

Multiple Interactive Learning Algorithm (MILA) in Teaching Oral Medicine and Radiology

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Abstract--- Traditional lectures are the most common teaching method employed by many dental institutions. It is the method where the teacher stands in front of the students and delivers a speech about a particular topic to make the students understand the topic. This method of teaching is very popular among teachers and is still being used by many. Unfortunately, this traditional teaching method has significant drawbacks often resulting in a poor understanding of the concepts taught to the students. This has led to the advent of the Multiple Interactive Learning Algorithm which is abbreviated as MILA. MILA teaching involves fragmentation of the entire duration of the class into multiple small sessions. Here, the word facilitator is preferred over the lecturer, as the teacher facilitates the students in learning a particular concept rather than lecturing it. MILA uses many innovative techniques that are interactive to make the learning process more efficient. MILA has improved the understanding and retaining of a concept in memory and has also made the students engage actively in the learning process. MILA is employed in teaching various topics in Oral Medicine and Radiology such as TMJ disorders, IOPA, radiation physics, etc. The paper aims to discuss the new and innovative teaching method MILA in Oral Medicine and Radiology.

Keywords--- Teaching, Traditional Lecture, Oral Medicine, Oral Radiology.

INTRODUCTION

Learning is an experience and experience gives wisdom. Teachers in our society have an immense responsibility towards the students as they play a crucial role in a student's life. They impart knowledge to the students and prepare them to face challenges in their lives. Imparting knowledge to the students is a unique, sensitive and a challenging task. The standard of a teacher is determined by how much the student is able to understand their teaching [1]. For a very long time traditional lecturing is the most popular and one of the widely used methods to transfer knowledge from the teacher to the student. In this method, the teacher is present in front of the students and delivers a speech about a particular topic. Certain teachers are exceptionally great at teaching and for them traditional lecturing is still an effective way to teach. Similarly certain students who are exceptionally brilliant can easily understand a topic

irrespective of the quality of the teacher. Unfortunately the majority of the teachers and students do not belong to this exceptional category. Most teachers often experience difficulty in making a student understand a concept through traditional lecturing and as a result of that the student is unable to appreciate and perceive the concept. The students often find the traditional lecture to be boring as many of them do not actively participate in the lecture. Over a period, this traditional lecturing has undergone certain changes like addition of certain supportive aids which would enhance the teaching. These include overhead projectors, use of audio visual aids like slide presentation (powerpoint, keynote etc) etc. In one of the studies it was found that powerpoint presentation was beneficial for teaching but the material in the presentation plays a vital role [2]. Another study revealed that with powerpoint presentation, the teaching was enhanced although the final grades of the students did not improve [3]. This means an enhanced presentation tool such as powerpoint was unable to bring about improvement in the final grades of the students. This could be probably attributed to the traditional lecturing method and this calls for a change in the learning method itself.

The drawbacks of the traditional lecturing method has led to the advent of a new and a creative learning method called 'Multiple Interactive Learning Algorithm abbreviated as MILA'. This method avoids lecturing and actively engages the students in activities which enhances their learning of a concept/topic. The students are provided with a short video describing the topic which the students have to see a day before attending the class. This prepares the student about the topic and this has been shown to be effective in a study done in 2016 [4].

In MILA the total duration of the class would be 120 minutes and the term teacher/lecturer is replaced with the term facilitator. It has been found that the human brain can concentrate on a particular topic for only 20 minutes [5]. Hence, the total duration of the class is divided into 6 micro sessions lasting for 20 minutes each. Once the class starts, the topic for the day is divided into 3 parts of a brief overview followed by 3 parts of activities after every overview [figure 1]. In the brief overview the facilitator simply explains a part of the topic in a nutshell which will be followed by an activity about the topic. Here the idea is to facilitate the students in learning by making them find out more about a topic and not actually lecturing about the topic. An activity can be anything that actively engages the student to explore further into the topic which was explained previously.

20 mins (brief explanation)	20 mins (activity)	20 mins (brief explanation)	20 mins (activity)	20 mins (brief explanation)	20 mins (activity)
Introduction Types of intraoral radiographs IOPA Bisecting angle technique Paralleling technique	<u>Scale up</u> occlusal radiographs & bitewing radiographs	Extraoral radiography Basic landmarks Types of extraoral radiographs & indications Panoramic radiography	<u>Problem solving</u> 2 cases are presented to 2 groups of students for which they have to prescribe an appropriate radiograph	Faulty radiographs errors due to faulty exposure & processing errors in digital radiography	<u>Game based learning</u> Jumbled words are given the students have to find out the word & arrive at a final answer

Figure 1: The Table is an Example Showing the Basic Framework of the MILA System of Teaching and Learning

Few examples of such activities include Process Oriented Guided Inquiry Learning (POGIL), Student-Centered Active Learning Environment with Upside-down Pedagogies (SCALE-UP), Game based learning, peer led learning, concept mapping, problem based learning etc. the facilitator also can come up with his/her own innovative activity which will actively engage students. The activity session enhances self directed learning. This makes the students interactive, work as a team to find a solution, and also teach their peers. This boosts the confidence of the students and improves the emotional and social intelligence of the students. Emotional intelligence is the ability of being concerned with effectively understanding oneself as well as others, maintaining good relationships with people and

adapting to and coping with the immediate surroundings to be more successful in dealing with environmental demands [6]. Social intelligence is something which is essential for a person to acclimatise with the peers, maintain relationships, help others and interpret social information, leading to accurate social inferences [7].

Researchers state a person with higher emotional and social intelligence are more successful than the one with higher intelligence quotient alone [8]. MILA provides an environment where the intelligent, emotional and social quotient are honed. Students who shy away and those who have low self confidence had transformed into good speakers and teachers at the end of the year. Thus the students had a personality development too along with their academic development.

TMJ Disorders (TMD)

TMJ disorders are an interesting topic yet difficult to understand. Diagnosis of TMD is challenging and difficult as it is multifactorial and there are many orofacial pain conditions which can be misdiagnosed as TMD pain [9]. This makes proper understanding of the topic paramount. Differentiating orofacial pain as odontogenic and non-odontogenic is the initial step and later finding out whether TMJ was the source for non-odontogenic cause is the following step in diagnosis of TMD [10]. Clinicians' knowledge of appropriate choice of treatment of TMD is the next challenge to be faced. Majority of TMD can be managed with conservative management such as pharmacotherapy, behavioural management, Transcutaneous Electrical Nerve Stimulation [TENS], physiotherapy. Surgical intervention such as gap arthroplasty, condylectomy, meniscectomy with implant reconstruction are advised in severe cases with major structural changes in TMJ [11]. The plan included flipped class in the beginning which was a video presentation to explain the concepts of TMD in a simplified manner with emphasis on the important sections such as etiopathogenesis, clinical presentations, diagnostic criteria, differential diagnosis, radiodiagnosis of TMJ Imaging and medical and surgical management of TMD.

Fundamental knowledge of normal anatomical structures and physiology of TMJ are important for differentiating the pathology from normal. This can be achieved with POGIL activity, in which each student was instructed to involve in mono acting of a particular anatomical structure of TMJ. The various bony components such as condyle, glenoid fossa, articular eminence and soft tissue components such as articular disk, muscles of mastication, ligament, tendon, synovial fluid and neurovascular structures, each of which will be distributed among the students and each student will perform mono acting on the structure explaining from the fundamental aspects to complete management of the pathologies related to that anatomical structure. This activity enables the students to be involved in learning the specific structure in depth and by listening to other students' mono acting. Complete knowledge of the complex anatomical structures of TMJ and basic functioning is possible only when students are made interactive during the lecture class. The case based learning was made effective using Jigsaw puzzle activity in which three groups of different clinical and imaging features pertaining to three main disorders of TMD based on RDC criteria [12] was displayed to students. The students have to pick out three disorders such as myofascial pain dysfunction syndrome [MPDS], anterior disk displacement with reduction and osteoarthritis from the three group of clinico-radiographic features arranged in a puzzle.

The activity of Concept mapping [figure 2] was given to the students at the end of the class which serves as a visual aid for revising the entire contents of TMD. There has been a significant increase in the students' performance [figure 3] which was assessed by various measures such as case based discussion, in which various TMD documentation cases with complete case history, investigations including Computed Tomography (CT), Cone Beam Computed Tomography (CBCT) and Magnetic Resonance Imaging (MRI) were displayed and the students' ability to diagnose, interpreting the radiographic image, arriving at a final diagnosis and formulation of the appropriate

treatment plan was assessed. The students' understanding skills and communication skills in presentation of the concepts were assessed based on debate topics such as CT versus MRI imaging of TMD, medical versus surgical management of TMD disorders. Overall, we believe teaching students by the MILA method was effective in TMJ disorders and aids students to achieve knowledge and excellence in the topic.

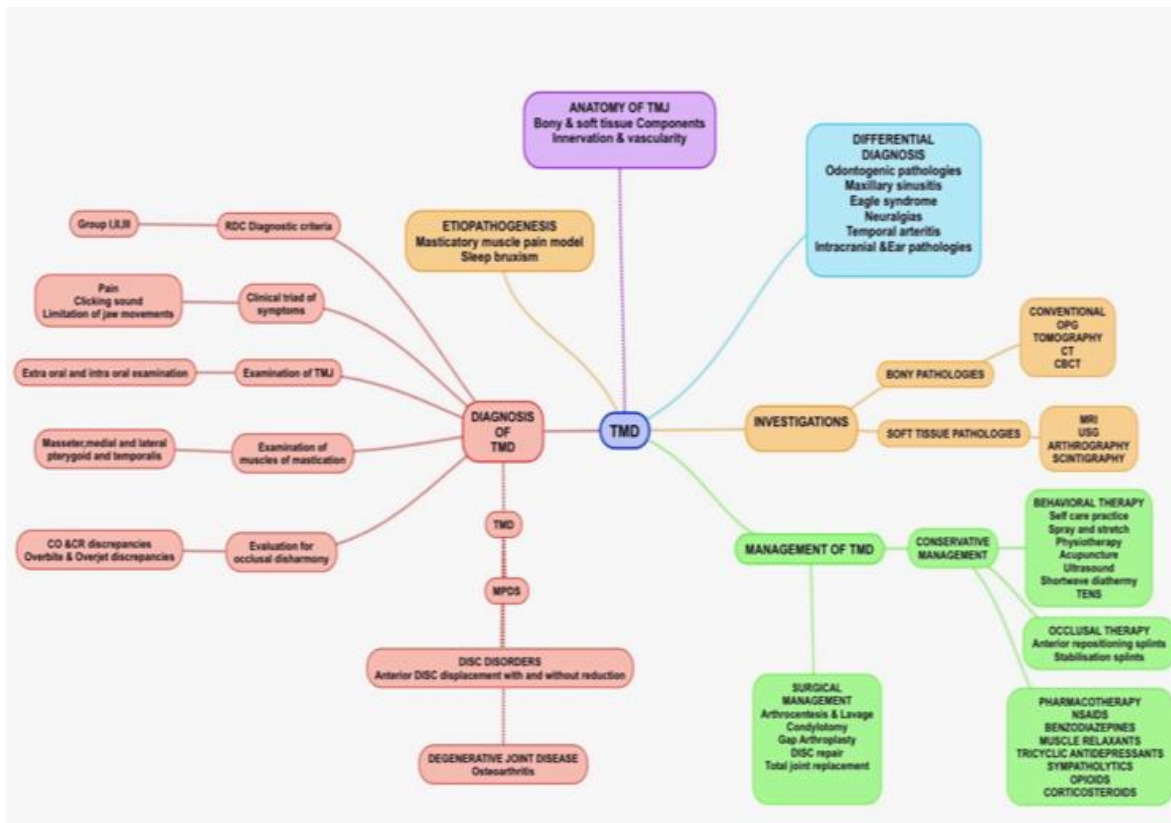


Figure 2: Picture Shows the Activity of Concept Mapping of TMJ Disorders

COMPARISON OF STUDENTS PERFORMANCE BEFORE AND AFTER MILA TEACHING OF TMD

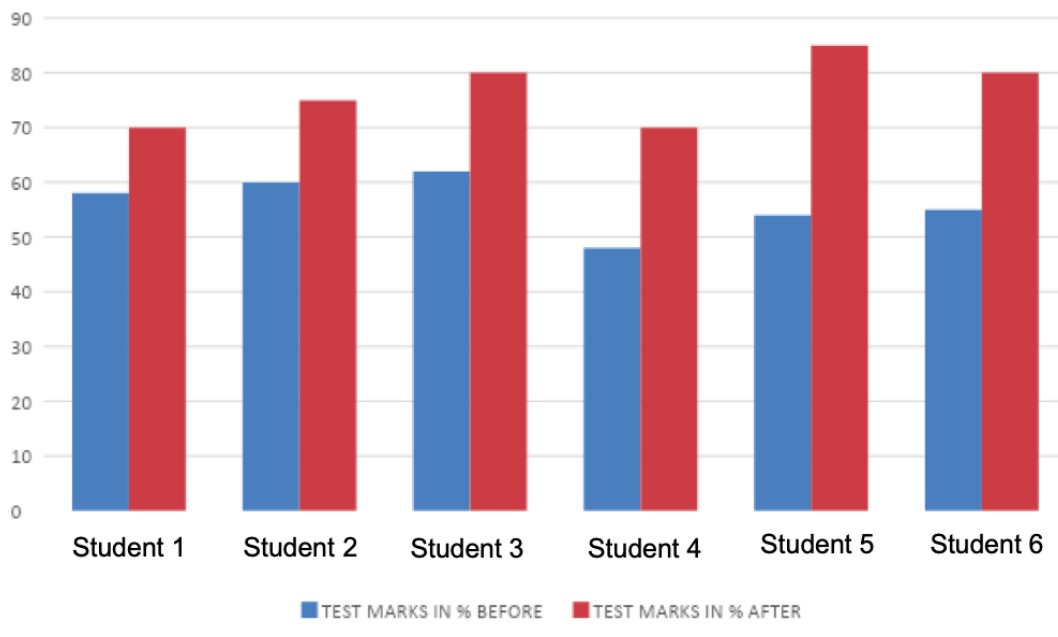


Figure 3: Graphical Representation of the Students Performance Before and After Using the Mila Teaching Method

Oral Manifestation of Systemic Diseases

Oral manifestation of systemic diseases is a vast topic in the subject of Oral Medicine and Radiology. The topic basically deals with the various oral manifestations of systemic diseases such as diabetes, vitamin deficiencies, haematological diseases etc. Students often find this topic to be difficult to understand. To be specific they find it difficult to remember the various oral manifestations found in each disease. Hence an activity called 'CONNEXIONS' was tried for the students to make them remember the various oral features of the systemic disease easily. In the activity the students are first taught about each disease by showing pictures of various oral manifestations. 4 pictures having the oral features of the systemic disease were shown to the student and student will guess the underlying systemic disease. This activity connects the various pictures together and the student was able to identify the disease and also easily remember the features of the disease.

'A picture tells a thousand words' is a famous quote which forms the core of this method of teaching. Even when a particular feature of a disease is well described by the teacher in the class, the understanding of that feature is only effective when the student actually sees the picture. A large percentage of the human brain is exclusively meant for visual processing. Images instantly capture our attention more than words [13].

This activity 'connexions' also is partially inspired from a simple game available for android & iOS devices called '4 pics 1 word'. In this game 4 pictures are shown with letters jumbled below the person has to guess the word using the pictures & the words [14]. Connexions also uses a few pictures which stimulates the reasoning and deduction skills of the student. This makes the students think about the pictures. The mind of the student then tries to connect the pictures and find something common about them. The students understood the disease features by seeing the pictures and finally when they were shown a few pictures common to that disease they were able to easily identify the disease.

Radiation Physics

Radiation Physics is a complicated topic. Students have difficulty in understanding the principles of Physics about Ionising radiation, their types, components of X-ray tube, X-ray beam production, interaction of X-rays with matter etc. By understanding the physics of radiation, one becomes familiar with the terminology and concepts used in the radiological sciences [15]. An article recommend that new teaching and information processes are needed to provide more beneficial learning environments about radiation and radioactivity [16] and by doing this, students' awareness towards radiation should be improved and information about radiation should be transferred at the right stage of education accurately [17]. Students show progress in their conceptual understanding about ionizing radiation and radioactivity after using some instructional strategies such as hands-on laboratory-based activities, interactive lectures, and worksheets prepared with directed-inquiry approach.

The plan included students advised to watch the short flipped class videos [18] the previous day before coming to the class. Video contains illustrative images and simultaneous explanatory voice over on types of radiation, parts of x ray tube, factors that can be used to alter X-ray beam, dosimetry and its various techniques, animation on step wise working of x-ray tube starting from heating up of tungsten filament to useful production of X-ray photons, bremsstrahlung and characteristic radiation, interaction of x-rays with matter.

The session started with an initial short explanation about the basic concepts such as introduction to X-radiation, types of radiation and parts of an X-ray tube, again refreshing those concepts with flipped videos followed by an activity to make an X-ray model with coloured clays and labelling them.

The next session had a short lecture on X-ray production and interaction of X-rays with matter and listening to flipped videos on that. After understanding the concepts thoroughly, activity on electron movements in orbital shells in X-ray photon production, its interaction is depicted by drawing the orbits and demonstrating the electron movements from one shell to another by moving the coloured small paper balls thereby knocking the electrons out aiding in X-ray formation and interaction.

The final session was on factors controlling X-ray beam and dosimetry. The students were made aware of the factors controlling X-ray beam and various radiological terminologies like Exposure, Radiation absorbed dose, Equivalent dose, Effective Dose by dividing them into 4 groups. Each group picks a topic. This activity is 'jigsaw'. From each group after learning about the topic, the person goes to the other groups to teach about their topic. In the end everyone learns about the concept by sharing what each learnt about their topic.

Hence, we believe teaching students by MILA method is very effective and beneficial as it makes learning and understanding a complicated topic such as radiation physics easy and enjoyable.

Intraoral Periapical Radiography and Radiographic Diagnosis

MILA in teaching has helped students to understand the angulations required for taking an intraoral radiograph and the radiographic appearances of the lesions or any pathology in Oral Medicine and Radiology which are considered to be very complicated and confusing. Unless the students know how to make a radiographic exposure of the teeth, they cannot understand the radiographic aspects of the oral diseases.

There are many students who have difficulty in understanding the radiographic angulations required for taking an intraoral radiograph. This is because different teeth require different angulations. Radiographic appearances of the pathology helps to differentiate radiographically the lesions present and also aids in coming to a definitive conclusion. This will ensure the correct treatment planning and provide great relief to the patient.

Interactive methods of pedagogy were utilised in the class. The plan included 20 mins of explanation and 20 mins of interactive session for a total of 6 sessions. We have used images and demonstrations to explain the students about the topic. We also used a modelling method by choosing 2 students randomly where one student acts as a dentist and other as a patient. In this way the students were able to understand the angulation required for a radiograph in all perspectives. After teaching for 20 mins the interactive session was taken where students were given activity and were provided with photos and materials to understand the various radiographic appearances [figure 4]. This was done to find out how much a student has grabbed the topic. For example, the Odontogenic myxoma has tennis racket like appearance radiographically or the calcifying epithelial odontogenic tumor shows snow driven appearance hence the images of a tennis racket and snow driven pattern using flour powder were done by the students [figure 5].

The visual method helps the students to retain the information because they could easily correlate them. This method resulted in an increase in the understanding of concepts. This will eventually help the students to become better radiographic diagnosticians and also helps in formulating the correct and an appropriate treatment plan.



Figure 4: Students Provided with Photos and Materials to Perform the Activity for Understanding Various Radiographic Appearances



Figure 5: Student Performing Activity Using Flour Powder to Mimic Snow Driven Appearance Seen in Clarifying Epithelial Odontogenic Tumor

Magnetic Resonance Imaging (MRI)

Teaching about Magnetic Resonance Imaging (MRI) is a very challenging task. The difficulties faced by the students are the principles of MRI and the modes used during the scan process. Interestingly in MRI the different modes have a direct bearing on the appearance of the tissues in the images. After reviewing the literature [19][20] and understanding the difficulties of the current trend of students, we decided to use an activity based learning to

help the students to understand the principles of MRI which provides a foundation for an effective use of MRI in Dental practice.

The plan was to use clay modelling in the demonstration of the principles of MRI followed by an active participation of the students to engage in the activity. The following materials were used in the activity,

- A bar magnet was made with clay with separate colours for the poles.
- To represent hydrogen atoms small paper balls were made.
- The paper balls had a different colour in one of the ends to indicate the polarity.
- A total of 6 paper balls were made.
- A white paper showing a graph of the x,y and z axis.

First the course facilitator placed the paper balls representing the hydrogen atoms of the body in random orientation, but in a manner where the net charge was 0. Then a bar magnet was modelled in clay with different colours for either poles and placed near the paper balls. On placing the bar magnet the paper balls were aligned such that the majority of the balls were aligned with the magnetic field in the spin up state and a smaller section of the balls were aligned antiparallel or in the spin down state. Subsequently one of the students was given a graph paper and asked to draw a net graph. Before placing the bar magnet the net graph was zero as all the atoms were aligned to cancel each other. On placing the bar magnet there was a development of a net vector moment.

In the second stage, an RF Pulse in the form of a pencil was placed perpendicular to the magnet and resulted in the paper balls representing hydrogen atoms to align themselves with the RF field in a perfect sense. The student keeping a track of the vector pointed out that the vector was much stronger in a direction with the RF field. This was explained as the cause of the T1 signal.

In the final stage of the activity, the RF pulse was taken away and the atoms represented by the paper balls fall back to their state in alignment as dictated by the magnetic field. The relaxation of the atoms was in two stages: viz: first stage were the atoms aligned to the magnetic field and in the second stages the atoms aligned either parallel or anti parallel to the field. This was explained as a T2 signal.

The same activity was repeated twice by the facilitator followed by the students playing it as a guessing game among themselves.

The students were given 5 questions in the form of a pre test (checking their understanding of the keywords) and post-test. We had also taken a verbal feedback from the students which showed that the students enjoyed the activity and felt it was easy. Further as the activity was more interactive it gave them an opportunity to repeat the activities and improve their understanding.

Radiodiagnosis

Students have difficulty in understanding the various pathological radiographic patterns in the extraoral radiographs and applying the same to interpret and to arrive at the diagnosis was challenging. This has been widely reported in various publications [21][22].

A method called DIY (Do It Yourself) - X rays was used. Following the first 20 minutes of pedagogy, students were given a set of cards that represents the pathologies and materials that are required to describe the various radiographic patterns were displayed. They were given a time period of 20 minutes in which they discuss the pathology and correlate the radiographic patterns and arrive at a possible radiographic impression. After a brief

discussion, with the use of given materials, they simulated the given radiographic patterns. For example-They demonstrated a honeycomb pattern for ameloblastoma, cherry blossom appearance for Sjogren's syndrome with the given materials. Following the DIY-Xrays, the capability of the students in identifying and interpreting the patterns in the given radiographs was dramatically increased. The students were evaluated at the end of the class by asking them to identify the classical radiographic appearances of the pathologies involving skull and jaws. This activity improved critical thinking, the problem-solving capacity of the participated students. Also, their competitive skills, communication, teamwork were tremendously improved among the students. MILA is a subtle but powerful hands-on way of learning the concepts. MILA has helped to deliver the concepts in a strong way. The order of teaching followed by activity has positively influenced the students to engage in the classrooms. This method of teaching with a small group of students helps to give personal attention to the students. In contrast to conventional teaching, one-one interaction with all the students is made possible. The flipped classes, which is a pre-recorded video on the classes, helps to deliver the concepts in a nutshell. MILA has made teaching so lively and interactive, the application of this teaching method greatly influences the memory and retaining capacity of a student which by itself is the strength of this system. Overall, teaching students by this method is effective for teaching the most challenging chapter Radiodiagnosis among undergraduate students.

CONCLUSION

The proof of the pudding is in eating. How do we prove that this method was effective? We had compared the university exam of students who had the conventional teaching method and the MILA teaching method. It was quite a difference. The highest mark differs by 20 marks. The 2016 batch who had conventional lecture classes scored 139 on 200 whereas the 2017 batch scored 159 on 200 as the highest. The number of students who scored above 60% was 55 in conventional teaching methods while 77 students scored above 60% in students taught by MILA. Thus multiple interactive learning algorithm proved to be an effective teaching methodology.

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