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Application and Relevancy of Anatomy Curriculum in the Clinical Years: A Malaysian University Experience

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ABSTRACT

Human anatomy is one of the fundamental subjects in medical and health education. In recent years, anatomy teaching in Universiti Sains Islam Malaysia (USIM) has undergone a major transition from a highly detailed, didactic method to student-centred pedagogy and clinical correlations. Hence, this study aimed to assess the perception of the anatomy curriculum amongst USIM clinical students and to evaluate the clinicians' cognisance of their students' anatomical knowledge and application. A cross-sectional study was conducted on 232 clinical students (fourth-, fifth- and final-year) and 32 clinicians from various disciplines with the validated questionnaires. Descriptive analysis was performed to analyse the findings regarding students' and clinicians' perceptions. The majority of the students agreed that the anatomy curriculum was adequately covered in the pre-clinical years except for the imaging and clinical correlation classes. In terms of the teaching method, most of the students perceived that the tutorials (99.2%), practical sessions (98.7%), lectures (97.4%) and problem-based learning (PBL) (96.1%) were the best approaches in understanding anatomy comprehensively. Results also indicated that the practical sessions (99.1%), lectures (94.8%), tutorials (94.8%) and PBL (93.9%) were the best methods in retaining anatomy knowledge. Besides, 62.9% of students strongly agreed that objective structured practical examination (OSPE) was the most helpful assessment for their anatomical knowledge retention. The majority of the clinicians perceived their clinical year students had a satisfactory level of anatomical knowledge ($n = 21$, 65.6%) and also believed that the anatomical correlation classes were essential for their disciplines. Students recognised the value of the current teaching methodology for their knowledge retention and comprehension. However, both clinicians and students felt there were limited opportunities for clinical application during teaching and learning. It is therefore imperative to implement appropriate restructuring to the current anatomy curriculum to address students' needs and preferences for their future medical practice.

Keywords: *Traditional curriculum, Discipline-based curriculum, Vertical integration, Horizontal integration*

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INTRODUCTION

Human anatomy is one of the fundamental subjects for medical and health education (1–2). It has always been identified as one of the most challenging subjects yet a vital foundation for clinical excellence (3). Anatomical knowledge is also essential for students to fully understand pathologies and clinical problems. Since the founding of Universiti Sains Islam Malaysia (USIM), the anatomy curriculum related to the body organs and systems has been educated in a highly detailed manner with didactic lectures and body dissection. Anatomy teaching also covers detailed information about histology and human embryology.

Learning anatomy in recent years has gradually become influenced by the increasing cost, shorter time and limited resources. As such, the curriculum is delivered in fewer hours but has become more clinically oriented (4). This trend leads to the conveyance of condensed information during anatomy teaching and the utilisation of some approaches that integrate the learning of anatomy with other basic medical science courses which usually emphasise functional and clinical relevance (5–6). Furthermore, there have been some modifications to the pedagogy of the current anatomy curriculum adopted by USIM to encourage independent learning amongst its students. For instance, fixed learning modules, self-directed learning packages and seminar presentations have been employed to replace certain didactic lectures. Moreover, theme-based learning, interactive modelling, radiological anatomy, whole slide imaging practice during histology lessons, horizontal integration of biochemistry and physiology in problem-based learning (PBL) as well as clinical correlations are introduced to complement the contemporary teaching methodologies.

The clinical application of anatomical knowledge has been widely discussed within the anatomy education literature (7–10). Students are usually required to master a

plethora of anatomical knowledge in pre-clinical years with a limited understanding of its application in clinical medicine. However, when they reached their clinical years to apply their learnings, it was found that a substantial part of their knowledge had not been retained entirely (11). This issue leads to most clinicians perceiving the prevailing anatomy education as inadequate to equip the students with sufficient application skills and is also below the minimum standard for a safe medical practice (12–15). Consequently, anatomists were often accused of educating superfluous details without truly emphasising the clinically relevant contents (14). Hence, strategies for examining and evaluating the current anatomy curriculum are necessitated to pinpoint its efficiency, relevance and learning benefits to the students. In this context, this study was conducted to examine the students' perception of the application and relevance of the traditional anatomy curriculum and to evaluate the perception of clinicians' satisfaction with the medical students' anatomical knowledge.

MATERIALS AND METHODS

A cross-sectional study was conducted in the Faculty of Medicine and Health Sciences, USIM of the 2017 to 2018 academic year. A total of 232 randomly selected clinical students (fourth-, fifth- and final-year) who had learnt their anatomy subjects without clinical integration before entering their clinical years participated in this study. Thirty-two clinicians with sound anatomical basic knowledge and directly involved in teaching the fourth-, fifth- and final-year clinical students were also randomly chosen for their participation in the current survey regardless of their specialities. This was because orthopaedic specialists were required to have good knowledge of the limbs and girdles whereas obstetricians and gynaecologists on female and male reproductive organs. Trainee lecturers were also selected as participants due to their active involvement in the teaching

and learning sessions with both clinicians and students. Although they were not the subject expert yet, they might have further knowledge of the students' performance and academic concerns.

Data collection was performed by implementing a self-administered questionnaire pre-designed in other studies (11, 12) and a pilot test was conducted before the actual survey. Voluntary participation and anonymity were ensured for all participants. The questionnaire for the students was divided into five parts. The first part was collecting the demographic data of the students. It was then followed from part two to four to appraise students' perception of their experience during the anatomy learning in terms of content coverage, relevance of teaching hours, teaching methods that influenced their understandings and knowledge retention as well as the effectiveness of examination on their knowledge retention. The responses were made on a four-point Likert scale ranging from "strongly disagree" to "strongly agree". The last part was a mini-test wherein a set of seven one best answer (OBA) questions related to regional anatomy that students had learnt during their pre-clinical years were asked to assess the effectiveness of the anatomy education to their knowledge retention. All questions were designed and validated by a group of trained and experienced anatomists. The students were also fully aware that their scores would not affect their final posting results. Besides, the clinicians' questionnaire validated prior to data collection was administered to grasp their perceptions of their students' understanding of anatomical knowledge and their ability to relate the knowledge in their current field of expertise. This study was approved by the Ethics Committee of USIM and consent was obtained from the students and lecturers before filling up the questionnaires. Data were analysed by employing SPSS Statistics Version 24. Descriptive analysis was also conducted to analyse students' and clinicians' perceptions.

RESULTS

A total of 232 responses were collected from USIM's undergraduate medical students in their clinical years (fourth-, fifth- and final-year). The majority of the respondents were females (70.7%) and were mainly from the fifth-year (34.5%), followed by the fourth-year (33.2%) and the final-year (32.3%).

Figure 1 demonstrated the perception of clinical year students on the adequacy of pre-clinical anatomy teaching and learning concerning the regional anatomy subject. The majority of the students agreed that the pre-clinical anatomy teachings covered all components comprehensively except for imaging and clinical correlation classes. More than 60% of students perceived the subjects of introduction, gross anatomy (upper limb, abdomen, pelvis, lower limb, head and neck), neuroanatomy, histology and embryology had adequate coverage while approximately half of the class opined that the anatomy teachings were "too short" for imaging (43.5%) and clinical correlation class (50.4%).

Figure 2 presented the perception of students in understanding anatomy through various teaching methods. Most of the students recognised that the tutorials (99.2%), practical sessions (98.7%), lectures (97.4%) and PBL (96.1%) were the best methods in learning anatomy. However, one-third of the students considered self-learning packages (SLP) (30.2%) and seminars (35.4%) did not occur to be the effective methods in comprehending anatomy.

In terms of anatomical knowledge retention, the majority of the students perceived the practical sessions (99.1%), lectures (94.8%), tutorials (94.8%) and PBL (93.9%) were the best teaching methods as shown in Figure 3. About half of the students observed that the SLP (40.9%) and seminars (48.7%) were not productive in assisting them in retaining their anatomical knowledge.

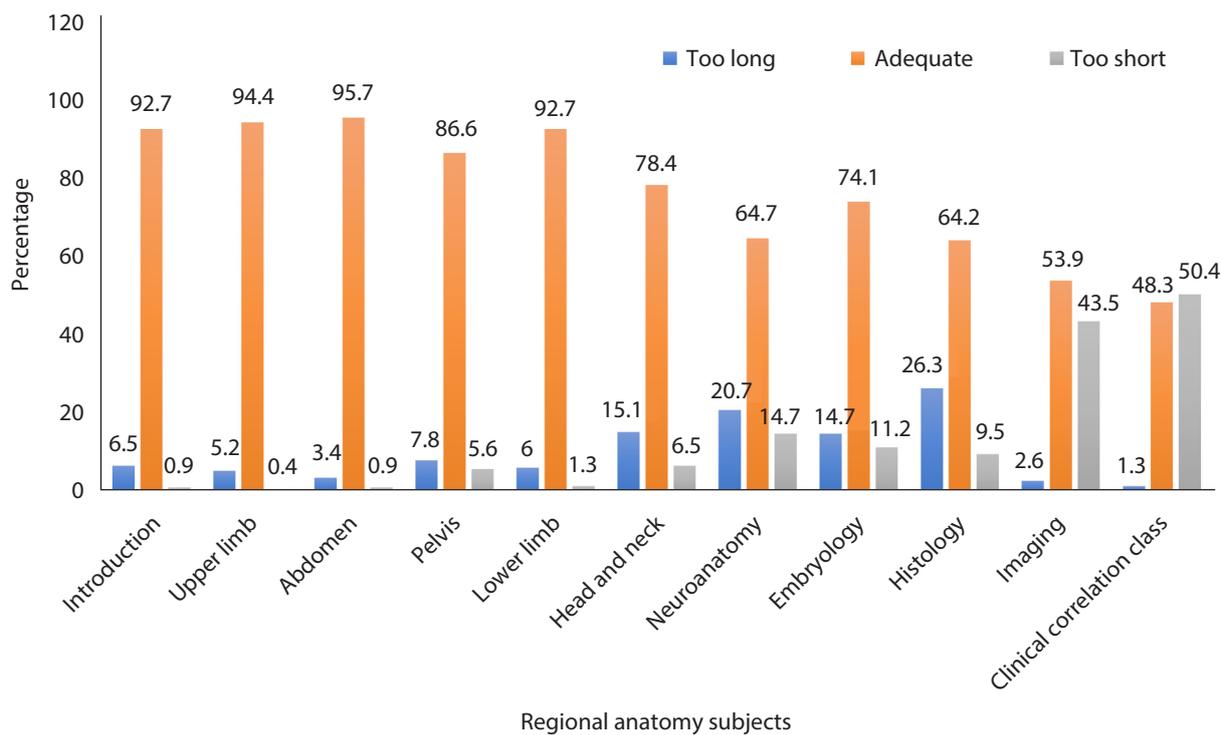


Figure 1: Perception on the adequacy of pre-clinical anatomy teaching and learning among clinical year students.

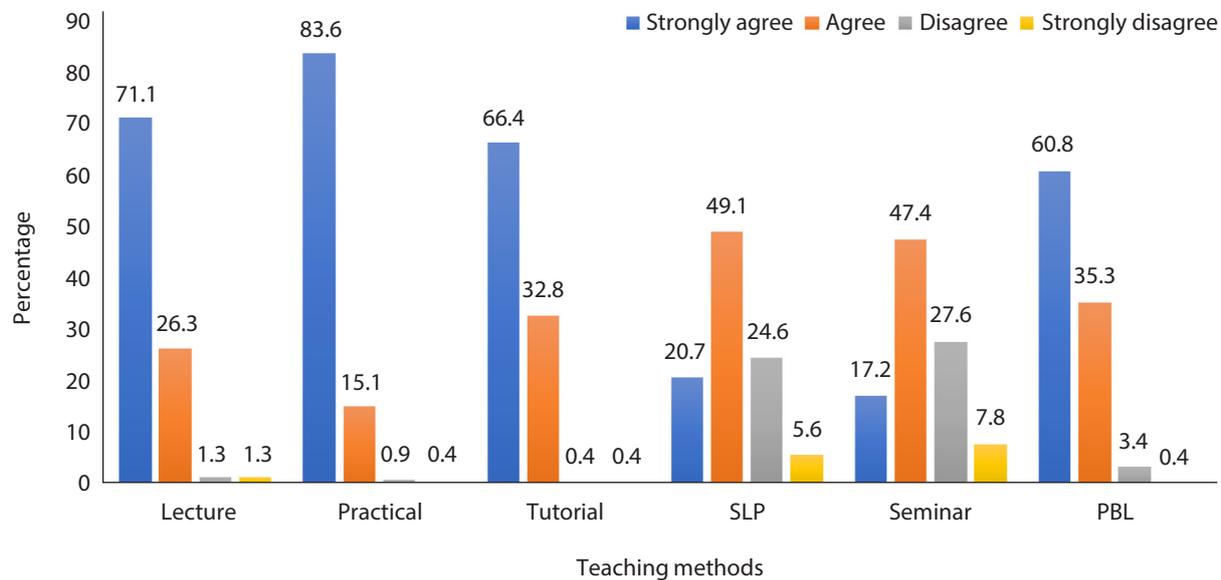


Figure 2: Perception in understanding anatomy using various teaching and learning method among clinical year students.

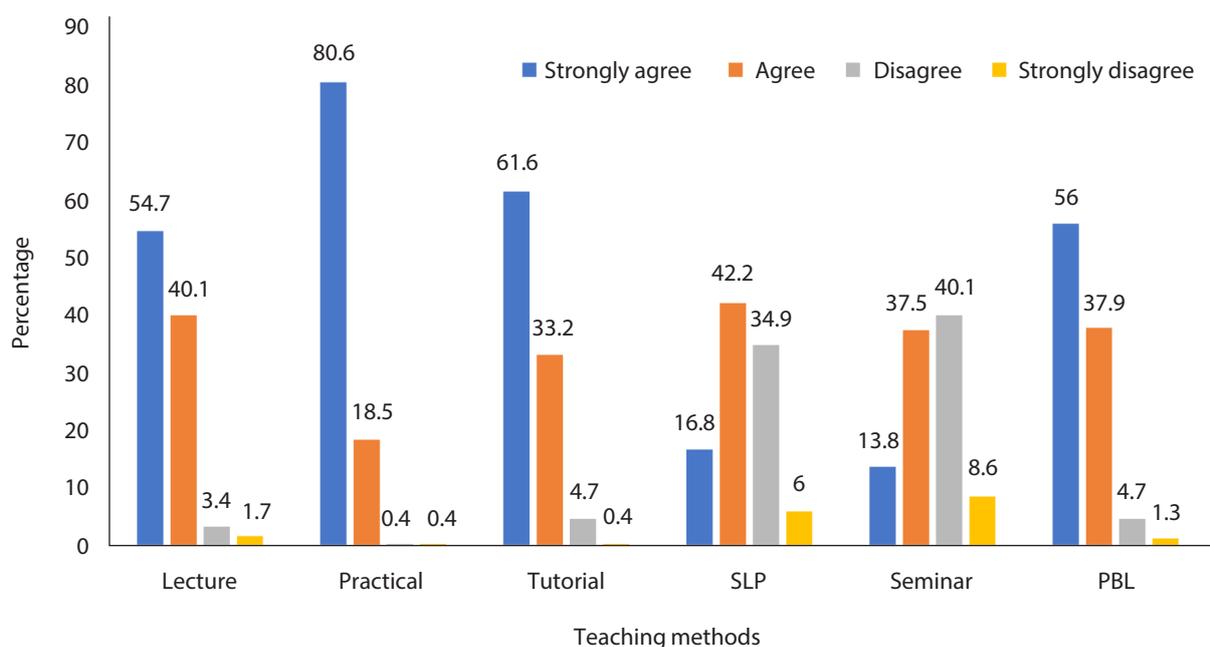


Figure 3: Perception in retaining anatomy knowledge through different teaching and learning methods.

Figure 4 manifested that the majority of the students perceived the durations allocated for lectures (86.6%), tutorials (76.3%), SLP (73.3%), PBL (72.8%) and practical sessions (72.4%) were sufficient. However, only half of the class saw the teaching period allocated for seminars (59.1%) was satisfactory with 36.2% of their counterparts observed that the duration was too long.

Figure 5 indicated the perception of students towards examination formats that helped to retain their anatomical knowledge. Amongst all types of examination formats, most of them strongly agreed that objective structured practical examination (OSPE) was the most effective assessment in knowledge retention (62.9%) followed by OBA (47.4%), modified essay question (MEQ; 44.0%) and multiple-choice question (MCQ; 35.8%).

Table 1 displayed the evaluation of students' anatomical knowledge through a set of application questions. Out of the seven questions, only two that evaluated the knowledge of the lower limb (79.3%) and neuroanatomy (72.8%) were correctly answered by the majority of the students. Questions regarding the abdomen, head

and neck, pelvis and perineum, and thorax were correctly answered by 50% to 70% of the students. The question that was the least able to be correctly answered by the students was related to the anatomy of the heart (32.8%).

In addition, a total of 32 responses were gathered from the USIM's clinicians as well. Amongst the clinicians, 17 respondents were female (53.1%) and 15 were male respondents (46.9%). Internal medicine was the discipline that recorded the highest number of respondents (21.9%) followed by surgery (15.6%) and ophthalmology (9.4%). There were two respondents (6.3%) for each discipline, including orthopaedic, obstetrics and gynaecology, otorhinolaryngology, emergency and perioperative medicine, psychiatry, paediatrics and family medicine. Only one (3.1%) was from forensic medicine, radiology and anaesthesiology, respectively.

The majority of the clinicians perceived the clinical year students had a satisfactory level of anatomical knowledge (65.6%), while nine believed that they did not have sufficient knowledge (28.1%) and only two considered the students to be well-

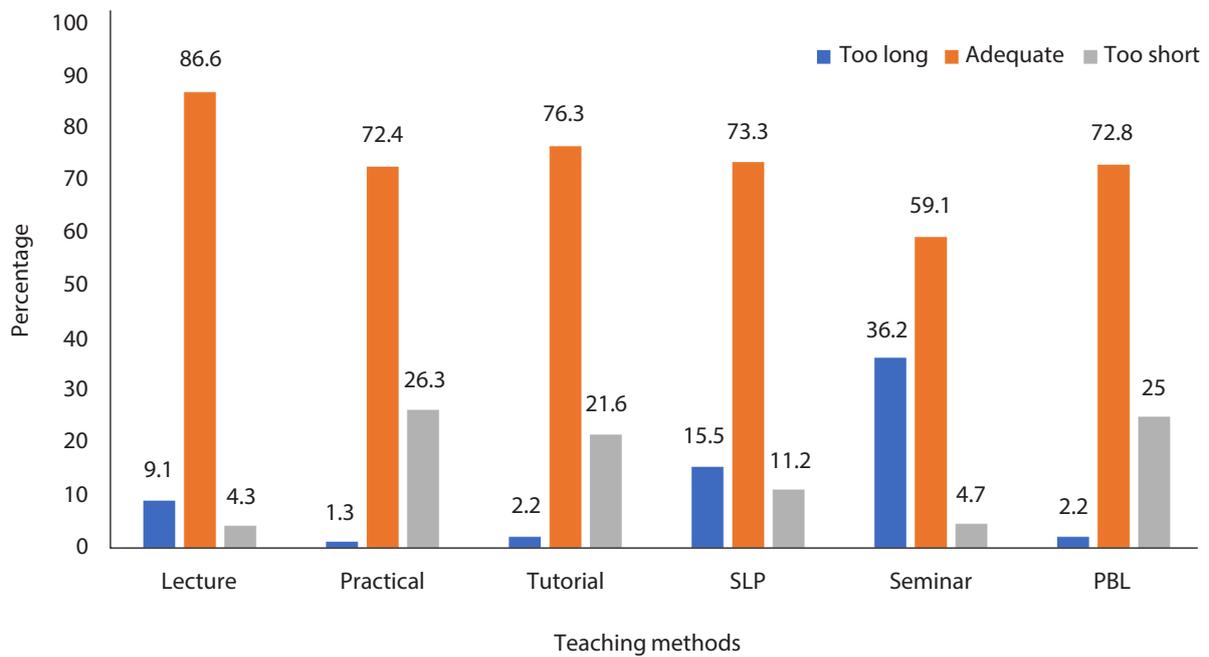


Figure 4: Perception on the adequacy of duration (time) in anatomy teaching among clinical year students.

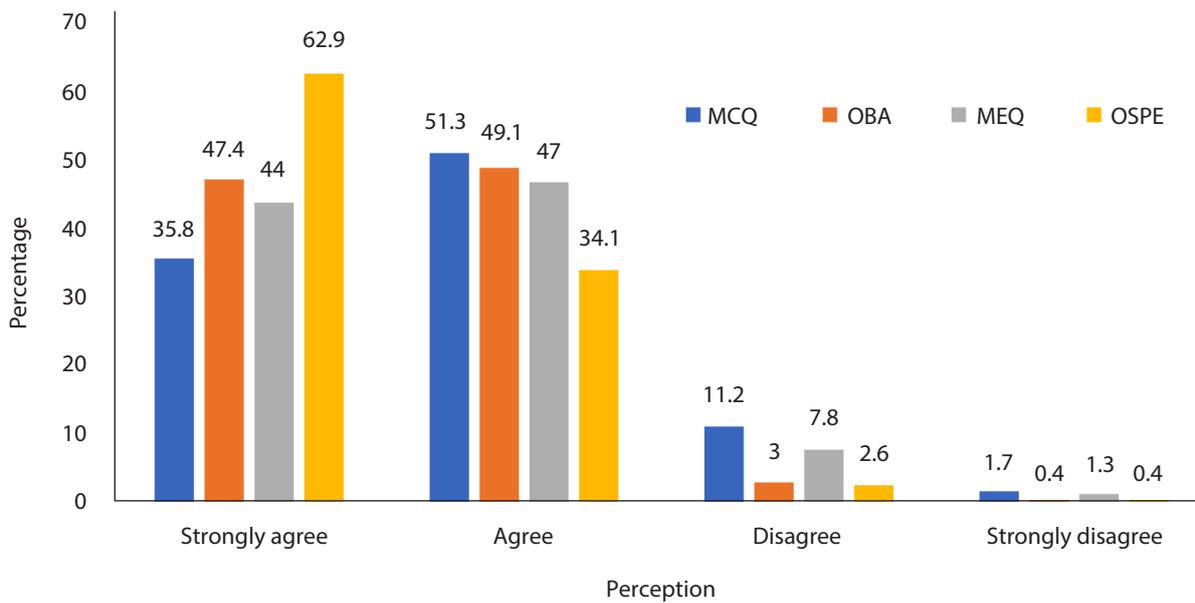


Figure 5: Perception on the examination methods that retained anatomy knowledge among clinical year students.

Table 1: Description of the correct answers provided by the clinical year students on applied anatomy questions

Questions	Correct (%)
A 40-year-old lady presented with a painless right breast lump. Investigations were done and she was diagnosed to have breast cancer on the upper medial part of the right breast. Name the most likely lymph node affected in this case.	119 (51.3)
A 56-year-old man was recently diagnosed with pericardial effusion planned for pericardiocentesis. Select the most likely layer that induces somatic pain during needle insertion.	76 (32.8)
A 60-year-old woman arrived at the emergency room complaining of acute abdominal pain. She was diagnosed with ischemic bowel resulting from an obstruction of inferior mesenteric artery. Select the most likely area spared from the ischemia.	161 (69.4)
A 45-year-old woman was seen in the emergency department complaining of a painful swelling in the region of the anus. On examination, a red and tender swelling was found on the right side of the anal margin. A diagnosis of ischiorectal abscess was made. One of the content of the ischiorectal fossa is _____ .	119 (51.3)
A football player injured his knee during a match. The doctor performs a "drawer test" by pulling and pushing on the leg with knee flexed. If the leg moves anteriorly, which one of the following ligaments is injured?	184 (79.3)
A 45-year-old man was brought unconscious to the hospital after involving in a motor vehicle accident. After investigation, he was diagnosed as extradural haemorrhage with skull fracture. Name the most likely artery affected in this case if pterion is the area that fractured.	153 (65.9)
A 72-year-old man was recently diagnosed with left cerebrovascular accident with right hemiparesis. During clinic visit, patient able to comprehend doctor's order, however, he could not articulate his words correctly. Name the most likely functional cortical area affected in this case.	169 (72.8)

equipped (2.3%). More than two-thirds of the clinicians agreed that the students could apply their anatomical knowledge in their clinical cases (68.8%) and almost all of them believed that the anatomical correlation classes were essential to their disciplines (93.8%).

DISCUSSION

Didactic lecture in anatomy teaching has been widely criticised for its inability to improve student engagement and facilitate higher-order cognition. Furthermore, the time constraint is still the biggest hurdle to overcome in finishing the entire syllabus of anatomy in many institutions that may have a negative impact on the sufficient coverage of anatomy taught to the students (16). Recently, anatomy teaching and learning

activities in USIM have been redefined by gradually shifting towards a more student-centred and blended learning approach.

This study was conducted amongst clinical students from different disciplines. When advancing towards their clinical years, students were anticipated to apply their knowledge learned during their pre-clinical years to the patients' clinical conditions. The findings had shown that the majority of the students agreed that there was adequate coverage of anatomy subject from all teaching methods except the clinical correlation classes wherein half of the pool perceived their exposure to these classes was too short. The clinical correlation classes could be improved, for instance, by organising a short hospital visit where students could better correlate their knowledge with relevant clinical

conditions and settings. This finding was also concurrent with Vasan and Holland's (17) conclusion that the higher usage of clinical correlations in the curriculum would improve students' understanding of the topics learnt.

Furthermore, the incorporation of clinical knowledge in the pre-clinical phase or vertical integration had been found to significantly benefit the students' knowledge retention and the depth of their understandings (18). It showed that the vertical integration could significantly improve comprehension and knowledge retention of anatomical topics (19). For example, Fitzpatrick et al. (20) demonstrated an effective vertical integration method in anatomy wherein they incorporated laparoscopy during the anatomy practical sessions of the abdomen to familiarise the pre-clinical students with the abdominal structures and surgical tools simultaneously. More than 80% of students responded positively to the experience they gained during the combined surgical-anatomy teaching. Unfortunately, physical and staffing resources remained a hindrance in some universities including that of the current study to conduct the aforementioned sessions. Although current educational technology such as Visible Body® was feasible to deliver vertical integration in anatomy, financial resources were also the obstacle to ensure that the technology was accessible to all students.

In addition, this study also indicated an alarming result wherein only 8 out of all 232 respondents (3.4%) scored full mark in their mini-assessment that evaluated their anatomical knowledge. This mini-assessment comprised a set of seven clinical applied anatomy questions in OBA format. The mean score was 4.23 (± 1.323) with no statistical difference in the years of study of the students from different academic years (fourth-, fifth- and final-year). This was consistent with the clinicians' perception that out of 32 of them, only 65.6% of the clinical students possessed a satisfactory

level of anatomical knowledge, while only 2.3% of the clinicians believed that the clinical students having a good level of anatomical knowledge. Moreover, most clinicians (93.8%) agreed that the clinical students required more clinical correlation sessions to improve their knowledge retention and application during their clinical years. This finding was similar to the study conducted by Waterston and Stewart (15) in which the clinicians unanimously agreed that their students had a poor level of anatomical knowledge and emphasised the benefits of vertical integration for students' learning experience. Orsbon et al. (21) also found the unanimous support of the clinicians from various specialities on the importance of anatomical knowledge in their fields was the potent impetus to the revision of the current curriculum based on the students' needs the clinicians.

Apart from that, techniques in teaching anatomy have been an endless debate amongst students, academicians and clinicians. In this study, although the majority of students observed that the practical sessions and lectures were very effective in learning anatomy, practical sessions, tutorials and PBL were believed to be the best methods in retaining their knowledge. As such, the students had a higher preference for the practical session, lecture and tutorial whereas SLP and seminar session received the least preference amongst the students. The reason behind this could be due to the high accessibility of information and reassurance from the lecturers in the settings of tutorials, practical sessions and lectures as compared to student-centred learning wherein they were independent on searching relevant information for themselves (22). The students' preference for the lecture could also be related to the Asian cultural influence in which teachers were perceived as the person holding the key to knowledge. With the technological advancements and incorporations of various modern techniques in teaching, alternative methodologies in teaching anatomy that promote a longer

period of knowledge retention would emerge. Although there has been a trend to shift from conventional teaching methods to various modern alternatives, it is vital to recognise the true essence of education, especially for anatomy. What is more important for the students is to grasp the human body structures and the ability to apply their anatomical knowledge in their relevant disciplines. This could be witnessed in a study conducted by Johnson et al. (4) that reviewed the student performance over 10 years when there was a shift from a traditional, didactic teaching method to a more interactive, functionally and clinically relevant anatomy learning sessions. They concluded that there was no single method that could overtake all the benefits of various methods in teaching anatomy. The key to successful anatomy teaching was to integrate multiple effective methods in multidisciplinary teaching.

Therefore, blended learning that incorporates the method of computer-aided teaching and learning has claimed its popularities lately. Adamczyk et al. (23) conducted a study comparing student preference for multimedia learning tools in a dissection course. They discovered that this learning method was just an adjunct to their primary learning processes such as classes and textbooks. There was another study investigating two groups of students in conventional teaching and blended learning groups, respectively. Although there was no difference in the learning interest, students in the blended learning group scored higher marks and passing rate during the assessment (24).

Besides, Smith and Mathias (25) emphasised the importance of assessment as a motivation for the students to learn anatomy as it was widely perceived that the assessment would drive learning. In this study, students' perception was assessed to identify which examination format could help them to retain their anatomical knowledge the most and the findings demonstrated that the OSPE was rated the

highest while MCQ the least. MCQ format consisted of a set of true or false questions that tested on students' knowledge recall capacity and required them to memorise a substantial amount of details that could be exhausting to students. On the other hand, OSPE assessed the students' ability to accurately identify the body structures and functions, and was perceived to be more interesting and relevant to the students. In a descriptive study conducted by Yaqinuddin et al. (26), they concluded that OSPE was the most efficient assessment to examine the practical aspects of students' anatomical knowledge. The methods of conducting OSPE was also investigated by Inuwa et al. (27) in 2011 wherein they conducted practical examinations for their students via both face-to-face and computer and found no significant difference between both methods in student performance.

CONCLUSION

The study discovered that the clinical students acknowledged the effectiveness of several teaching methodologies including the practical sessions, lectures and tutorials in understanding and retaining their anatomical knowledge. However, both clinicians and students perceived the use of clinical correlations was inadequate despite being a valuable technique in improving students' knowledge retention and application. The study is also open to any improvement opportunities concerning the implementation of pedagogical integration to enhance the students' understanding, retention and application of their anatomical knowledge.

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REFERENCES

1. Gillingwater TH. The importance of exposure to human material in anatomical education: a philosophical perspective. *Anat Sci Educ.* 2008;1(6):264–6. <https://doi.org/10.1002/ase.52>
2. Arráez-Aybar LA, Sánchez-Montesinos I, Mompeo-Corredera B, Mirapeix RM, Sánudo-Tejero JR. Relevance of human anatomy in daily clinical practice. *Ann Anat.* 2010;192(6):341–8. <https://doi.org/10.1016/j.aanat.2010.05.002>
3. Bandyopadhyay R, Biswas R. Students' perception and attitude on methods of anatomy teaching in a Medical College of West Bengal, India. *J Clin Diagn Res.* 2017;11(9):AC10–4. <https://doi.org/10.7860/JCDR/2017/26112.10666>
4. Johnson EO, Charchanti AV, Troupis TG. Modernization of an anatomy class: from conceptualization to implementation. A case for integrated multimodal-multidisciplinary teaching. *Anat Sci Educ.* 2012;5(6):354–66. <https://doi.org/10.1002/ase.1296>
5. Drake RL, McBride JM, Pawlina W. An update on the status of anatomical sciences education in United States medical schools. *Anat Sci Educ.* 2014;7(4):321–5. <https://doi.org/10.1002/ase.1468>
6. Biasutto SN, Ignacio CL, Esteban Criado del Río L. Teaching anatomy: cadavers vs. computers? *Ann Anat.* 2006;188(2):187–90. <https://doi.org/10.1016/j.aanat.2005.07.007>
7. Bergman EM, de Bruin ABH, Herrler A, Verheijen IWH, Scherpbier AJJA, van der Vleuten CPM. Students' perceptions of anatomy across the undergraduate problem-based learning medical curriculum: a phenomenographical study. *BMC Med Educ.* 2013;13:152. <https://doi.org/10.1186/1472-6920-13-152>
8. Hall S, Stephen J, Parton W, Myers M, Harrison C, Elmansouri A, Lowry A, Border S. Identifying medical student perceptions on the difficulty of learning different topics of the undergraduate anatomy curriculum. *Medical Science Educator.* 2018;28:469–72. <https://doi.org/10.1007/s40670-018-0572-z>
9. Trautman J, McAndrew D, Craig SJ. Anatomy teaching stuck in time? A 10-year follow-up of anatomy education in Australian and New Zealand medical schools. *Australian Journal of Education.* 2019;26(3):1–11. <https://doi.org/10.1177/0004944119878263>
10. Alharbi Y, Al-Mansour M, Al-Saffar R, Garman A, Alraddadi A. Three-dimensional virtual reality as an innovative teaching and learning tool for human anatomy courses in medical education: a mixed methods study. *Cureus.* 2020;12(2):e7085. <https://doi.org/10.7759/cureus.7085>
11. Pabst R. Gross anatomy: an outdated subject or an essential part of a modern medical curriculum? Results of a questionnaire circulated to final-year medical students. *Anat Rec.* 1993;237(3):431–3. <https://doi.org/10.1002/ar.1092370317>
12. Zahid AK, Masood A, Musaed AF, Khalid K, Muhammad Z, Assad, J. Does the existing traditional undergraduate anatomy curriculum satisfy the senior medical students? *South East Asian Journal of Medical Education.* 2010;3(2):20–6.
13. Ettarh R. Anatomy past and present: evolution of curriculum and teaching in anatomy. *Austin J Anat.* 2014;1(2):1009.
14. Arroyo-Jimenez MDM, Marcos P, Martinez-Marcos A, Artacho-Pérula E, Blaizot X, Muñoz M, Insausti R. Gross anatomy dissections and self-directed learning in medicine. *Clin Anat.* 2005;18(5):385–91. <https://doi.org/10.1002/ca.20129>

15. Waterston S, Stewart I. Survey of clinicians attitudes to the anatomical teaching and knowledge of medical students. *Clin Anat.* 2005;18(5):380–4. <https://doi.org/10.1002/ca.20101>
16. Singh R, Tubbs RS, Gupta K, Singh M, Jones DG, Kumar R. Is the decline of human anatomy hazardous to medical education/profession? A review. *Surg Radiol Anat.* 2015;37(10):1257–65. <https://doi.org/10.1007/s00276-015-1507-7>
17. Vasan NS, Holland BK. Increased clinical correlation in anatomy teaching enhances students' performance in the course and national board subject examination. *Europe PMC.* 2003;9(5):SR23–8.
18. Dahle LO, Brynhildsen J, Fallsberg MB, Rundquist I, Hammar M. Pros and cons of vertical integration between clinical medicine and basic science within a problem-based undergraduate medical curriculum: examples and experiences from Linköping, Sweden. *Med Teach.* 2002;24(3):280–5. <https://doi.org/10.1080/01421590220134097>
19. Parmar SK, Rathinam BA. Introduction of vertical integration and case-based learning in anatomy for undergraduate physical therapy and occupational therapy students. *Anat Sci Educ.* 2011;4(3):170–3. <https://doi.org/10.1002/ase.225>
20. Fitzpatrick CM, Kolesari GL, Brasel KJ. Teaching anatomy with surgeons tools: use of the laparoscope in clinical anatomy. *Clin Anat.* 2001;14(5):349–53. <https://doi.org/10.1002/ca.1062>
21. Orsbon CP, Kaiser RS, Ross CF. Physician opinions about an anatomy core curriculum: a case for medical imaging and vertical integration. *Anat Sci Educ.* 2013;7(4):251–61. <https://doi.org/10.1002/ase.1401>
22. Jones A, Jones D. Student orientations to independent learning. *Higher Education Research & Development.* 1996;15(1):83–96. <https://doi.org/10.1080/0729436960150107>
23. Adamczyk C, Holzer M, Putz R, Fischer MR. Student learning preferences and the impact of a multimedia learning tool in the dissection course at the University of Munich. *Ann Anat.* 2009;191(4):339–48. <https://doi.org/10.1016/j.aanat.2009.03.003>
24. Pereira JA, Pleguezuelos E, Merí A, Molina-Ros A, Molina-Tomás MC, Masdeu C. Effectiveness of using blended learning strategies for teaching and learning human anatomy. *Med Educ.* 2007;41(2):189–95. <https://doi.org/10.1111/j.1365-2929.2006.02672.x>
25. Smith CF, Mathias HS. What impact does anatomy education have on clinical practice? *Clin Anat.* 2010;24(1):113–9. <https://doi.org/10.1002/ca.21065>
26. Yaqinuddin A, Zafar M, Ikram MF, Ganguly P. What is an objective structured practical examination in anatomy? *Anat Sci Educ.* 2012;6(2):125–33. <https://doi.org/10.1002/ase.1305>
27. Inuwa IM, Taranikanti V, Al-Rawahy M, Habbal O. Anatomy practical examinations: how does student performance on computerized evaluation compare with the traditional format? *Anat Sci Educ.* 2011;5(1):27–32. <https://doi.org/10.1002/ase.254>