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Medical Students' Preferences of Curricular Elements: Lessons Imparted by a Prototype Radiological Anatomy Study

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ABSTRACT

Students have a myriad of preferences of the various curricular elements especially teaching-learning methods, teaching aids and content. Taking radiological anatomy as a prototype, the responses from medical students in the clinical years regarding the rationale for preferences for the curricular elements were studied in a private university in Malaysia. The students' responses to the research question were analysed qualitatively through thematic analysis. Analysis was conducted until no new themes emerged and data saturation was complete. The final themes were subjected to investigator triangulation. While searching answers for our research question of why students prefer certain curricular elements, the sub-themes that emerged were deep approach to learning, enabling transferability of knowledge to workplace, managing cognitive load and suiting learning styles. These sub-themes were categorised into two large themes namely student interaction with learning environment and relevancy of content to context. This prototype study sheds light on students preferred curricular elements. Curricular elements which employ effective student interaction with the learning environment and ensure relevancy to the context are highly sought. It could be concluded that active learning entailing student-centred methods and clinically relevant content is most preferred by students. This prototype study provides potential findings that benefit other disciplines as well.

Keywords: *Learning style, Learning approach, Contextual knowledge, Cognitive load, Active learning*

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INTRODUCTION

Learning is influenced by a myriad of factors including the teacher, students, curriculum and the overall educational environment (1). A formal medical education curriculum denotes the educational experience of the learner that is stated, formally offered and endorsed (2), the representation and imparting of which plays an important role in knowledge acquisition and deficit identification (3). Employing various teaching methods in an optimal teaching environment would cater to the learning needs of the students as they are provided with choices of several ways to excel (1, 4). On the other hand, this also ensures adaptability, and an interest in life-long learning (4) with improved performance and higher levels of motivation (1). It is the prerogative of curriculum planners to ponder over the content, the instructional methods and their connection that helps teachers understand how learning occurs in students (5). An effective way to fathom the preferences of students is to carry out an evaluation and feedback study to help the faculty appreciate the basis of their preferences (6). Curricular preferences fall under the umbrella term "educational preferences" that involve a large target audience (6). A study was conducted in University of Cyberjaya, Malaysia to investigate the perception of students on the integration of radiological anatomy (RA) in preclinical teaching. This study can be likened to a learning needs assessment to bridge the gap between what the student is already exposed to and their expectations that should be fulfilled to gain competence (6). The study instrument employed both closed and open-ended questions on the curricular preferences of students. The closed-ended questions highlighted the curricular preferences of students in RA, whereas the open-ended questions explained the rationale behind their preferences. The scope of this article is the decoding of the answers to the open-ended questions to cast light on the research question (RQ), "What is the rationale behind the choice of students on their preference of the curricular elements, namely the teaching-learning methods, the content and the teaching aids?" Since the study was on RA, the teaching aids included the radiological modalities such as X-ray, ultrasound, computed tomography and magnetic resonance imaging commonly employed for student teaching. Many studies have been carried out on the factors that influence students' penchant for anatomy curriculum. RA is comparatively newer and subject to intense exploration. Though this study is based on RA, anatomy being a core discipline in the curriculum, enables the findings to be extrapolated to the medical curriculum in general, and action plans can be formulated to ease student learning (6).

METHODOLOGY

Context of the Study

RA teaching within preclinical gross anatomy in University of Cyberjaya Malaysia was selected as the context of this study. The tenure of MBBS study in the university is five years, comprising of two years of preclinical and three years of clinical teaching. Basic medical sciences are horizontally integrated in the first two years with few clinical subjects vertically integrated as well.

The feedback and perception of the students were investigated using a questionnaire adapted from a study conducted at Newcastle University UK among students who were undertaking clinical rotations at Sunderland Royal Hospital (7). The questionnaire was pre-tested and piloted accordingly to ensure reliability and response process validity (8–9). With an overall alpha of 0.7 and good response validity over 1 for every item, the questionnaire was used for data collection.

The RQ answered in this study is the rationale behind the choice of students for their preference of the curricular elements namely, teaching learning methods, content

and teaching aids. The participants who voluntarily participated in this cross-sectional study were medical students from the clinical years (Years 3, 4 and 5) of MBBS in the medical programme. The participants had successfully completed their preclinical years and were using their integrated basic medical science knowledge in the clinical years. The rationale for choosing medical students in their clinical years was to explore the transferability of basic medical sciences knowledge for clinical applications using RA as a prototype. The study was conducted at the end of the academic session to enable the clinical students who had completed all their modules/rotations in their respective years to reflect on the reasons as to why they chose certain curricular elements.

All clinical students were approached with an invitation to participate in the study along with the participant information sheet and consent form. Among the total number of 287 clinical students, 212 students responded to the invitation on a voluntary basis. The total number of responses received according to the RQ and year of study is shown in Table 1.

Data Analysis

The students' answers to the RQ were analysed by thematic analysis based on constructivist grounded theory in which researchers deciphered the phenomenon of how individual meanings were the end product of their experiences (10). The responses were thoroughly validated initially and responses which did not provide any meaning were excluded from transcription. Examples of such responses were "not much", "no comments", and "nothing specific".

The authors employed a constant comparison method to decipher the meaning behind the student experiences. Two authors transcribed the answers to create codes using the framework analytical approach based on the grounded theory of data analysis (11). Further individual analysis of the responses culminated in revising the codebook, collapsing some codes and creating new codes. The codes were then collapsed into sub-themes and themes. There were frequent discussions between the authors during this process. Analysis was conducted until no new themes emerged and data saturation was complete (12). The final themes were checked by a different author to achieve investigator triangulation (13).

RESULTS

The scope of this article was based on the transcription of the open-ended responses received from 212 clinical students (Year 3 = 79, Year 4 = 78, Year 5 = 55). Responses to the questions were intended to identify the reasons behind the preferences of students for the teaching-learning methodologies and content of the subject, which included the radiological/topographical anatomical content and radiological anatomy teaching aids. The results were decoded with the intention of extrapolating the findings to the general medical curriculum. Some of the selected student quotes are presented in Table 2.

Table 1: The total number of responses received against the number of responses transcribed

Question	Total number of responses					
Are there any particular reason(s) why students prefer certain teaching-learning modalities, content and teaching aids in the curriculum?	Year 3		Year 4		Year 5	
	R	T	R	T	R	T
	61	59	68	63	47	34

Notes: R = Number of responses received; T = Number of responses transcribed

Table 2: Selected quotes for the major themes and categories

Categories	Themes	Representative quotes
Factors that influence student interaction with learning environment	Learning style	"The reason is just because of my own unique way of learning. So, for example, I learn the information best when it's visual or when I put it in a diagram to visualise it."
		"I love practical sessions because it is very easy to learn when you can see and touch the model."
		"Anatomical lab session is useful for us to remember the structure, by vision and touch."
	Learning approach	"Better in understanding and memorising."
		"To enhance the knowledge and strengthen the memory when the knowledge is been repetitively delivered in many suitable sources and modalities."
		"Some anatomical structures are arranged in layers from superficial to deep (such as the muscles of the leg) and would thus require cross-sectional views to fully grasp their relations to each other."
	Managing cognitive load	"I prefer these methods as it helps me manage the content." "Due to heavy content in anatomy." "Helps to highlight the contents."
Relevancy of the curricular content to the context	Transferrable knowledge	"Thorax and brain are more important as these regions requires excellent skills to interpret deformities."
		"Some are more routinely done in clinical practice than the others."
		"We see them a lot during clinical years. And if we have a lot of exposure to the films, when we go to clinical years, we can correlate it with the patient's and pathophysiology, as well as discuss with the specialist."
		"It is very useful for clinical years as most clinical lecturers expected us to have more knowledge about it."
		"As clinical students, there are certain radiological modalities that we are expected to master, not all (especially X-ray). Therefore, exposure during preclinical years would be extremely beneficial as this skill would be needed when they enter clinical year."
		"X-rays are the most commonly used radiological intervention and are easily accessible to study in the wards. Next are CT scans. Ultrasonography (USG) scans are mainly encountered in O&G and the occasional breast or neck USG in surgery. MRI is rarely encountered and not all patients have to undergo the intervention."
		"Introducing earlier in preclinical phase about radiological modalities somehow would enhance the knowledge and make it easier in applying the knowledge in clinical years since by the time we entered in clinical phase, most clinical doctors would already expect us to know what would be the expected findings related to the case given."

The initial codes that were identified were active learning, better understanding, long term memory for retrieval, content-friendly, suit learning styles, meeting teachers' expectations, availability of teaching modalities and commonality of cases. These codes were collapsed into four sub-themes namely; (a) deep approach to learning, (b) transferrable knowledge to workplace, (c) managing cognitive load, and (d) suiting learning styles.

Since managing cognitive load, deep approach to learning, and suiting learning styles were indicative of interplay of the students in their learning circumstances, they were grouped into a single theme (10). The emergent theme was named as student interaction with learning environment. Use of available teaching aids, meeting teacher's expectations and common cases encountered in the clinical field ensured the transferability of knowledge to workplace, which is highly contextual. Hence, the emergent theme comprising of the above sub-themes was renamed as relevancy of curriculum to the context. Figure 1 is representative of the data analysis procedure.

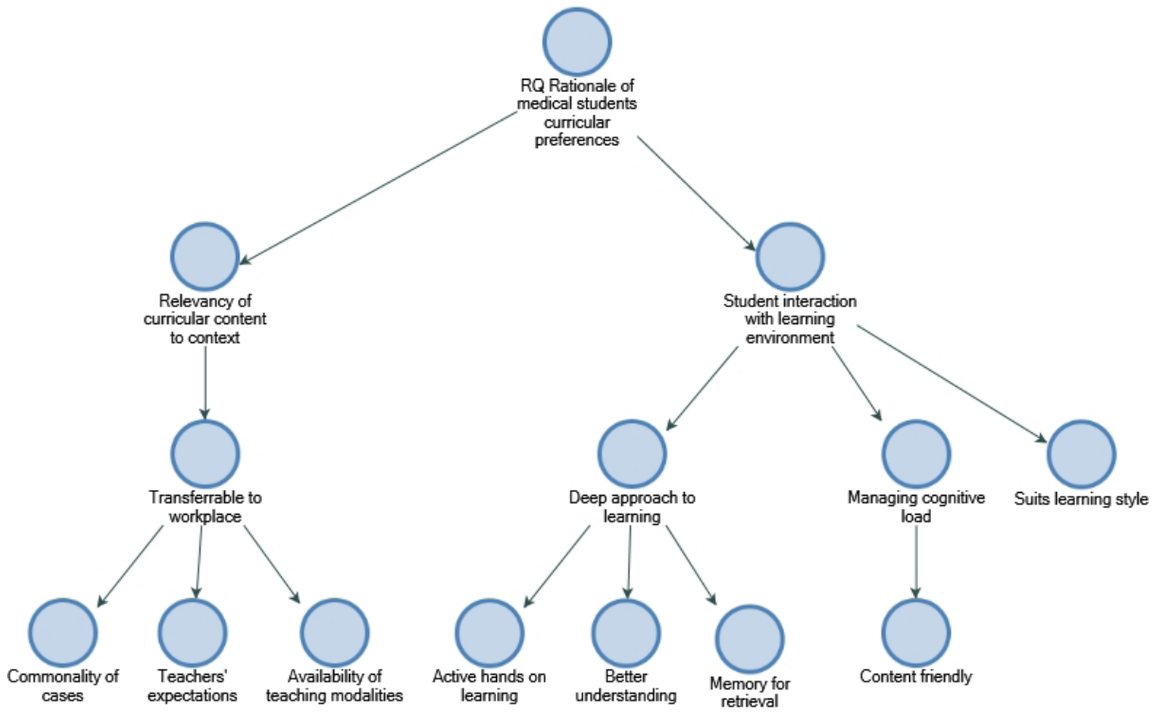

Figure 1: Rationale of medical students' curricular preferences.

Student Interaction with Learning Environment

Learning styles and learning approaches to manage the cognitive load were the main factors that governed the students' preferences. For the preference for teaching methodologies, almost all students stated that their learning style preference was an important factor, especially visual and kinaesthetic learning styles. The students felt empowered when the teaching-learning methodologies suited their style. The students who preferred kinaesthetic learning, indicated that their learning style employed hands-on learning, which is a form of active learning that sparked their interest. The students also indicated that in-class lectures were a source of boredom for them whereas hands-on experience provided them with necessary interaction to grasp the subject better.

On the same note, the students' learning approach towards the learning environment was also substantial. The students preferred approaches that helped them manage the laborious cognitive load and enable deeper understanding of the content for long term memory storage. The students felt that it was pointless if the curricular content was not aligned with their styles and approaches as it was easily forgotten (14). The cognitive load in the medical curriculum is heavy and the approach that highlights the salient points of the content and metacognition would make learning feasible.

Relevancy of the Curricular Content to the Context

The students reiterated that they preferred vertical integration where basic medical sciences were complementary to clinical knowledge, empowering transferability of knowledge. This gives meaning to the basic medical sciences knowledge known as effective clinically applicable knowledge. The students mentioned that when facts are presented without emphasising on the application, it begets boredom. The content (region) to be focused in clinical anatomy relies heavily on the commonality of that region affecting patients and how important that knowledge was for early diagnosis and therapy. This also reflected the deliberate practice that students should undergo to nurture effective skills. According to the students, learning is fun when the knowledge acquired is effectively applied.

Relevancy not only relies on the common regions involved in clinical learning, but also on the widely available teaching aids used, such as the radiological modalities in this case. The students felt that introducing advanced teaching aids in the local context was an unnecessary loss of student learning time due to the non-availability of those teaching aids in their setup. However, the students were also embarrassed if they were unable to identify certain features in the commonly used teaching aids explaining the fact, they wanted to exhibit adequate knowledge to satisfy teachers' expectations and avoid embarrassment.

DISCUSSION

The results of this study indicated that the students' interaction with their learning environment and relevance to the context were the most common reasons why students preferred certain curricular elements. RA was chosen as the prototype as it is a combination of basic medical and clinical sciences, embodying vertical integration in the medical curriculum (7). Hence this discussion is centred around how these results can be extrapolated to the medical curriculum as a whole. The attempt to decipher the preference of curricular elements is akin to investigating learner's needs which underlie the cause of the preference (4, 15) as well as bridging the gap between the expected and actual performance (16). The input from needs analysis is suitable for curricular design and continual development, as it provides information on the content that is perceived as valuable by students (15, 17). The needs must be matched with the organisational

culture to identify the non-performing elements that hinder outcome achievement (16). The process of needs analysis with respect to the situation, and tailoring the course to the needs and evaluation are all an integrally connected continuum (15). Two themes emerged based on the students' answers, namely "student interaction with learning environment" and "relevancy of the curricular content to context" which have further subdivisions. Discussing these themes in detail would provide a detailed view of the students' preferences.

Student Interaction with Learning Environment

Learning styles

The individual learning style reflects the way which learners gather, process, interpret, organise and analyse information (18). Individuals develop unique learning styles based on their preferences and employ strategies to interact with the information provided to increase effectiveness and efficiency (18–19) when matched with curricular elements. The use of various teaching styles depends heavily on the learners' styles and capabilities, interpersonal relationship and educational environment (4). Meshing hypothesis is of the idea that a conducive learning environment that encompasses various learning styles encourages learning (18). According to Grasha, learning styles can be categorised as dependent, independent, collaborative, avoidant, facilitative and competitive which are catered by specific teaching styles and classroom techniques (4). Based on the visual, aural, read/write, kinesthetic (VARK) model, there are four types of learning styles dependent on the mode of perceiving data namely, vision, auditory, read-write, and kinaesthetic (1, 20). Students prefer certain teaching learning methods due to them being accustomed, familiarity and expectance of positive outcome (18), specifically on previous exposure to syllabi, teachers' styles and training, as well as examination styles (21). Additional teaching methods are preferred alongside didactic lectures to accommodate the enormous cognitive load, expand students' ability to use learning styles, and to enable different strategies to learn with less anxiety (4).

Students who are aware of their learning styles are able to devise effective strategies for learning (21–22). They practice either unimodal or multimodal learning styles and their preferences for active learning and assessment strategies rely heavily on these characteristics (1). Studies have shown that in the early years of medical school, students have a multimodal choice of learning style (1) but over the years in medical school, they identify their choice of learning style and their preference of curricular elements tend to match their styles (19). A mixture of styles that stretch the learner's capabilities induces tension and disequilibrium and pushes for a better learning experience in comparison to the unimodal learning style that begets weariness (4). Studies have also pointed out that high achievers prefer the multimodal style, a factor which enables them to adapt different teaching methods in comparison to low achievers (19). Students prefer active learning strategies as they inculcate critical thinking, problem-solving and decision-making skills (18). This study is an answer to the findings of Kharb et al. (18) on insufficient evidence of whether students' preferences of learning styles influence the teaching-learning methods. It is imperative that curriculum designers should have an idea about the overall learning styles of the class to synchronise with the style of the faculty (5), as suggested by the results of this study.

Learning approaches

Learning approaches, especially deep approach practised by self-motivated students has been proven to create an impact on the assessment outcomes (20). The tripartite model on learning approaches divides learning into three categories driven by motivation. The

superficial apathetic approach indicates rote memorisation without much understanding, deep approach emphasises on understanding concepts and connecting ideas, and strategic approach induces learning to achieve the highest possible grades with increased awareness towards examination, but poor integration of topics (22). The motivating factors for superficial learning are fear of failure of targeted grades, higher workload, and lack of time in a packed medical curriculum (22). Students who are extrinsically motivated to be successful, engage in timely strategic learning with knowledge that is still considered insufficient. Students with intrinsic motivation engage in deep learning with personal interest, driven by the need to understand the content and connect it with previously gained knowledge (20). This trait is principally exhibited in universities over schools, proving that high school performance does not always guarantee a good performance in medical school (22). Students prefer deep learning if they are interested in the subject or material, inculcation of which is the main concern for educators (20). According to Kolb's learning theory medical students are either accommodators or convergers. Accommodation is the concrete experience transformed into active experimentation, whereas convergence is active experimentation of abstract concepts (5). However, the results in this study contradicts with a Sri Lankan study which proved that both preclinical and clinical undergraduate medical students prefer superficial learning (22).

Managing cognitive load

Medical curriculum is infamous for its factual overload and lack of integration between preclinical and clinical knowledge (23). Outcome based education has helped in the paradigm shift of the medical programme from facts to redefining the curriculum in terms of what graduates must be able to achieve at various stages of the programme (23). The challenge in medical education is the imparting of the colossal content within a small-time frame in an effective way that enables interpretation, retention and retrieval (22). Three types of cognitive loads have been identified according to the cognitive load theory, which includes essential intrinsic load, poor instructional design mediated extrinsic load and deliberate cognitive strategies-induced germane load (24–25). With research proving that the effect of germane on learning is not obviously seen within a short time frame, students prefer deliberate strategies that enable schema formation and automation (24–25). The postulation that suggests that intrinsic load is indicative of task performance and germane load to task learning, differentiates both, and confirms that students like activities pertaining to germane load which they can control (25). Intrinsic load is beyond the control of the learner and is modifiable by simplifying the task (24–25).

Cognitive load is managed effectively with apt presentation and simplifying complex concepts (26). Providing working examples, solving pre-existing problems, efficiently presenting information with respect to modality boundaries and reducing redundancy effect can reduce the extrinsic load (26). This is because when visually appealing information is presented verbally, students use their working memory, resulting in excessive extrinsic cognitive load (27). As proven in our study, if the instructional method suits the presentation of the content, it tremendously reduces the cognitive load, creating interest in the content as well.

Cognitive load also emphasises on declarative knowledge which is a corner stone in medical education, enabling long term memory, encompassing problem-solving abilities and clinical reasoning (28). Memorising is considered as the first basic step that provides a strong foundation for the complex clinical learning (28) and students prefer curricular elements that help them retain knowledge.

Transferability of Knowledge to the Workplace

Learning in context, a heavily discussed topic in medical education, can be deciphered as situations in which the job is carried out (29). Knowledge is transferable when the learning environment is akin to the retrieval environment (29). One way to achieve this is to set well-defined learning objectives to realise the outcomes (29). Students have voiced out that the closer the content of teaching resembles the context of practice, the better the learning, thereby increasing fidelity (29). On the other hand, semantic context indicates how well the context contributes to learning (29).

Teaching aids which promote memorisation over application, fail to provide the overall conceptual meaning (30). The content and structure of the curriculum are equally important for students to build knowledge over pre-existing concepts (31). Students strive for a thorough understanding of the content to develop problem-solving and clinical reasoning skills to expand effective illness scripts and handle diverse patients for improved patient outcomes (31–32). The learning opportunities must be innovative to enable knowledge retention and retrieval, to transfer basic science knowledge to the clinical situations (32). Vertical integration from the early years of medical school bridges theory and practice, ensuring meaningful learning (31). Early clinical experience improves the clinical skills tremendously and inculcates entrustable professional activities (EPA) (31).

Students are bound to form aspirations through various processes including reflection, imitation and adaptation though their day-to-day interactions with strongly influential individuals (33). The individuals include peers, parents and teachers of which teachers' expectations are considered to be significant in comparison with that of peers or parents (33). Most research conducted was for the teacher expectancy in schools. But the findings could also hold true for university students as well. Teachers communicate their expectations both implicitly and explicitly which influences student achievements (33), often resulting in a self-fulfilling prophecy (34). Teachers' expectations also play a role in deciding learner needs (15) similar to our study, wherein students mentioned that their teacher's expectation was one of the main reasons why they should be exposed to certain content in the discipline (15). Alternatively, students performed better with high expectation teachers as those teachers incorporated highly effective teaching-learning strategies, were more positive in student assessment and capabilities, and exuded a positive class environment (35). Investigating and evaluating teachers' expectations boosts students' performance by realising outcomes (36).

CONCLUSION

This prototype study is based on the students' opinion on the integration of RA within preclinical gross anatomy teaching. However, the findings of this study can be perceived as student learning needs and generalised to curriculum design and development. RA as a newer discipline is contextual, reduces the cognitive load, embarks a problem-solving approach and is a good example of vertical integration, which best suits the current students' preferences. Curricular elements are highly sought after if the process entails effective student interaction with the learning environment, and ensures relevancy to the context. Student-centred active learning and clinically relevant knowledge is the need of the hour in medical education. These qualitative research findings are expected to provide an insight for curriculum developers and faculty to work towards improving students' learning.

Limitations

A major limitation of this research is that it is a single-institutional study based on a single subject, reflecting the needs of only their clinical students. Nevertheless, the results and discussion of this study could be the stepping stone for a larger inquiry in the educational context in future.

Recommendations

The scope of this study could be further extended to include major curricular elements in medical school and tap students' preferences, while considering continuous quality improvement and curricular design and development. This study can also be extended to compare the approaches between medical schools to promote standardisation.

ETHICAL APPROVAL

This study received an external ethical approval from University of Malaya (UM.TNC2/UMREC - 959) and was endorsed by University of Cyberjaya (UOC/CRERC/EXTERNAL/05/2020[UM.TNC2/UMREC-959]) for data collection.

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