

ORIGINAL ARTICLE

Effectiveness of a Musical-based Learning Approach on Knowledge and Happy Index Related to Anatomy Syllabus: A Quasi-Experimental Pilot Study

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ABSTRACT

Introduction: Musical-based education has been linked with improved students' academic performance and mental wellbeing. This study aimed to evaluate a musical-based anatomy learning module using the combination of music, choreographed movements and 3D anatomy illustrations on muscles of the hand. **Methods:** A 5-minute duration video on muscles of the hand was developed through series of discussions with expert panels to incorporate the three stated components, emphasizing on the use of catchy music and simple terms to assist memorization skills. A single arm quasi-experimental pilot study was conducted with pre- and post-intervention measurement of knowledge, perception, stress and happy index related to learning anatomy. A total of 157 medical students were recruited and exposed to a total of 20 minutes video duration over three days. The effectiveness of the intervention was investigated using paired t-test and was interpreted based on the pre- and post-measured exposure mean differences. **Results:** The newly developed musical-based anatomy learning module had effectively improved knowledge and happy index related to learning anatomy, with significant mean differences were observed on the total mean scores for knowledge (MD= 2.707, $p < 0.001$) and happy index (MD=3.256, $p < 0.001$), as well as significant reduction of the mean scores for the negative items for perceptions and stress. **Conclusion:** The improved knowledge and happy index related to learning anatomy reflecting the positive impact of music used in combination choreographed movements and 3D illustrations to strengthen memorizing skills of medical students as well as instilling positive mood.

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INTRODUCTION

Studying medicine is the dream of many excellent students despite the long duration of training and the high level of stress associated with the medical curriculum. It requires strong cognitive abilities, a positive attitude, top-notch time management and finest coping strategies to effectively dealing with the challenges and potential stress throughout the programme. The numerous modules demand the students to cope with the increasing learning workload, which eventually may disrupt the

wellbeing and mental health, as well as their ability to learn and academic performance.

Medical students reported higher emotional disturbances than that in the general population, with stress being the commonest emotional problem. A 31.1% prevalence of depression was reported among medical students in a public university in Malaysia, which were dominated by those of moderate category (1). Additionally, the same study also reported 53.9% and 26% were experiencing anxiety and stress respectively (1). Meanwhile, higher stress prevalence of 29.6 % (2) and 41.9% (3) were reported in two earlier local studies among undergraduate medical students in two different public universities in Malaysia (3), and a higher with a stress prevalence of 61.4% was demonstrated among medical students in

Thailand, with almost similar demographic background previously reported in a Thai medical school (4). With the significantly worrying level of stress reported among students enrolled in the medical program, which was steadily increasing with the year of curriculum (5,6), the need to adopt a more innovative, creative, as well as stress-free medical education is urgently needed.

Human anatomy is an important subject during the pre-clinical years and is not the only subject requiring a lot of memorization skills, which can be a mental burden to some students. The use of class lecture, which is a common conventional teaching method can potentially reduce students' concentration level, understanding and memory retention among students. An intervention study evaluating the impact of background music on students' anxiety, satisfaction and performance in dissection room demonstrated a significant reduction of acute anxiety [aOR: 0.423 (95% CI: 0.160- 0.710)], and higher grades among students in the intervention group (7).

Music has been used as a tool to stimulate students' engagement as well as providing alternative platform for connections and deeper understanding and known to influence the emotions. The nature of music and its disposition is distinctive (8) of music makes listening to musical sounds or patterns of sound produces psychological reactions, within us (8). Teaching and learning in the presence of background music were which shown to reduce anxiety levels, as well as enhancing cognitive wellbeing and improve the academic performance among students (7).

Listening to music is also linked with happiness through emotional regulations, which was reflected by the significant interrelation between music preference and happiness (9). Happiness has been used to reflect individual's mental or emotional states, as well as their life satisfaction and well-being (9). Apart from the use of music, using song specifically composed to stimulate learning has been used in teaching and learning. However, focus was given mainly for children of primary school or pre-school children, for language development and competency (9). According to Zeromskaite (10), apart from positively influencing phonological skills, musical training may also positively influence reading skills in another language, due to its effect on the speech segmentation of the brain (11), reflecting its widely used as teaching methods among pre-school or primary school children. Repetitive hearing to the song specifically geared to the content of the syllabus able to increase the memory and the understanding of students (12), which may improve the academic performance of students. In view of the memory enhancer role of songs this pilot study aimed to assess the effectiveness of a musical-based intervention module using the combination of song and choreographed movements on knowledge, perceptions, stress and happy index related to anatomy learning.

MATERIALS AND METHODS

An anatomy song entitled "muscles of the hand" was composed especially for this study, through series of focus group discussions among experts in the field of anatomy and music, using anatomy terms as the main body of lyrics. Two music experts were involved in composing and arrangement of the song. The development and recording of the song took approximately four months. A catchy melody was ensured to encourage students' engagement, with the lyrics' texts were written into coherent English sentences to make memorization of anatomy terms even easier and directly comprehensible. Individual muscles were illustrated in a 3D drawings and muscle movements were later choreographed according to the lyrics. A video lasted roughly for five minutes was developed consist of a song with written lyrics, a talent demonstrating the choreographed movements and 3D anatomy illustrations. The whole process from development of the song, recording and development of the video was approximately eight months due to COVID-19 related enforcement of Movement Control Order (MCO) at that time.

The data were gathered among the medical students at a public university in Klang Valley, Malaysia, regardless of their year of study and exposure towards the musculoskeletal module. A single arm quasi-experimental pilot study design was conducted among 157 medical students consisting of 1st 2nd, 3rd, 4th, and 5th years medical students using Zoom application with a total of five sessions (20 minutes) given to each student for over three days. Pre- and post- measurements of knowledge, perception, stress, and happy index were conducted at baseline and after completion of the 4th session. The knowledge section consists of 10 items, which were measured using 3-point Likert scale (True, False, Unsure). One point was given for every true answer and nil for false and unsure answer. Meanwhile perception (1=strongly disagree; 2=disagree; 3=neutral; 4=agree; 5=strongly agree) and stress (1= Never; 2= Almost never; 3=Sometimes; 4= Often; 5= Very often) were measured using 5-point likert scales. A total of 10 items were also used to measure perception, with the use of negative statements in item 2, 4, 5, 6 and 7 (refer Table II). On the other hand, happy index was measured using a 10-point likert scale (0 to 10) Pemberton Happiness Index (PHI), with 0 being total disagreement and 10 being total agreement (13). The PHI was designed to measure happiness in the general population, through measurement of remembered (11 items) and experienced (10 items) well-being. However, for the purpose of this study, only the 10 items of experienced well-being (positive and negative events that occurred the day before) were measured to reflect the students' experience in learning anatomy using the newly developed module. The content of the questionnaire was validated by expert panels from the field of anatomy and community health, and face

validity was performed among 10 medical students from a private university, to ensure the comprehension of the statements used.

The data was analysed using SPSS version 26, with significant value was set $p < 0.05$. The paired sample t-test was used to establish scores which were normally distributed, to assess changes in mean scores of individual items as well as the total scores for each outcome over time. The effectiveness of the intervention was assessed according to the mean difference of the total score for all outcomes.

This study was approved by the the Ethic Committee for Research Involving Human Subjects, Universiti Putra Malaysia (JKEUPM), reference number JKEUPM-2020-157 prior to data collection. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

RESULTS

The descriptive analysis of the demographic characteristics showed the mean age of 20.980 ± 0.990 years old among the respondents (Table I), which was dominated by female respondents (68.2%), Malay ethnic background (66.2%), Muslims (67.5%) and second year medical students (40.8%).

Meanwhile, paired t-test was conducted to assess the pre- and post- intervention mean scores for individual items for knowledge, perceptions, stress and happy index related to learning anatomy (Table II). All the 10 items for knowledge were showing significant difference

in mean scores with items one and three are showing significant reduction of mean following exposure towards the intervention. On the other hand, only four items for perceptions towards learning anatomy were experiencing significant mean difference, with two of them showing significant reduction of the post-intervention mean scores (items 5 and 6), in which both were negative statements, indicating the positive impact of the intervention to reduce negative perceptions towards learning anatomy.

Similarly, two out of three items for stress that showed significant mean difference had reduced post-intervention mean scores (items 1 and 2), which is also reflecting the positive impact of the newly developed module on stress level related to learning anatomy. As for happy index, seven items had significant mean difference, with item 4 is showing the highest increase in post-intervention mean score compared to pre-intervention (mean difference=0.647). Further analysis assessing the mean differences on the total mean scores for knowledge, perceptions, stress and happy index related to learning anatomy showed only knowledge and happy index were found to significantly improved following intervention (Table III).

DISCUSSION

Having adequate anatomy knowledge is crucial to assist medical students to better understand disease characteristics during the clinical years. The paradigm shift in medical education, require students to actively participate in class including in teaching and learning anatomy, particularly the musculoskeletal system (14). The use of multimedia to improve anatomy related knowledge (15,16,17) have been reported, with paucity observed in the use of song, particularly in combination with choreographed movements. Course management systems are frequently used to offer digital resources to students to help them with their assignments and studies (15).

Our study showed overall significant improvement of medical students' knowledge after exposure to hand music video. Majority of the items in this component were scored significantly, reflecting the effectiveness of the music video in transferring hand anatomy knowledge without any doubt. The role of music in fostering learning was also reported in a study by Lehmann and Seufert (18). Although written learning modality associated with better recall than the spoken ($d = 0.97$) or sung text ($d = 0.78$), sung modality was associated with better comprehension than written learning modality ($d = 0.40$), implying that dually coded using verbal and the melodic information in sung texts-based learning led to better recall and comprehension than single coded spoken texts (18). The rhythm provided in each melody eases the recall of lyrics (19) and allows the building of information into larger musical patterns which facilitates

Table I: Demographic characteristics of the respondents (N= 157)

Variables	n (%)
Age [Mean: 20.980 (0.990)]	
Gender	
Male	43 (27.4)
Female	107 (68.2)
Ethnicity	
Malay	104 (66.2)
Chinese	24 (15.3)
Indian	25 (15.9)
Others	4 (2.5)
Religion	
Islam	106 (67.5)
Buddhist	17 (10.8)
Hindu	23 (14.6)
Christian	10 (6.4)
Others	1 (0.6)
Year of study	
1	58 (36.9)
2	65 (40.8)
3	19 (12.1)
4	15 (9.6)
5	1 (0.6)

Table II: Bivariate analysis (N = 157)

Item description	Mean score (SD)		Mean difference ^(b-a)
	Pre-exposure ^a	Post-exposure ^b	
Knowledge on anatomy of the upper and lower limbs			
1. Muscles of the hand are called intrinsic muscles	0.100 (0.3030)	0.040 (0.207)	-0.057*
2. Thenar muscles are involved in abduction and adduction of little finger	0.590 (0.493)	0.910 (0.286)	0.318**
3. There are three intrinsic muscles of the hand	0.430 (0.496)	0.170 (0.373)	-0.261**
4. Hypothenar muscles are involved in thumb abduction and opposition	0.570 (0.496)	0.900 (0.295)	0.331**
5. Other three muscles of the hand are lumbricals, palmar brevis and palmaris longus	0.250 (0.433)	0.760 (0.430)	0.510**
6. Palmaris brevis improves handgrip	0.620 (0.487)	0.990 (0.113)	0.369**
7. Thenar muscles also involves in thumb extension	0.160 (0.367)	0.460 (0.500)	0.299**
8. IP joint extension involves the lumbrical muscles	0.510 (0.502)	0.940 (0.233)	0.433**
9. Palmar and dorsal finger movements involve the interossei muscles	0.620 (0.487)	0.950 (0.221)	0.331**
10. Palmaris brevis also involves in fingers flexion	0.280 (0.451)	0.710 (0.454)	0.433**
Perceptions towards learning anatomy			
1. I found anatomy is very interesting	4.030 (0.947)	4.430 (0.727)	0.408**
2. Anatomy is a very tiring and exhausting subject	3.540 (1.169)	3.410 (1.220)	-0.121
3. Anatomy education is important towards the development of my professional medical skills	4.570 (0.662)	4.600 (0.553)	0.025
4. Anatomy is a difficult module	3.740 (1.014)	3.750 (0.986)	0.006
5. The human anatomy is difficult to memorize	4.000 (0.870)	3.850 (0.939)	-0.146*
6. There is a lot to learn in anatomy	4.640 (0.601)	4.470 (0.694)	-0.166*
7. There is not enough time to learn everything in anatomy	3.890 (0.877)	3.820 (0.890)	-0.070
8. I prefer a new method of learning anatomy	4.080 (0.855)	4.240 (0.777)	0.153*
9. I prefer a simpler way of learning anatomy	4.530 (0.675)	4.540 (0.665)	0.013
10. I prefer an attractive and fun way to learn anatomy	4.660 (0.563)	4.630 (0.569)	-0.025
Stress related to learning anatomy			
How often were you....			
1. under stress while studying human anatomy?	3.750 (0.945)	3.560 (0.943)	-0.191*
2. facing difficulty to memorize the anatomical structure of the human body?	4.050 (0.846)	3.830 (0.907)	-0.223*
3. having difficulty to cope with anatomy learning process?	3.420 (0.941)	3.270 (0.943)	-0.153
4. feel confident studying human anatomy?	3.050 (0.883)	3.180 (0.813)	0.127
5. received assistance/help from your lecturer/family members/ peers to cope with stress related with anatomy learning?	3.350 (1.103)	3.590 (0.967)	0.242*
6. perceived anatomy as a boring subject?	2.320 (1.093)	2.400 (1.049)	0.076
Happiness Index			
1. I am very satisfied with my life	7.400 (1.924)	7.850 (1.680)	0.462**
2. I have the energy to accomplish my daily tasks	7.240 (2.049)	7.660 (1.842)	0.423*
3. I think my life is useful and worthwhile	7.410 (2.298)	7.940 (1.722)	0.551**
4. I am satisfied with myself	6.820 (2.198)	7.450 (1.940)	0.647**
5. My life is full of learning experiences and challenges that make me grow	8.220 (1.726)	8.310 (1.563)	0.109
6. I feel very connected to the people around me	7.170 (1.972)	7.570 (1.795)	0.404*
7. I feel able to solve most of my daily problems	7.240 (1.912)	7.450 (1.658)	0.224
8. I think that I can be myself on the important things	7.540 (1.893)	7.830 (1.680)	0.295*
9. I enjoy a lot of little things every day	7.590 (2.184)	7.870 (1.804)	0.282*
10. I have a lot of bad moments in my daily life	4.680 (2.504)	4.540 (2.523)	-0.141

*P<0.05; **P<0.001

Table III: The mean difference of total knowledge, perceptions, stress and happy index scores before and after exposure towards the musical based intervention (N =157)

Variables	Adjusted mean (95% CI)	MD	p-value	
Knowledge	Pre-intervention	4.13 (3.83, 4.40)	2.707	< 0.001
	Post-intervention	6.84 (6.62, 7.04)		
Perceptions	Pre-intervention	41.70 (41.01, 42.34)	0.076	0.794
	Post-intervention	41.79 (41.06, 42.58)		
Stress	Pre-intervention	19.98 (19.53, 20.45)	0.121	0.591
	Post-intervention	19.85 (19.39, 20.35)		
Happy Index	Pre-intervention	71.21 (68.99, 73.63)	3.256	< 0.001
	Post-intervention	74.46 (72.32, 76.63)		

MD= Mean difference

recall (20). Furthermore, the selection of correct melody may also act as motivation stimulator and therefore, should foster deeper understanding and increased learning outcomes (18).

The use of 3D anatomy illustration may have also enhanced the positive effect of the video. The 3D sketching style approach utilized in the multimedia graphics can further intensified medical students' understanding on musculoskeletal anatomy (14), which support the theory related to technology-enhancement improves students' learning outcomes (21). However, two items in the knowledge component did not improve following exposure towards the music video, which were "Muscles of the Hand are called intrinsic muscles" and "There are three intrinsic muscles of the hand". Given reasons are perhaps they are confused with the other extrinsic muscles of the upper limb since a hand has twenty total muscles. Furthermore, they might be exposed to the previous lecture which has different delivery terminologies (22). Anatomical models and e-learning are being used to complement and enhance the conventional teaching approaches. Despite these developments, little is known about the teaching and learning preferences in medical education generally and specifically in learning anatomy (23).

The newly developed music video was also found to effectively improved the happy index among students. Music has positively improved, both physiological arousal (e.g., heart rate, blood pressure, and hormonal levels) as well as psychological stress experiences (e.g., restlessness, anxiety, and nervousness) (24) are well established. The reduction in cortisol levels while listening to music is associated with stress-reducing effects (25,26). Furthermore, Allen et al. (27) concluded that under stressful situation, listening to music will influence relaxation, which may increase coping mechanism and reduce psychological stress. It has been a common culture nowadays for many students to listen to music of preferable genres, in order to alleviate their stress and anxiety while studying for a test or completing homework assignments.

On the other hand, an overall significant improvement of perception towards learning anatomy using the music video was not observed in this study. Interestingly, significant reduction in post exposure mean scores for negative items such as "The human anatomy is difficult to memorize" and "There is a lot to learn in anatomy" were demonstrated, indicating partial effectiveness of the music video to reduce negative perceptions towards learning anatomy. The well-known positive effect of music on mood and arousal (28,29), may have contributed towards improving learning perceptions among students.

Similarly, although the total mean score for stress was not significantly improved following music video exposure,

significant reduction in the post exposure mean scores were observed for the two negative items listed. The use of videos was found to result in more personalised learning experiences, through better control over the learning direction (30). Furthermore, videos serve as an educational "enabler and complementary tool" in the teaching and learning process as it promotes better involvement with content, and better engagement, leading to improved knowledge transfer, and memory building (31). Shorter video was preferable and is more appealing to viewers more than longer portions, advising that videos not exceed 15 minutes in duration (31), as proven in our study.

CONCLUSION

Our findings highlight the positive effect of the music video developed to improve knowledge and happiness in learning anatomy among medical students. However, the absent of a control arm for comparison purposes in this study may limit the interpretation. The effectiveness of the music video using combination of song, choreographed movements, and 3D anatomy illustration of the hand over the conventional learning methods through reading books and diagram is yet to be explored in a comparative experimental study. Similar approach should be considered to involve other body parts or whole-body movements to facilitate anatomy teaching and learning, in parallel with the advancing technology and the needs for more innovative teaching and learning. Exploring the use of a wide range of music genres and how the diverse individual music preference is affecting the learning abilities and performances would also be interesting.

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