problems and challenges, particularly on interaction and instructional qualities during lessons delivery (Selvanathan *et al.*, 2020; Darici *et al.*, 2021). Additionally, continuous feedback regarding the educational environment can eventually improve the educational environment (Irum *et al.*, 2018).

2.2.3 Evidence of the effectiveness of students' perceptions in assessing the educational environment

Student feedback is a powerful tool to evaluate the educational environment, which has a great impact on student's academic achievements, behaviour, and well-being (Pimparyon *et al.*, 2000; Genn, 2001; Genn, 2009). While doing so, students' intrinsic factors, such as background and personality that have a hand in students' learning preferences, strategies, and academic performance need to be taken into consideration as they may affect the students' judgments in how they perceive their educational environment (Kintu *et al.*, 2017; Zakaria *et al.*, 2018; Arain *et al.*, 2021). For instance, students with greater academic achievements perceived their education environment as more positive (Ahmed *et al.*, 2018).

Previous studies have regarded students' perceptions of anatomy learning (Anderton *et al.*, 2016; Attardi *et al.*, 2016; Lochner *et al.*, 2016; Akeel, 2021; Huynh *et al.*, 2021) as fundamental information to refine the educational environment quality (Dunne *et al.*, 2006). A study by Ojuka *et al.* (2021) has illustrated that students are critical in providing their perceptions of the educational environment. As proof of the prior statement, Alsoufi *et al.* (2020) probed the COVID-19 pandemic's disruptive effects on the Libyan medical students' training through students' feedback. Hence, the researchers were able to identify beneficial comments and address difficulties faced by students. Furthermore, Tackett *et al.* (2017) stated that positive perceptions of the educational environment are associated with a cut above live quality and reduced burnout among students. Besides that, students' lifelong learning skills can be encouraged by giving them the power of being actively involved in reshaping the curriculum through their reflection on the educational environment (Gupta *et al.*, 2018).

A study by Dost *et al.* (2020) compared students' perceptions of the online educational environment with the previous face-to-face educational environments in the United Kingdom and found that students preferred online learning less. Another study by Anwar and Wahid (2021) conducted in Indonesia revealed general satisfaction of students' perceptions with the shift into an online learning environment during the pandemic, however, the students suggested improvements in incorporating activities that stimulate critical thinking including student-teacher interactions and the betterment of internet connection. Therefore, with the shift of anatomy teaching and learning towards online learning during the pandemic, students' feedback can serve as a powerful tool to express their thoughts on the lesson content and how the virtual classes are being conducted (Singal *et al.*, 2021).

2.2.4 Anatomy educational environment and its measurement

Ever since the revamp of the medical education curriculum, anatomy education underwent significant changes from a traditional disciplinary-based to an integrated system. Throughout the revolution there are many issues related to anatomy education, namely lack of anatomy staff, declining teaching hours, and shortage of bodies for cadaveric dissection, which could not accommodate the increase of medical students' enrolments into medical schools (Guimarães *et al.*, 2017). In 2020, the COVID-19 pandemic triggered a greater change in the teaching, learning, and assessment paradigm of anatomy education, whereby online and remote education became more prominent, despite increasing concerns among anatomists about the lack of hands-on laboratory-based teaching (Pather *et al.*, 2020). These ongoing changes provide room for investigations of the anatomy educational environment.

2.2.4(a) Inventories for education environment

Many inventories have been used for measuring the educational environment. When evaluating the medical education environment, Learning Environment Questionnaire (LEQ), Medical School Learning Environment Scale (MSLES), John Hopkins Learning Environment Survey (JHLES), Medical School Environment Questionnaire (MSEQ), Medical School Environment Inventory (MSEI), Course Valuing Inventory (CVI), and Clinical Undergraduate Educational Environment Measure (UCEEM) have been used (Soemantri *et al.*, 2010; Miles *et al.*, 2012; Schonrock-Adema *et al.*, 2012; Gruppen *et al.*, 2016; Dent *et al.*, 2017; Dunham *et al.*, 2017; Tackett *et al.*, 2017). While the measurement of educational environment for the medical postgraduate level includes the Postgraduate Hospital Education Environment Measurement (PHEEM), Surgical Theatre Educational Environment Measure (STEEM), Ambulatory Care Learning Education Environment Measure (ACLEEM), Anaesthetic Theatre Educational Environment Measure (ATEEM). In medical and health sciences, the Dundee Ready Educational Environment Measure (DREEM) has been widely used for diagnosing, making comparisons, and checking relations of educational environment (Miles *et al.*, 2012). However, this inventory has several drawbacks such as it contains too many items (i.e., 50 items) and the interpretations are too varied (e.g., DREEM can be interpreted using each item, based on the outcome of the subscales—students’ perceptions of learning, students’ perceptions of teachers, students’ academic self-perceptions, students’ perceptions of atmosphere, students’ social self-perceptions, or overall interpretation—positive or negative) making synchronisation of findings difficult (Miles *et al.*, 2012). Besides, most of these inventories lack specific criteria on students’ perceptions of anatomy learning resources. In many medical institutions, the anatomy education environment was

measured using DREEM or by their own questionnaires which is less established (Dost *et al.*, 2020; Farhan *et al.*, 2021).

Thus, an inventory that is more specific for anatomy education, Anatomy Education Environment Measurement Inventory (AEEMI) was developed and validated in a single institution. It initially contained six domains and 25 items (Hadie *et al.*, 2017). During its initial validation process, some of its important items were omitted, thus, making the inventory more generalised, which led it to be cross-validated into AEEMI-26. AEEMI-26 is a universal indicator in the Malaysian context, that can measure the quality of the anatomy educational environment in medical schools. After refined from the initial 11 factors and 132 items of AEEMI (Hadie *et al.*, 2017; Hadie *et al.*, 2021), AEEMI-26 comprises only 26 items, reducing the risk of errors as compared to a lengthy questionnaire (Peytchev and Peytcheva, 2017). AEEMI-26 was developed from the original version of AEEMI that was cross-validated among the 11 medical schools in Malaysia to further represent the anatomy education scenario that is not only specific to one institution (Hadie *et al.*, 2021). Therefore, AEEMI-26 is a valid and reliable tool to measure the crucial aspects of the anatomy educational environment which involves the teaching and learning of gross anatomy, histology, neuroanatomy, and embryology. Besides, AEEMI-26 can depict a particular institutional capability, and areas of concern, and enable opportunities for improvements (Hadie *et al.*, 2021). AEEMI has previously been used in Malaysian universities to evaluate how the students perceive their anatomy environment (Jalani *et al.*, 2021; Yen *et al.*, 2021). Hence, AEEMI-26 serves as an availing inventory to measure the educational environment of interest (i.e., anatomy) in USM for this study.

2.2.4(b) Measurement of anatomy knowledge relevance

Previously, anatomy subject has been described as content-driven, as students are often burdened with factual knowledge without emphasising the relevance (Patel and Moxham, 2006). Smith *et al.* (2014) reported that students perceived anatomy subjects as having excessive content and details and doubtful relevancy. Nevertheless, being a significantly valued subject in the medical profession (Fitzgerald *et al.*, 2008; Böckers *et al.*, 2010; Gorgich *et al.*, 2017), anatomy is indispensable in the medical education because the subject has high clinical relevancy (Moxham and Plaisant, 2007; Hadie *et al.*, 2013; Estai and Bunt, 2016; Leveritt *et al.*, 2016). The knowledge relevance of a subject has also been used as an indicator to evaluate teaching quality in a previous study (Feistauer and Richter, 2017).

Higher cognitive skills, namely anatomy knowledge application can be attained by merging basic sciences with clinical education (Ahmadipour and Hajmohammadi, 2016), and by explaining the relevance of learning content to clinical practice (Dent *et al.*, 2017). In turn, anatomy knowledge relevance has been related to the student's engagement and motivation (Hutchinson, 2003; Pai *et al.*, 2014). For instance, it is common for students to fail to relate the learning content to what is important for their medical practice (Dent *et al.*, 2017). Not understanding the need to learn a certain learning content could demotivate them from learning the topic (Smith *et al.*, 2014). Besides, the basis of the medical profession and medical graduates' future lies within their undergraduate period, because understanding the basic anatomical structures in the preclinical year is required before applying the knowledge in the clinical position (Latiff *et al.*, 2019), and incorporating clinical knowledge has been depicted as useful by preclinical medical students (Jeyakumar *et al.*, 2020; Preston *et al.*, 2020). For good measure, it is worthwhile to probe into students' perceptions of a subject's relevance,

because students' perceptions of a topic being relevant have a significant indirect impact on students' examination scores (Hamilton and Mallett, 2018). Hence, the relevancy of the learning contents should be highlighted in curriculum planning (Dent *et al.*, 2017; Sakaran *et al.*, 2021).

2.2.4(c) Measurement of anatomy educators

Anatomy educators have an important role in shaping the anatomy educational environment (Roff and McAleer, 2001; Genn, 2012). According to Hattie and Timperley (2007), an ideal educational environment occurs when the students and educators have a mutual ground in defining the learning goals and the methods to achieve those goals. In order to achieve the learning goals, educators need to provide subsequent guidance to students after task completion, based on the students' needs obtained from a feedback process. Apart from that, anatomy educators can enhance the students' learning experience and engagement via interactive classroom activities (Patera, 2021). Hence, it is within the educators' responsibility to provide what the students need (Lumpkin *et al.*, 2019). For example, anatomy educators can use various teaching modalities from kinesthetic experience to other newer methods such as imaging to promote students' understanding and visualisation of human bodily structures (Srivastava *et al.*, 2021). The educators' characteristics such as self-efficacy and enthusiasm also contribute to students' cognitive engagement (Cerbin, 2018), performance, and motivation (Mahler *et al.*, 2017). Based on these grounds, students' perceptions of educators were commonly assessed in higher institutions to measure the quality of teaching (Feistauer and Richter, 2017; Hadie *et al.* 2018).

The geographically distant students and educators in remote learning during the COVID-19 pandemic may negatively impact students' learning experience (Pather *et al.*, 2020). This is due to the nature of online learning that may impose disruption of communication between educators and students due to unstable internet connections and improbable conversations with educators (Nassr *et al.*, 2020). Students have conveyed that their satisfaction with online learning can decline as they have limitations to interrupt educators (Selvanathan *et al.*, 2020). Even though delivery of effective lecturing during the pandemic hour is achievable, it may require creativity from the educator (Nik-Ahmad-Zuky *et al.*, 2020). It is also important to highlight that lecture delivery and good lecture preparation should not be compromised by the use of technology (Darici *et al.*, 2021). Educators had mentioned that they were underprepared to teach using online platforms at the commencement of the untimely nature of the COVID-19 pandemic (Cheng *et al.*, 2021; Muda *et al.*, 2021). These circumstances could hamper non-verbal communication during teaching activities such as hand gestures, facial expressions, or body language, which may cause students to perceive them negatively (Anwar and Wahid, 2021). Hence, the evaluation of students' perceptions of anatomy educators is vital.

2.2.4(d) Measurement of anatomy subject mastery

Subject mastery is also a core component of a curriculum that needs to be fulfilled by students prior to actualisation of a task (Dent *et al.*, 2017). For example, integrating the clinical aspects of medical education prior to clinical years may further enhance knowledge relevance and mastery skill (Bandiera *et al.*, 2018). However, in most educational systems, understanding the concept and mastery of knowledge is less