MILA in Teaching Physiology for Dental Students

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Abstract--- MILA, Multiple interactive learning algorithm is a learning innovation based on activity based learning. Traditional teaching methodology doesn't seem to inspire the current generation as their concentration span has considerably reduced. Also they have loads of information to learn and remember. It is easier for the students to understand the complex topics when learnt through activities. A minced into portions that can be significantly remembered and applied in routine practice make the graduates successful practitioners. MILA in teaching physiology has made the subject much easier, understandable with a long term memory. In this article difficult topics from physiology were chosen and the students were taught by MILA. They were assessed for their learning and the results showed significant differences in the understanding of the students.

Keywords--- MILa, Learning, Physiology, Neurophysiology, Respiratory System.

INTRODUCTION

Lecture sessions have been established to be one of the most inefficient methods of knowledge sharing for many decades (National Research Council et al. 2002). The average student remembers less than 10% of what is taught in class and the overall standard of education is compromised by the use of large classrooms with impersonalised speeches. (Attard and Holmes 2019) Lecture sessions are also reported to be boring and inconsistent when similar topics are repeated between classes. Although adjuvants like presentations and slides promised to make lectures more effective. By the early 2000's SMART classrooms were considered the holy grail of education. (Gray 2015) The major contender with tremendous promise was the iPad®/Tablet system coupled with polished software that promised to make course work and learning easier. (Attard and Holmes 2019) To an extent, these systems have shown some successful integration.

The use of vital books and tablets notes have become common practice in most institutions and however the impact of this on the student learning and long term retention are questionable. (Fry, Ketteridge, and Marshall 2003) Video based tutorials in youtube and in classrooms have become very popular and seem to impact the understanding of the learning of the individuals. (Chtouki et al. 2012) Classrooms have even gone virtual with Zoom®, Google Meet®, CiscoWebX® etc. (Teneqexhi and Kuneshka 2019) These methods have opened new paradigms for teachers

to connect with students across long distances. It's evident from above mentioned facts that the majority of the focus in education primarily aimed to make teaching fancy, more technologically savvy etc.

Pedagogic styles like SCALE UP have called for the need to covert lectures into activity based discussions to avoid boredom and improve learning efficacy. (Syarafina, Jailani, and Winarni 2018)(Syarafina, Jailani, and Winarni 2018; Oliveira, Teixeira, and Neto 2020) Activity based learning has also shown the promise of making the process of learning more inspiring yet, maintaining the speed of content delivery. Therefore activity based learning reduces the work required from the faculty, improves the student interaction and also helps complete the syllabus in time. This is one of the prime reasons for the extraordinary success of this method. (Concepción, Holtzman, and Ranieri 2009) (Concepción, Holtzman, and Ranieri 2009; Ozyer and Wilson 2016).

Dental education is fairly robust especially in comparison with medical education in that the learning is less didactic, with a lot of hands on learning. However, a significant group of teachers continue to pursue education research in dentistry. (Majidi et al. 2015) (Cunningham 1987) These publications have been primarily focussed on simulations labs, hands on training protocols and their effectiveness in achieving better dental training. There is very little research that exclusively focuses on the teaching learning process. Furthermore the impact of interactive learning is experimented by few groups however, not much groundbreaking research has been published with regard to interactive learning. Therefore to quench this everlasting thirst to find methods to improve student learning with ease, this thesis aims to analyze the impact of our new interactive learning protocol known as the Multiple Interactive Learning Algorithm (MILA) in various aspects of dental education.

MILA in Teaching Neurophysiology

Neurophysiology is a very complicated concept in Physiology. Students have difficulty in understanding the concepts of various neural pathways of the brain. This has been widely reported in various publications.

Students find it difficult to get into their heads what goes on in their heads: how billions of nerve cells, working in parallel on individual tasks in separate areas of the brain with no coordinating supervision, are nevertheless able to assemble sensual input into coherent perceptions of the world, create decisions and come up with new ideas. How can our intuition fail so fundamentally when it comes to studying the organ to which it owes its existence—that is, when it comes to understanding how the brain works? We imagine that there is a central entity at work in our heads, which we equate with our conscious self and that has all the wonderful abilities that distinguish us as humans (Singer 2007). This intuition imposes itself so persuasively—even overwhelmingly—that it is not surprising that, throughout our cultural history, scientists and philosophers have speculated as to where in the brain this all-powerful and all-controlling entity might be (Fries, Nikolić, and Singer 2007).

Commonly used teaching methods may include class participation, demonstration, recitation, memorization, or combinations of these. We practice a unique method of teaching called "Multiple Interactive Learning Algorithm" (MILA) which includes Pogil, Peer led team based learning, Jigsaw, critical pedagogy, clay molding, journal discussion etc. We teach through keynote video based teaching and we give notes in Ibook, wherein we upload salient points with relevant pictures and videos. So that the students can understand the concepts in a much better way, it is also helpful in preparing for university exams and other competitive exams. It gives a space for the students to participate in the lectures and learn with interest. It is more of an activity based teaching than a monotonous lecture that made the change in the students perspective of the subject and show better performance in the studies and as well as research.

The protocol included from the MILA for understanding the concepts of Neural pathways in the Central Nervous System is "GAME BASED LEARNING".

Game based Learning

Incorporating technology into your teaching is a great way to actively engage your students, especially as digital media surrounds young people in the 21st century. Interactive whiteboards or mobile devices can be used to display images and videos, which helps students visualize new academic concepts. Learning can become more interactive when technology is used, as students can physically engage during lessons as well as instantly research their ideas, which develops autonomy. Mobile devices, such as iPads and/or tablets, can be used in the classroom for students to record results, take photos/videos (Beale et al. 2007).

I utilised a method of game based learning activity, one such example is woollen thread model, for understanding the concepts of neural pathways in the brain. For this method of teaching, we will be having a small group learning which consists of four to five students in a group. So totally a whole class of 25 to 30 students will be splitting into small groups of 4 members in each group. For this activity, I Will be playing a 4 mins flipped class video to every group on the particularly difficult topic on neural pathways in the brain which will be followed by a 20 mins MILA activity. Initially by playing the video, we try to bring the difficult concepts to life with visual and try to impart that visual knowledge into practical learning experiences. By attaining the visual knowledge, the students tend to impart that knowledge in their practical activity. After visualisation, the students have to do it practically, for this purpose, the students from each group have been provided with different colourwoollen threads and a thermocol. Then the students have to trace the neural pathway by using colour threads. This makes the students to easily understand each and every process which is taking place in those difficult pathways. This activity encourages the students of mixed abilities to work together by promoting small group or whole class activities.

Through verbally expressing their ideas and responding to other students will help to develop their self-confidence, as well as to enhance their communication and critical thinking skills which are vital throughout their life.

There has been a dramatic change after these small group activities. The students felt very comfortable and fun based learning in understanding the difficult topics.

Students Feedback

Effective feedback helps individuals to understand what they did well and what they could do better. Once they know what is good and what isn't, they are able to adapt their behaviour and work to improve it. Thus, feedback is a key tool for improving both individual and team performance.

The students have felt this activity based teaching methodology is very helpful in understanding the difficult topics in a better way. Moreover, this woollen thread activity is such a wonderful and fun filled activity for the students in such a way that they can easily trace the difficult neural pathways in a simple and better way.
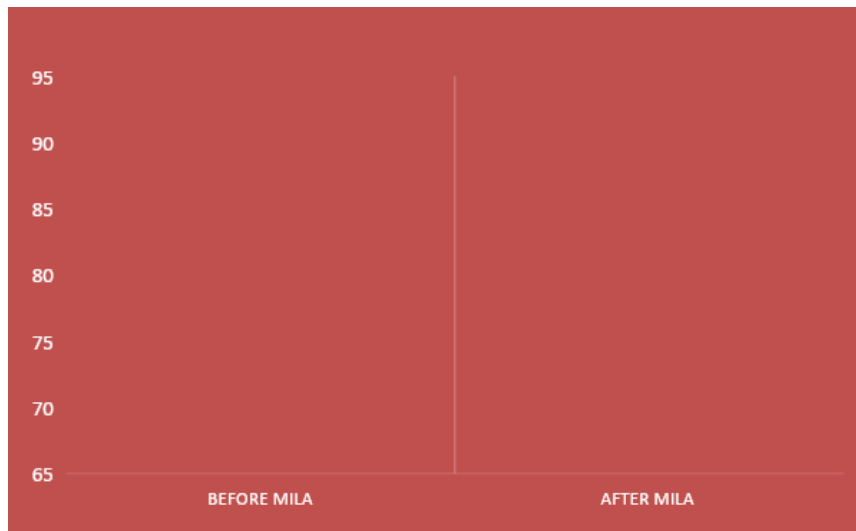
Figure 1: Students Performance Before and After MILA

MILA in Teaching Respiratory System

MILA in teaching Respiratory physiology is a very complicated concept. Students have difficulty in understanding the regulation of respiration because it has complex multiple connections with other disciplines. Factors like ability to reason causally, think about dynamic systems and understanding the physiological mechanisms, and analyse the different levels of organization simultaneously, understanding and remembering the figures, tables and graphs, practice and usage of abbreviations and symbols are the difficulties from a student's perspectives. This has been widely reported in various publications. (Modell 1997)(West 2008) (West 2008; Sturges and Mauner 2013).

The protocol included preliminary flipped class teaching followed by activity based learning, interactive sessions like fill the blocks and keywords. In the activity based learning, students were divided into teams. For each team, clay, chart and sketches were given to make the respiratory centers model without labelling. The function of each of the respiratory centers were discussed earlier. Then each team was shooted with questions related to a respiratory center and were asked to label the corresponding respiratory center. The evaluation was based on the following criteria.

1. Labelling the correct area
2. Creative and neat presentation
3. Timing of completion of the activity
4. Detailed representation
5. Clarity in justification of the answer

By doing so, students attained clear understanding of the functions of the respiratory centers and enhanced group work and creative skills. This activity aimed to help students to organize their knowledge base into functional models of the respiratory system.

The next activity given was the 'Fill the blocks' in which the flowcharts of factors affecting respiratory centers were projected with blanks. The students filled the blanks in the flowchart. This helped them to recall the steps in physiological mechanisms involved that affect the respiratory regulation. One example is the sequence of events in Hering Breuer reflex (Figure 2). Students were able to clearly explain the flowchart that they have answered. The students were able to improve their verbal communication as they express their mental models in their own set of words. This learner centered method of teaching transformed classrooms into an active learning environment.
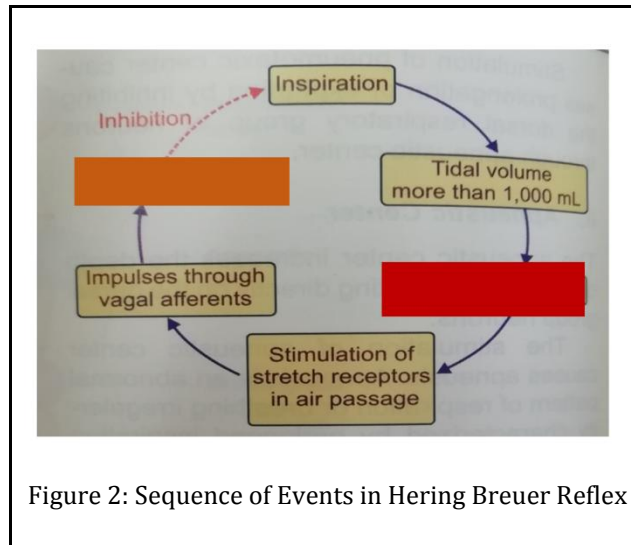
Figure 2: Sequence of Events in Hering Breuer Reflex

The final activity was 'Keyword' in which important terminologies and abbreviations were projected. The students answered in order. One of the difficult parts of respiratory physiology is an extensive table of abbreviations, symbols and terminologies which are new to the fresh readers and feel tough to associate in contexts. The 'Keyword' activity helped students to register all the important terms and abbreviations and they were able to associate to the context.

There has been a dramatic change in the students' perspective of understanding the concept and absorbing permanent knowledge that one can appreciate the integrated nature of physiological mechanisms and co-ordinate with different disciplines.

### MILA in Teaching Regulation of Respiration

Physiology is considered bedrock of all undergraduate medical students of different disciplines (Rabiya Rehan, 2016). It is highly challenging for the students to understand the various mechanisms involved in the subjects which require substantial cognitive effort from the students (Michael J, 2011). One of the most complicated topics in physiology is respiratory physiology which involves mechanics, volumes, capacities and regulation and respiratory disorders. A study by Kay Louis Colthorpe also reported that 79.2% of the students cited respiratory physiology to be the difficult concept to understand in physiology (Kay Louise Colthorpe, 2016). There are many reasons for difficulties faced by the students in understanding the concept. One such difficulty addressed by the students is that this system requires strong foundation in physics, chemistry and mathematics to understand the mechanics involved in respiration (Rovick AA, 1999). Those students who do not have a strong foundation in these basic subjects are subjected to face understanding difficulties. Student's understanding of the concepts, not only depends on the nature of the concept, but also on the teachers who take efforts in imparting the subjects in a very easier, uncomplicated way.

Incorporating active learning activities in teaching physiology is found to be beneficial and are now well documented and reported by cognitive science (Michael 2006). In our college, Multiple Interactive Learning Algorithm (MILA) System of teaching is being followed which is an activity based learning system comprising 2 hours of lectures which are divided into 6 segments. Each segment comprises 20 minutes of teaching followed by 20 minutes of activity. This system of teaching keeps students active and involved. This helps students understand the concepts in an easier way. This helps students in active interaction in the class. Experiential learning theory supports the use of this activity type, since it involves multiple learning environments (thinking, feeling, behaving (doing), and perceiving) (Kolb, and Kolb 2005).

To understand the concept of regulation of respiration, the students were given a brief lecture for a period of 20 minutes and this was followed by the activity called Role play. Role-play is enacting activity when you either put yourself into somebody else's shoes. In role play activities, the students enact the role of each element involved in the concept. In regulation of respiration, the students are given the role of different receptors, different centres, nucleus in the centres, neurons, effectors. They enact their roles by movement and explaining their role and their act in every step of the regulation of respiration. The 17 students were assessed by giving one mark questions before and after the activity of role play. For which, 25 one mark questions were framed in the topic and given to the students before the activity and after the activity of role play. Pass percentage of 17 students were calculated before and after the activity. The performances of all 17 students before and after the activity were assessed by their marks before and after the activity. From the study, it was found that 9 students only passed by evaluation before the activity whereas 16 students passed by evaluation after the activity. (Figure 3) Thus the activity facilitates the participation of each and every student and the students enjoy learning by the activity based learning. They also develop love towards the subject and show enthusiasm in the class to enact their roles. Their interest is being kindled by this way of role play activity based learning.

The obtained feedback from the students also shows that their interest for the concept is increased and the subject can be remembered for long term. They felt that long term memory of the concept is being initiated by this way of learning experience. Overall even the least performer in the class is also motivated to be involved in the class. By this way, all the students in the class are made to engage and the concept is reinforced to the students by activity based learning.

The students are thus kept active throughout the lecture hours. The performance after the activity based learning has drastically improved with greater significance. Thus there is a vast variation in the performance before and after the activity based learning.

Figure 3: Students Academic Performance Before and After Activity Based Learning
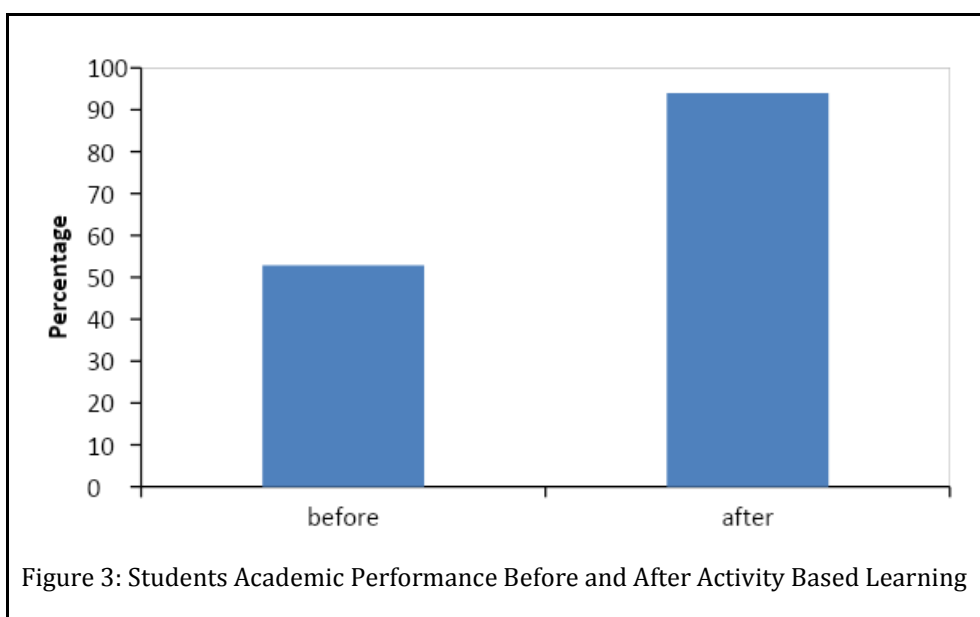
MILA in Teaching Structural Organisation of Protein

Mila (Multiple interactive learning algorithm) is an activity-based learning technique. The traditional method of teaching is not that useful to make the students understand all the difficult concepts in the subject. And it is also difficult to make all the students get involved in the class. Hence we followed the activity based teaching method which involved many activities like pogil, jigsaw, clay modelling, concept mapping, peer led team based learning,

journal discussion etc. Different activities will be adopted for different topics to make the students involved in the class and also to make them understand the concept in a better way. MILA, thus helped to improve the student's perception towards the subject. This also helped the students to memorise all the things and to reproduce them during their examination. Thus there was a tremendous improvement in the academic performance of the students by following the MILA method of teaching and learning. This has been widely reported in various publications (Surapaneni and Tekian 2013). The study by Krishna et al, explained about the use of concept mapping in learning biochemistry. The study was conducted in Saveetha medical college among the undergraduate medical students. In their study they divided the students into two groups – one group receiving the traditional teaching and another group attending the innovative programme. The Student performance was measured using three written tests. The study revealed that the concept-mapping program resulted in higher academic performance compared to the traditional course. They especially valued the use of concept mapping as learning tools to foster the relevance of biochemistry to clinical practice, and to enhance their reasoning and learning skills, as well as their proper and deeper understanding for biochemistry.

The Structural organisation of protein is a very complicated concept. Students have difficulty in understanding the differences between primary, secondary, tertiary and quaternary structures, and the bonds involved in different structural organisation. Hence making the students understand the concept of protein structure is difficult by conventional methods of teaching. We utilised the clay modelling method of pedagogy. The protocol included the clay modelling of the primary, secondary, tertiary and quaternary structures of protein. They studied structural organisation from ibook and books. Then the whole batch (comprising 17 students) was divided into two groups. Chart papers, clay, sketch pens and other stationeries were provided to the students. Both the groups were assigned to do the clay modelling (Figure 4). Both the groups discussed among themselves about how to do the modelling. Then using different colours of clay they modelled the different structural organisation of proteins. All the students were actively participating in the clay modelling. While they are doing the activity, they are able to understand the differences in the different levels of structural organisation of proteins. And both groups did the clay modelling in different ways which revealed their differences in perception and innovation. The whole activity was fun filled and very interactive also. At the end of the activity both the groups were asked to describe the topic. Both groups explained the topic very well, which revealed that they understood the concept better than before. Thus this activity helped a lot to make the students understand the concept of protein structure.

A peer led team based activity was given to understand and explain about the bonds that stabilize the protein structure. The whole batch is divided into 6 groups. Each group.
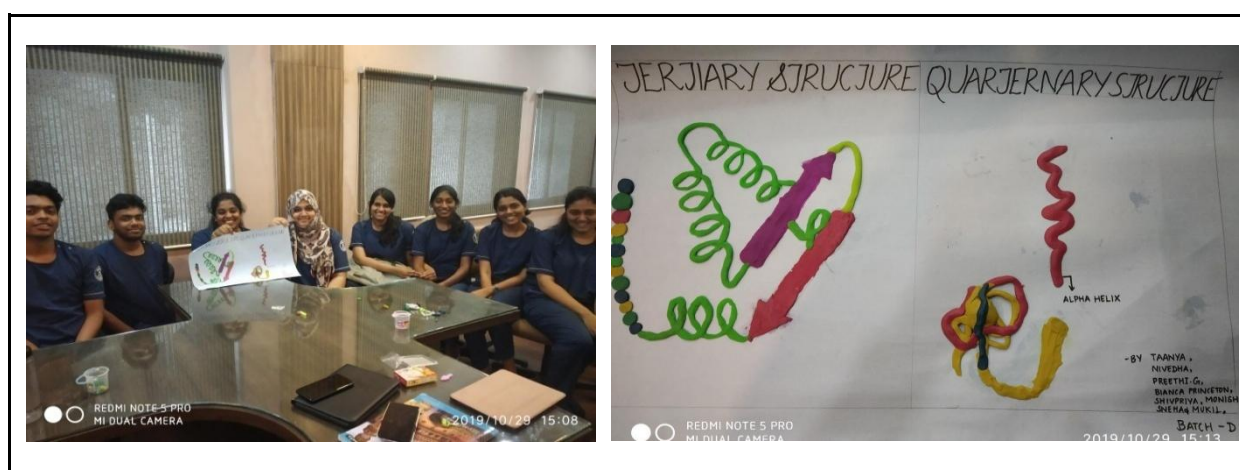

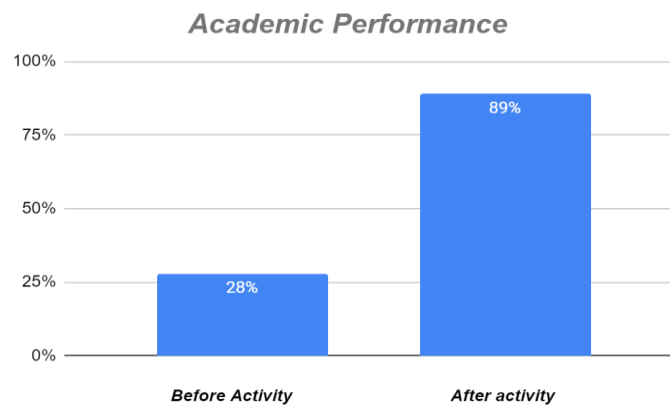Figure 4: Group of Students who Performed the Activity and the Work Done

Figure 5: Students Academic Performance Before and After Activity based Learning

is assigned to describe different types of bonds like peptide bond, hydrogen bond, hydrophobic interaction, van der waals force, electrostatic bond and disulphide bond and its role in protein structure. One person from each group will lead the group and help others to understand and study the topic. Each group explained the topic well. At the end of the activity a dramatic increase can be observed in understanding the topic, which was actually difficult to understand by conventional learning and teaching.

The lectures on the classification of carbohydrates, lipids and amino acids, which are more confusing and difficult to understand by the students. Hence for these topics we adopted the concept mapping method. Here each of the students are asked to do concept maps on each of these topics by using mind map application. With the help of ibook and the faculty they can develop a concept map which makes them realise the topic more easily and to memorise it without any confusion and difficulty. With this concept map alone they can explain the whole classification easily. (Figure 5)

MILA in Teaching Renal Physiology

Renal Physiology is a very complicated concept. Physiology is considered to be challenging for students due to its conceptual nature. In Physiology, there are diverse ranges of difficult topics that have been identified which include Excitable tissue, Renal physiology, Gastrointestinal System, Respiratory System, Cardiovascular System and Nervous system (Colthorpe et al. 2018)(Cheng 2015). Kidney has been inextricably linked to Homeostasis of the body and thereby allowing the physiological freedom to move into varying environments and also take various diets and fluids. Kidney is interlinked with many other systems in order to maintain homeostasis. While studying this concept, students have difficulty in understanding. The factors may include nature of discipline, lack of physiological concepts, lack of effort to develop a deep understanding of the topic.

Multiple Interactive Learning Algorithm (MILA) is an activity based learning method of teaching. The main Motto of this methodology is to make concepts clear, understandable and also keep every brain active throughout the class.

In renal physiology, students are facing difficulty in understanding the concept of urine formation. As a physiology teacher, I decided to choose appropriate learning strategies to understand the concept in an easy manner and thereby improve student's academic performances. With the aid of MILA teaching, I planned to teach urine formation in a simple manner. First 20 minutes, I have given brief introduction about the nephron parts and its importance, followed by Activity part I. Ionic reabsorption and secretion mechanism of each part of nephron were explained to students with the help of diagram in flipped videos, followed by Activity part II.

Every 20 minutes class is divided with activity related to that topic. In MILA, there are many activities available like POGIL, JIGSAW, Critical pedagogy; Game based learning, Role play and so on. I utilised Game based learning - Clay modelling method of pedagogy in this class. Students were divided into 3 sub groups. Each group had been allotted different parts of nephron. Group 1 received Proximal Convoluted Tubule, Group 2 received Loop of Henle, and Group 3 received distal convoluted tubule and collecting duct. Before starting the activity, students were instructed properly. Activity Part I: First, they have to draw nephrons in the chart and then each part of the nephron is differentiated with a different clay colour. Activity Part II: Each ion colour was chosen and then placed in the respective part of the nephron. By using arrow marks, ions reabsorption and secretion were marked. If the ions are reabsorbed, the arrow should be facing towards the tubule and for the secretion arrow coming outward from the tubule. If the ions are reabsorbed by active mechanism, it is represented in double arrow or by passive mechanism can be represented in single arrow. Time allotted for this activity is 15 minutes. After 15 minutes, they have to explain the concept with their prepared model.

By doing clay models, students have the opportunity to develop creativity. It improvises the fine motor skills by activating the neurological process between the hand and brain. After this model preparation, students have to discuss with their friends. So this helps them to develop the self confidence level.
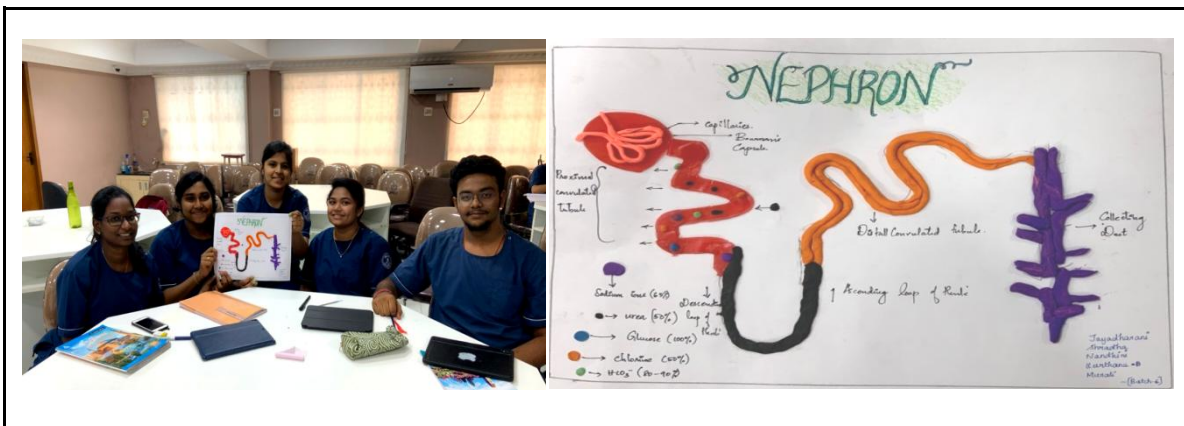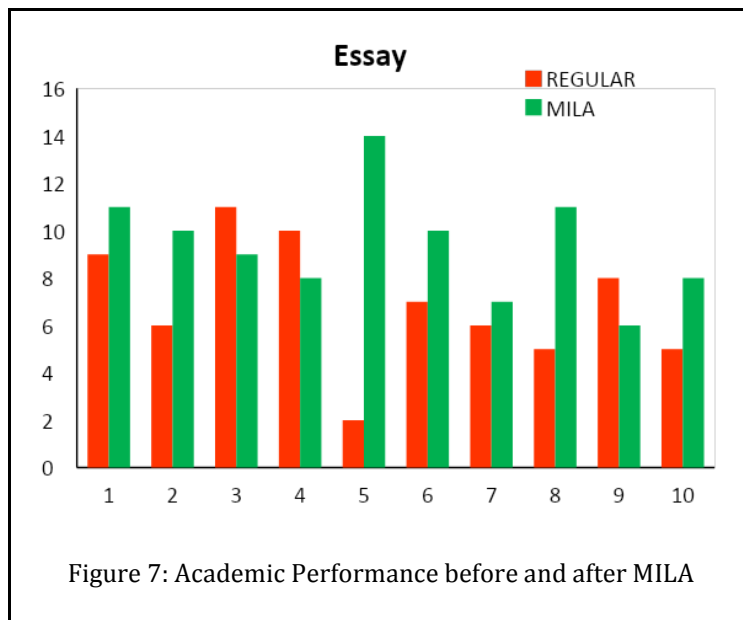

Figure 6: Students Performing Activity

Figure 7: Academic Performance before and after MILA

Student Feedback: Before introducing game based learning, they felt it was difficult to visualize the reabsorption and secretion of ions in the tubule. Due to the complexity of diagrams in books, it is also complicated to understand

them. After this activity, they gained a better idea on the concept. At the end of this session, students were confident about the mechanism of urine formation.

After the introduction of MILA teaching to students, they are active throughout the class. Students are very much interested in participating in the activities. Students have improved their learning strategies and helped them to overcome learning hindrances. Students retrieve new information to clarify any gaps or misunderstanding which aids them into deeper conceptual understanding.

When comparing the performance of the students between regular and MILA teaching. Randomly 20 students' academic marks were selected before and after the MILA method of teaching. Each group consists of 10 students. Urine formation and its mechanism is an essay. After MILA teaching, students secured 14 marks out of 15. There has been a dramatic change noticed in their academic performance after MILA teaching. Students had the ability to recall the concepts and were able to present in their paper without any confusion. This method of teaching aids both high and poor achievers. Good students tend to seek new information from external sources to extend their existing knowledge. Poor achievers also significantly showed the improvement in academic as well as self confidence level.

CONCLUSION

Multiple interactive learning algorithm, ia an activity based learning methodology. The above mentioned topics are complex. Understanding their structure and function with their clinical application is a challenge. Students need to remember these basics for lifetime as it has lots of clinical implications. MILA proved to improve their understanding and clinical application better at the initial stages of their career. Hence its proved yet another time that activity based learning is effective in higher education and MILA is the next level of innovation to transform learning into a joy.

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