ORIGINAL ARTICLE

Medical Student's Perception of Role Plays as an Effective Teaching-Learning Strategy for a Complex Topic in Biochemistry.

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Abstract

Introduction: Biochemistry is considered a tough subject by many students as the complex biochemical processes and metabolic pathways are difficult to comprehend and remember. The objective of the study was to assess the effectiveness of role play as a teaching strategy in conveying the complex concepts of biochemistry to year-1 medical students.

Methods: An academic role-play was conducted after an initial briefing of relevant facts and concepts of lipoprotein metabolism related to the kinetics of chylomicron. The role play was conducted for around 40 minutes and at the end of the session, a pre-validated questionnaire was provided to the students to give feedback. The questionnaire comprised of close-ended (using a 5-point Likert scale) and open-ended questions to obtain their opinion on the effectiveness of role play as a teaching-learning method for biochemical concepts.

Results: In this study, 87.5% of the students agreed or strongly agreed that the role play enriched their learning experience; 72.9% supported this teaching-learning strategy and stated that the role play helped them to visualize a mind map and recall the concepts better. 79% of the students felt that role play avoids boredom in the class.

Discussion and conclusion: The present study attempted a creative and innovative use of role play to help students learn chylomicron kinetics in a large group setting. In the current role-play, the different regions of the whole lecture theatre served as different characters or components involved in the kinetics of chylomicrons. This idea of personification and anthropomorphism used in the role-play of lipoprotein metabolism are unique and novel. The feedback from the students revealed it to be more engaging and effective than a didactic lecture.

Keywords: Role-play, innovative teaching-learning, lipoprotein metabolism, chylomicron kinetics, anthropomorphism,

Introduction

Role-play acts as an important learning tool to gain knowledge and skills at all levels of education.[1] Role-play simulation can be a one-on-one session or incorporated into large-group teaching-learning activities. According to Knowles, adopting teaching approaches such as dyads, case studies and role-plays can make the students comfortable and reduce their apprehension, which facilitate active learning.

A lecturer could use role-play to stimulate brainstorming, to improve communication skill and to enhance the practical skill of the learner.[2] Karwowski and Soszynski explained that role-play could be considered as a new way of cultivating creative ability among children, youth and adults.[3] The role-play technique is useful in engaging the students and facilitates focussing on the topic and connecting with their peers. The added advantage of this technique is that shy or reticent students, who hesitate to interact in the class room, could be coaxed by the lecturer to come forward and take part-in a role-play.[4] In practice, role-plays are often embedded within didactic lectures or group discussions.[5]

Role-play in teaching and learning activity in medical school:

In medical school, role-play has so far been successfully applied and implemented in teaching clinical scenario, such as doctor patient interaction and history taking. Most often role-play has been incorporated as a simulation method performed in various ways by the medical students. For example, role-play simulation for the acquisition of patient-centered interviewing skills and communication skills.[1,6]

However, studies on the effectiveness of role-play role in conveying complex molecular concepts and their interaction in pathogenic process in pre-clinical topics are limited. This study was done to execute role-play as a tool to teach biochemistry to the first-year medical undergraduate students and to assess the students' perspective on the effectiveness of role-play in teaching complex concepts of biochemistry.

Compared to other pre-clinical subjects, biochemistry is considered tough for students as the complex biochemical process and metabolic pathways are difficult to comprehend and remember. Explaining the different topics in biochemistry through traditional didactic lectures to students is intrinsically tedious and often perceived as 'boring', which poses a challenge for teachers. Creative improvisation of a traditional lecture through innovative teaching approach is essential for effective communication of knowledge and information to the students during large group teaching. With that goal in mind, we investigated the effect of role-play in teaching the complex biochemical process of exogenous transport of lipids to the first year medical students.

Methodology

This was a cross sectional, questionnaire-based study conducted on 1st year medical undergraduates of faculty of medicine following a role-play-embedded large group teaching on lipid transport. The participation in this study was made voluntary. The session included an initial briefing on lipo-protein metabolism for 20 min based on the PowerPoint slide set circulated a few days earlier as a preparatory learning resource. The session took 60 minutes to complete. The academic role-play after the briefing took around 40 minutes of time. At the end of the role-play, the lecturer clarified any doubts regarding the topic. After that, student feedback was obtained online. The questionnaire comprised of both close-ended (using a 5-point Likert scale as a response scale ranging from 1 = strongly agree to 5 = strongly disagree) and open-ended questions to obtain their feedback on the effectiveness of role-play as a teaching method for biochemistry.[7]

Student volunteers who performed the role-play were selected from the same cohort of the first year MBBS. The role-play team was given the

script two days in advance for the preparation and rehearsal along with the lecturer. The rehearsal was conducted to practise the right combinations of words to articulate what exactly the role-play wanted to convey, to get a sense of how much time it took and to polish the content. The script of role-play was written in English. In this role-play, the biochemistry lecturer acted as chylomicron, the 'hero' of this concept.

Title of role-play: Exogenous pathway for the transport of lipid

***Representation for the role-play*:**

1. Dais of the Lecture Theatre (LT) as the intestine
2. Lecturer as chylomicron
3. A student as the "HDL angel"
4. Wad of Cotton as TAG from chylomicron
5. Aisles of LT as the capillaries
6. A few students as lipoprotein lipase embedded in the wall of the capillaries
7. The two main entrances of LT as the muscle and adipose tissue
8. A vacant corner of LT as the liver

The Concept and the Sequence:

The dais of LT was considered as intestine-where chylomicrons are synthesized. At the time of synthesis, the chylomicron had only a "head" (Apo B48, an apolipoprotein) and had no "arms" (Apo C-II & Apo-E). The lecturer, acting as a chylomicron, carried TAG (wad of cotton) tied on her head and walked along the space between dais and aisle thus representing the transport of the chylomicron from intestine to capillaries. In the capillary (aisle) the benevolent HDL (a student acting as the "HDL angel") donated Apo C-II and Apo-E (symbolized as the two arms) to the chylomicron (lecturer). Upon receiving the functionality of the two arms, the lecturer expressed happiness (by the gesture of raising both arms up in the air). It is again explained to the students that the two newly gained arms symbolized Apo c-II and Apo-E respectively.

With the left hand, the lecturer, as a fully formed chylomicron, waved to those students, who were designated as lipoprotein lipase and were lined up along the sides of the aisle that represented the capillary walls. It was then explained that the lipo-protein lipase lining the capillary wall was waiting for the signal of Apo-c-II to act on the TAG of chylomicron (Lipo-protein lipase is activated by Apo c-II and convert TAG of chylomicron to free fatty acids).

From the whole wad of cotton, symbolizing TAG, a small portion of cotton, symbolizing free fatty acid, was plucked by the student (lipo-protein lipase) to convey the fact that the free fatty acids (FFA) were released from TAG of chylomicron. It was then explained to the whole group that based on the energy demand at that moment, the released FFA would be stored in adipose tissue (Entrance 1) or undergo β-oxidation in the nearby muscle cell (Entrance 2) (Figure1 and 2). The process of release of FFA would continue until the formation of chylomicron remnants. This sequence was acted out by the removal of small portions of cotton sequentially by the students playing the role of lipo-protein lipase. Finally, the chylomicron remnant reached the liver to get attached to the receptors located on the hepatocyte through Apo-E. This was enacted by the lecturer, with all the cotton wad removed, by walking over to the vacant corner that symbolized the liver. On reaching the liver, the lecturer pretended to knock with right hand (Apo-E) and explained that Apo-E of chylomicron remnant will bind to receptor located on the hepatocyte. To make the student understand better, the lecturer used an interesting analogy: "Like all the rivers finally flow in to the oceans, the chylomicron remnants have the liver as their final destination."

***Debriefing after the role-play*:**

The lecturer summed up the whole concept of lipo-protein metabolism and correlating the significance of each step of the role-play to reinforce the salient points.

Results

A class of 150 undergraduate medical students of year-1 participated in this study and were invited to give feedback on the role-play activity. The role-play was completed within 60 minutes which included a briefing at the beginning and a debriefing at the end of the class. Ninety-six students volunteered to fill in the online feedback. The students were quite impressed by this role-play. Students rated 9 questions on a Likert-type scale ranging from 1(strongly agree) to 5 (strongly disagree). The class agreed that the role-play enriched their learning experience and improved critical thinking. They disagreed that the role-play during lecture was childish and immature.

In free text comments, students reported that the role-play was effective as it helped them to pay more attention in class and enhanced their understanding towards the topic. Most of the students were appreciative in their comments while few of them had also suggested ideas for improvement of the role-play. The free text comments are tabulated in Table 1 and 2.

In the present study, 87.5% of the students agreed/strongly agreed that the role-play enriched their learning experience, while 11.5% preferred to stay neutral and only 1% of the participants disagreed (Figure 3). 79% of the participants also believed that the role-play improved their critical thinking (Figure 4). Most students (83.3%) agreed that the role-play helped them to understand the complex concept of biochemistry topic on Lipoprotein metabolism and the remaining stayed neutral. None of them disagreed (Figure 5).

Most of the participants (83.3%) agreed that the role-play made the session interesting, while the remaining remained neutral on their opinion, and none of them disagreed (Figure 6).

Most of the students (72.9%) supported and stated that the role-play helped them to mind map and recall the concepts better, while only 2.1% disagreed (Figure 7).

A little more than half of the students (54%) disagreed that role-play was childish and immature, while 20% stayed neutral and the remaining 26% felt that it was childish (Figure 8).

79% of the students felt that role-play avoided boredom in the class. About 20% stayed neutral in their opinion. No one disagreed (Figure 9).

Role-play was appreciated as a more effective tool than traditional didactic lecture by 75% of the participants, while 24 % remained neutral in their opinion; only 1% of the group disagreed (Figure 10).

Discussion

Role-play is considered as an appropriate teaching tool for medical students. In our study, over 80% of the students reported that the role-play enhanced their learning experience and improved their critical thinking. According to Randel, et al., students should not be expected to learn to deal with complexity unless they have the opportunity to do so and they believe that role-playing provides an opportunity to address such complexity.[8] In this current study, majority of the students reported that the role-play helped them to understand the complex concept of lipoprotein metabolism. Henriksen (2004) too expressed concerns that the students might be anxious doing the role play and they might think that role-play was childish.[9] However, in our study, less than 20% of the students felt that role play was childish and immature.

Role-play was favoured by the students as an interesting educational tool and it can be adopted for effective knowledge transfer between the teacher and the students.[10] In the present study, the participants preferred role-play as it helped them to be more engaged and found it to be more effective than a didactic lecture. Further the students found role-play to be interesting, exciting and recommended other lecturers to implement role-play in their teaching learning

activities. Role-plays are more meaningful when the students are asked to perform as the characters of the script. In the current role-play, the different regions of the whole lecture theatre served as different characters/components. This idea of personification and anthropomorphism used in the role-play of lipoprotein metabolism are unique and novel.

The lecture covered both the exogenous and endogenous pathways for lipoprotein metabolism, but the role-play was limited to demonstrate the exogenous pathway alone. It was explained to the students that the pathways are more or less similar with a few exceptions.

The role-play pattern followed in the present study was partially scripted and involved participants that included students and the lecturer. Partially scripted approach had the advantage as the lecturer had the liberty to make some relevant comments and minor adjustments while performing the role-play to make it more meaningful. For example, the lecturer used an interesting analogy as an impromptu improvisation of the script: "Like all the rivers finally end in the oceans, the chylomicron remnants reach the liver as their final destination". The schematic representation of the lecture theatre or class room (anthropomorphism) can be done in various class room settings. Minor modifications can be done according to the convenience of the lecturer and the layout of the venue. The basic requirement is just the seating arrangements as depicted in Figure 1 and 2. The role play concept is simple and can be recreated by others with ease. Lesson plan (Appendix 1), Facilitator guide for role play (Appendix 2) and student feedback form (Appendix 3) are provided for reference.

Limitations

Though 150 students were present in the class, only 96 gave their online feedback as it was optional and voluntary.

In general, role-play required lot of preparatory work involving all the key players.[11]

The planning and preparation for role-play required more time for rehearsals, which was challenging for the lecturer and the students in their tight academic schedule.

The use of props involved cost and needed financial support from the university management.

The role-play needed creativity and new ideas and might be difficult to execute for all topics.

Conclusion

The present study attempted a creative and innovative use of role play to help students learn lipoprotein metabolism in a large group setting. The students perceived role-play to be more effective and engaging than traditional teaching.

Acknowledgment

We would like to thank the students of the first year MBBS (2018 intake) for their enthusiasm, active participation and encouraging feedback on this exercise. We also place on record our sincere thanks to Dr Matiullah Khan and Dr Swe Swe Latt for their support during the preparation of this manuscript.

Disclosures

None to report

Funding / support

None to report

Conflict of Interest

The authors declare that they have no conflict of interest.

Ethical approval

Reported as not applicable as the mode of large group teaching is left to the individual lecturer as long as they adhere to the prescribed specific learning outcomes. Student feedback was purely voluntary in nature.

Table 1. Thematic analysis of the free text comments of appreciation

Remembering and Recalling
• *It is easier to remember the concepts and processes.*
• *Able to focus and remember better; the contents are now easy to recall.*
• *Clear picture of what I have to remember.*
• *I can recall better based on the role-play rather than the words spoken.*
Attentiveness:
• *Kept me enticed throughout the session.*
• *Interesting and able to capture our attention.*
Arousal:
• *Not feeling sleepy during this lecture; avoided boredom.*
• *Not stale or boring as the usual lectures.*
Visualizing:
• *It helped us to visualize the topic better.*
• *Some students can remember things by imagery; by participating in the role-play, I can visualize everything and remember it.*
Appreciation:
• *The effort put by the role-players is much appreciated.*

Table 2. Free Text Comments on suggestions for improvement

Characters need to hold labels to avoid misunderstanding.
Maybe use more of 'props'?
The presenters should talk loudly.
Shorter preparation time before starting the role play.
A bit more explanation in dialogue form.
Carry out the role-play at the center of stage in front so that all students can see.
Sometimes, role-play takes time, so I think just for role-play, they should have dedicated slots

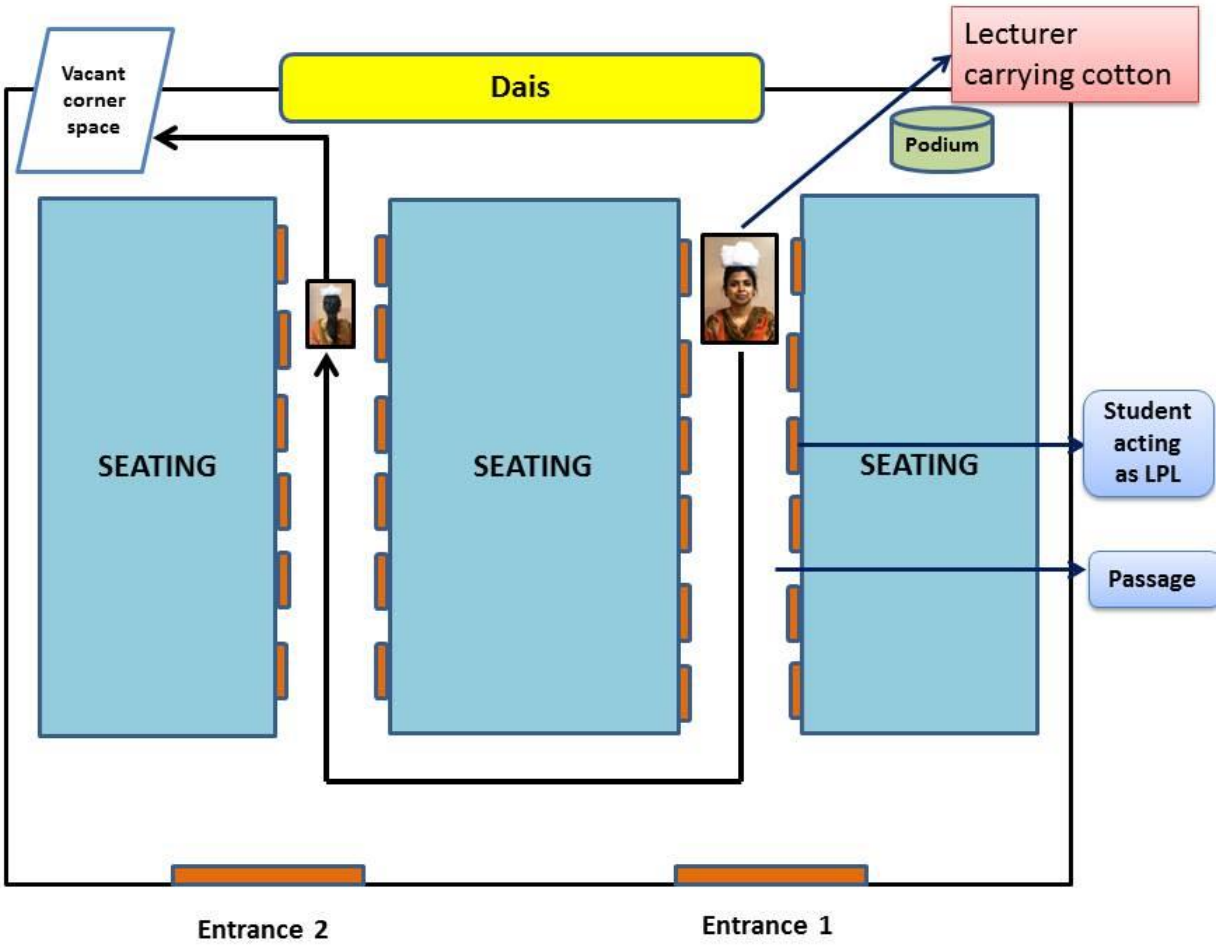

Figure 1. Schematic representation and seating arrangements

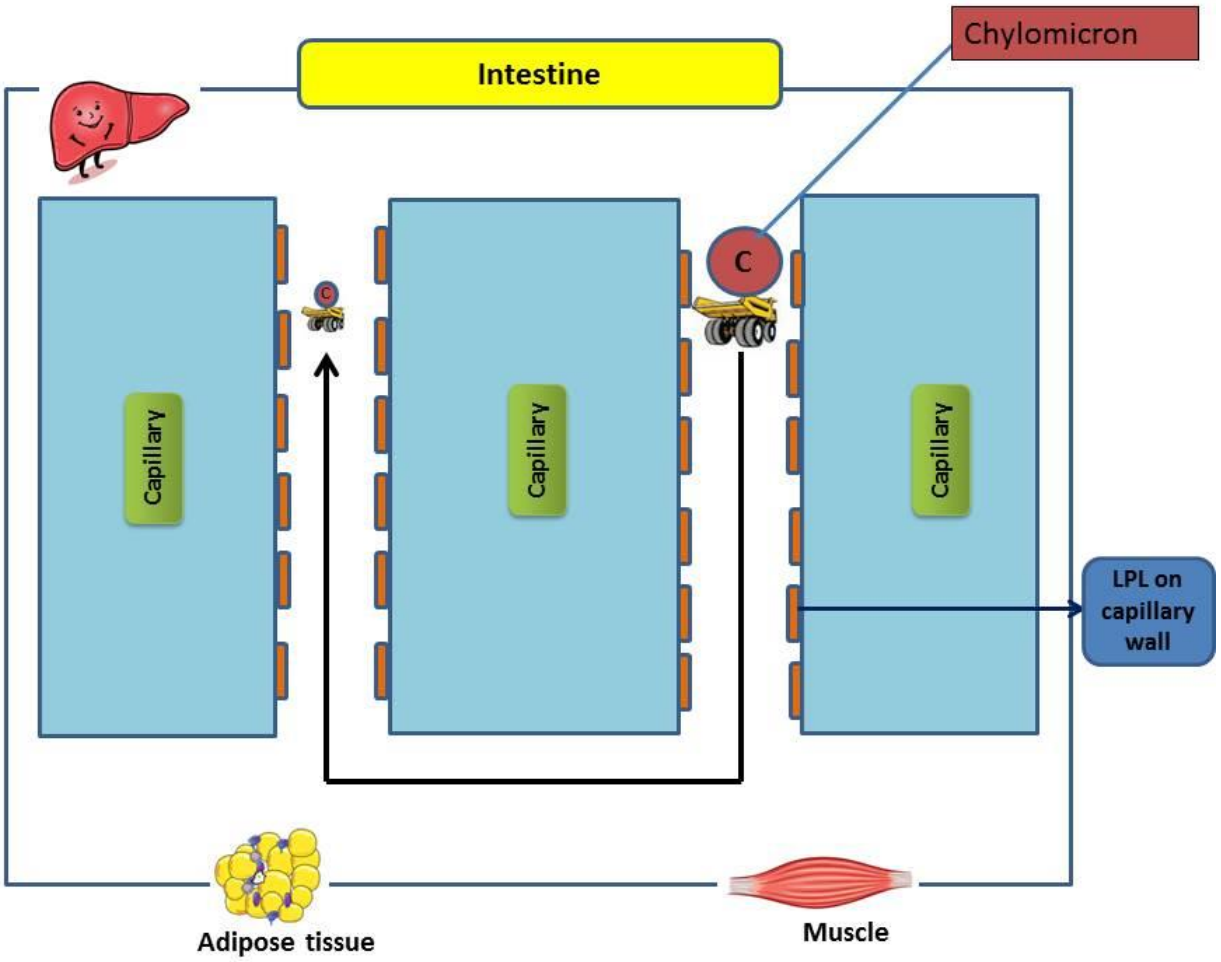

Figure 2. Schematic representation and seating arrangements

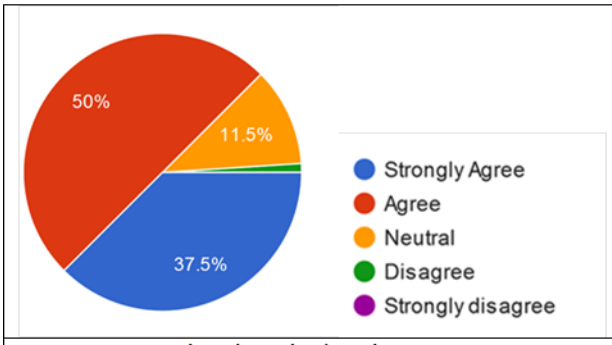

Figure 3: Role play during lecture on lipoprotein metabolism: i. enriched my learning experience

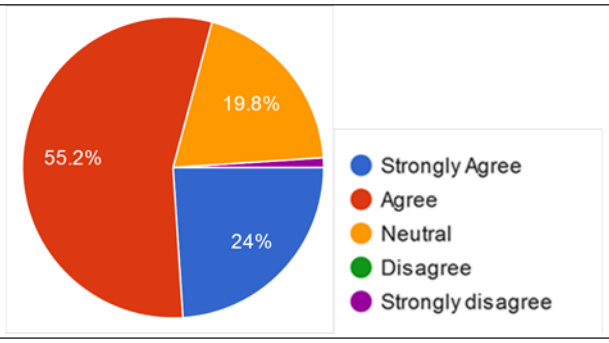

Figure 4: Role play during lecture on lipoprotein metabolism: ii. improved my critical thinking

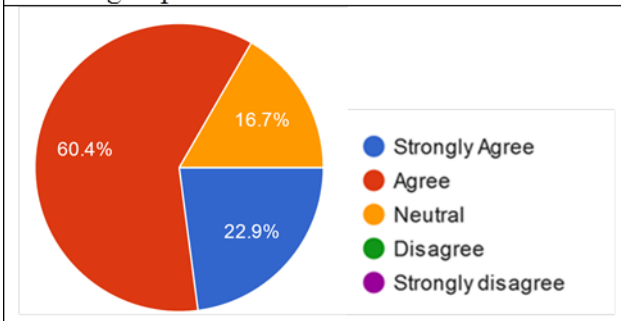

Figure 5: The use of role play during lecture enhanced my understanding of a complex concept in biochemistry

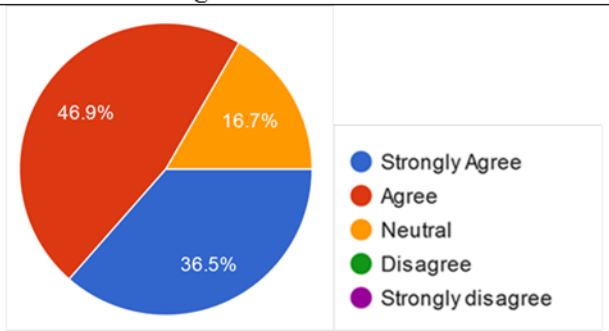

Figure 6: Role play during lecture made the Teaching/ Learning session on lipoprotein interesting and exciting

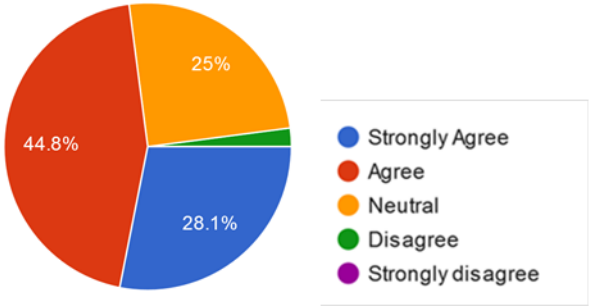

Figure 7 : Due to the role play during the lecture, I am able to mind map and recall the concepts better.

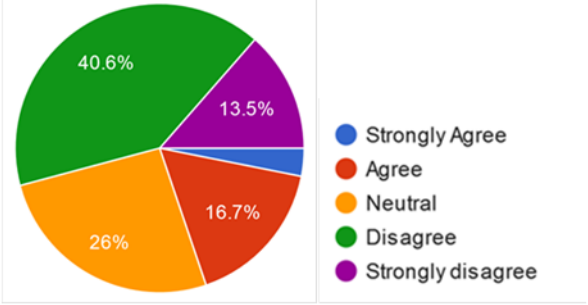

Figure 8: I find the role play during the lecture childish and immature.

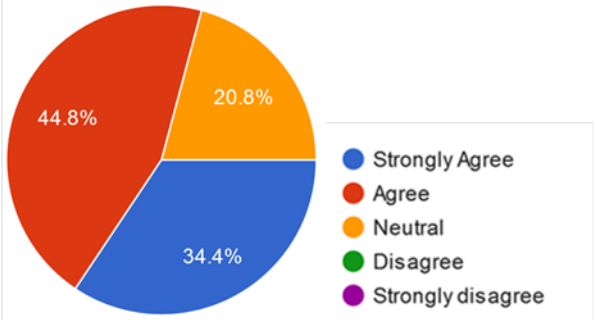

Figure 9: Role play during lecture helped me to be more engaged and focused to the topic (avoids boredom)

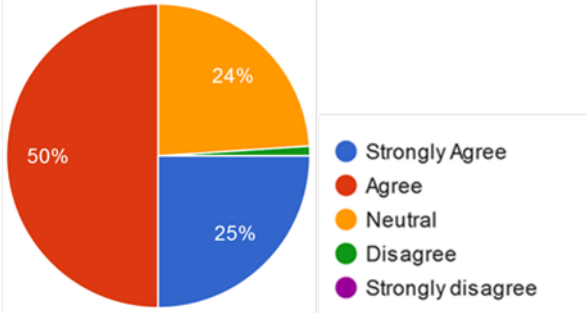

Figure 10: Lecture embedded with role play is more effective that a traditional didactic lecture

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Appendix 1. Lesson plan-Metabolism of lipoproteins

Session objectives	The objective of this interactive session is to discuss • the classification and importance of lipoproteins • the exogenous and endogenous pathways for transport of lipids • common disorders of lipid transport
Learning outcome	At the end of the lecture, the student should be able to • Describe the structure and classification of lipoproteins. • Discuss the importance of lipoproteins. • Distinguish between exogenous and endogenous pathways for the transport of lipids. • Discuss the disorders associated with lipid metabolism and transport.
Bridge in /Motivation/Warming up	• Lipid, hydrophobic, lipoprotein (familiarity of the above terms on the topic to check where their current knowledge lies) • A cartoon picture of LDL and HDL to start a conversation (Refer lecture slide number 1 in ppt)
Teaching points and content input strategies (Teaching) -Briefing (20 minutes) -Role play (20 minutes)	Learning activities (Application) • Concept mapping • Role play • mnemonics
Debriefing (10 minutes) Time for questions (5 minutes)	• Unlabeled diagrams: Q-A discussion (Refer lecture slide number 27 and 28 in ppt)
Closure and feedback (5 minutes)	• Google form

Appendix 2

Title of role-play: Exogenous pathway for the transport of lipid

The script reader asks the students to imagine to different components of the Lecture Theatre (LT) as represented below (Anthropomorphism)

- Dais of the Lecture Theatre (LT) as the intestine
- Aisles of LT as the capillaries
- The two main entrances of LT as the muscle and adipose tissue
- A vacant corner of LT as the liver

The lecturer and the students played the following roles

- Lecturer as chylomicron
- A student as the "HDL angel"
- A few students as lipoprotein lipase embedded in the wall of the capillaries

The props required for performing this role play

- Wad of Cotton as TAG from chylomicron
- Basket to carry the wad of cotton
- Angel dress and wings (optional) for student acting as HDL

The Concept and the Sequence:

Script reader: The dais of LT was considered as intestine-where chylomicrons are synthesized. At the time of synthesis, the chylomicron had only a "head" (Apo B48, an apolipoprotein) and had no "arms" (Apo C-II & Apo-E).

The lecturer, acting as a chylomicron, keeps her/his hands folded behind, carried a basket of wad of cotton (TAG) on her head and walked along the space between dais and aisle thus representing the transport of the chylomicron from intestine to capillaries.

Script reader (*mimic like oracle*): Announces the donation of arms by the HDL to chylomicron (use background music for dramatization)

In the capillary (aisle) the benevolent HDL (a student acting as the "HDL angel") donated Apo C-II and Apo-E (symbolized as the two arms) to the chylomicron (lecturer).

Upon receiving the functionality of the two arms, the lecturer expressed happiness (by the gesture of raising both arms up in the air).

Script reader: The two newly gained arms symbolized Apo c-II and Apo-E respectively.

With the left hand, the lecturer, as a fully formed chylomicron, waved to those students, who were designated as lipoprotein lipase and were lined up along the sides of the aisle that represented the capillary walls.

Script reader: The lipo-protein lipase lining the capillary wall was waiting for the signal of Apo-c-II to act on the TAG of chylomicron (Lipo-protein lipase is activated by Apo c-II and convert TAG of chylomicron to free fatty acids).

From the whole wad of cotton, symbolizing TAG, a small portion of cotton, symbolizing free fatty acid, was plucked by the student (lipo-protein lipase) to convey the fact that the free fatty acids (FFA) were released from TAG of chylomicron.

Script reader: Based on the energy demand at that moment, the released FFA would be stored in adipose tissue (Entrance 1) or undergo β-oxidation in the nearby muscle cell (Entrance 2) (Figure1 and 2). The process of release of FFA would continue until the formation of chylomicron remnants. This sequence was acted out by the removal of small portions of cotton sequentially by the students playing the role of lipo-protein lipase. Finally, the chylomicron remnant reached the liver to get attached to the receptors located on the hepatocyte through Apo-E.

This was enacted by the lecturer, with the entire cotton wad removed, by walking over to the vacant corner that symbolized the liver. On reaching the liver, the lecturer pretended to knock with right hand (Apo-E) and explained that Apo-E of chylomicron remnant will bind to receptor located on the hepatocyte.

To make the student understand the concept, the script reader recites an interesting analogy: "Like all the rivers finally flow in to the oceans, the chylomicron remnants have the liver as their final destination."

Appendix 3

AIMST UNIVERSITY	**AIMST UNIVERSITY** **FACULTY OF MEDICINE**	

Please recall the role play on lipoprotein conducted on 26.04.2019 at 8.00 am to answer this questionnaire.
Your participation in this feedback is essential to enhance the T/L activities.
Please note that the participation in this feedback is purely on voluntary basis.

MBBS BATCH 24 **LIPOPROTEIN METABOLISM**

Qs	Feedback statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Q1	Role play during lecture on lipoprotein metabolism:					
i.	enriched my learning experience					
ii.	improved my critical thinking					
Q2	The use of role play during lecture enhanced my understanding of a complex concept in biochemistry.					
Q3	Role play during lecture made the Teaching/Learning session on lipoprotein interesting and exciting.					
Q4	Due to the role play during the lecture, I am able to mind map and recall the concepts better.					
Q5	I find the role play during the lecture childish and immature.					
Q6	I recommend that more lecturers should use role play during Teaching and Learning exercise.					
Q7	Role play during lecture helped me to be more engaged and focused to the topic (avoids boredom).					
Q8	Lecture embedded with role play is more effective than a traditional didactic lecture					
Q9	State what you consider to be the strengths of the teaching through role play					
Q10	State area(s) where you think the teaching through role play could be improved.					
Q11	Any other specific comments.					