

MILA in Teaching Biochemistry for Dental Students

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Abstract--- MILA, multiple integrated learning algorithms, is an innovation in learning methodology. This varies from conventional one way communication to interactive learning. The students participate in active learning in these sessions. Biochemistry is a complex subject with several enzymes which rhyme the same, it is difficult for the students to remember the terminologies and reciprocate the same. Also this becomes the hurdle in their clinical application. Hence, small group learning with numerous activities like role play, clay modelling, concept mapping, pogil, castle top were utilised to enhance their memory. In this study, we have chosen two topics which involve many cycles to memorise. This was made easy by providing a flipped class video ahead of class and the students were asked to work in groups during the class hour with the given activity. Their learning was assessed at the end of the session and it proves to be effective.

Keywords--- MILA, Biochemistry, Activity based Learning, Lipid, Carbohydrate.

INTRODUCTION

One of the greatest challenges that daunts every teacher while delivering an effective lecture is keeping the audience engaged. Of course, there are stellar orators who can keep the audes captivated for hours with ease. But not all teachers are great orators and when we discuss pedagogy we need to discuss its effectiveness not just efficacy [1]. The methods need to be effective irrespective of student compliance, faculty compliance, environment, time of day and other factors. Hence we need to discuss methods to counter these potential factors in order to make any pedagogic technique effective across the varied settings [1,2].

One of the most common traits observed across many powerful orators is their uncanny ability to narrate a story, this narrative style connects with the audies in an emotional manner. This is what keeps the brain engaged across long spans of time. The most common emotions in a human mind are fear, hate, love, empathy, enlightenment. It's obvious from the above list, that enlightenment is the only path an orator can use to make an audience excited about new ideas and information. For enlightenment to occur in the classroom, a faculty needs to be seen as a role model in the eyes of a student [3,4]. Not all faculty are able to captivate their students to look at them as a role model. We need a method of pedagogy that all faculty would be able to produce successful outcomes in a fast and efficient manner [5]. Another benefit of interactive learning is that faculty are not the only content providers in the class, here the faculty and students together work as a cohesive group to share and teach each other [6]. Even if a particular faculty member is not able to exude the charisma of a powerful orator, the group dynamics itself will be captivating enough for students to be attentive for long periods of time.

When multiple interactive activities are scheduled one after another there is a chance for this also to reach a certain level of boredom. Therefore we need scientific knowledge on the particular sequence activities that should be followed to produce the most effective optimal teaching learning performance [7]. Generally there are many established systematic reviews that agree on the consensus that the students' attentiveness in lectures / instructions sessions last only around 18 minutes. Therefore there is custom to break up the classes into 15 minute intervals with breaks and activities intertwined to reset boredom and maintain attentiveness over the hour [8,9]. Simple measures like moving, standing up, discussing with a partner or team for a couple of minutes have shown great potential in maintaining attentiveness. Nevertheless, one should also be aware of the potential for activities to become very distracting. Such disruptive procedures actually increase the time required by the students to regain focus in class [9]. We have previously observed that in experimental settings, certain activities are more suitable to teach certain subjects. Although this concept is logical and expected, the sequence of activity and its impact on learning has not been well understood. This thesis delves into hundreds of such techniques tried over multiple programs. Towards the end, we hope to hypothesize a recommended protocol to train students in the most effective way with minimal effort.

The concepts of flipped classes and Castle top training have become incredibly popular in certain fields of education [10]. Essentially a flipped class reduced the didactic session further to home made short videos, followed by extended discussions / groups assignments in class [11]. Essentially flipping homework and classwork. In our experience although we do believe flipped classes are very effective, the faculty come out with feelings of dissatisfaction [12]. Maybe it is the innate need of the faculty to receive gratification in the form of nodding heads (by students) or the preconceived notion that they failed to execute their job if they do not perform an hour long lecture. Eitherway, unless the faculty are satisfied, they are unlikely to hop on board. Castle top learning just adds a layer of out of class lateral thinking activating to the already robust in class curriculum traditionally followed across the globe [13]. In our experience, students tend to report that the path of inquiry provides wisdom however such wisdom was seldom evaluated or calibrated to evaluate the success of the system. Therefore, we are more inclined to use traditional lectures supplemented with in class activities to improve optimal outcomes in student attentiveness, faculty satisfaction and speed of content coverage [14]. These three pillars can set a stable foundation for any system in learning.

Our MILA system of Interactive learning was developed with these policies in mind. In this article we have tried MILA (Multiple Interactive Learning Algorithm) where biochemistry is taught with numerous activities. Here we have two case studies in which the effectiveness of activity based learning was assessed among the first year students in learning biochemistry.

MILA in Teaching Lipid Metabolism

Biochemistry is a science that deals with chemical processes within living organisms. Biochemists focus mainly on the function, role and structure of biomolecules. Concepts of Biochemistry are potentially important for Medical and Dental students. Many students study Biochemistry in an aim to pass the examination [15]. Especially the concepts involving metabolism like Lipid metabolism seems to be difficult for the students to understand and moreover even if they understand, they tend to forget on a long run. Lipid metabolism involves pathways such as lipid biosynthesis, Cholesterol and sterol biosynthesis and degradation, Beta oxidation, ketosis etc. Especially when it comes to shuttling pathways such as shuttling of acetyl CoA and fatty acids inside and outside the mitochondrial matrix is conceptually tough to understand and also difficult for the teacher to explain. Teaching a difficult concept in an easy manner and to make the students understand is the task for every teacher. Here the teaching methodology with MILA proves to be a boon for the student as well as teachers. MILA is an activity based learning system consisting of lectures interspaced

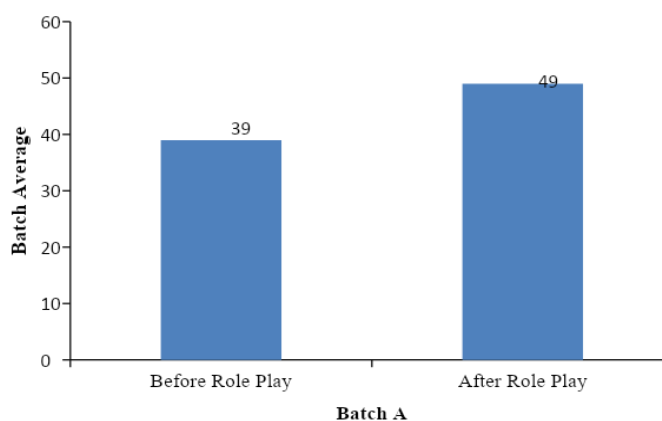
with activities. Activities such as jigsaw, POGIL(Process Oriented Guided Inquiry Learning), mind mapping, game based learning, critical pedagogy, peer-led team based learning, role play and scale up not only keep the students interested in the topic but also help them break down and easily understand challenging topics and reproduce the concepts easily. This system also helps the teachers to evaluate and assess the understanding of individual students regarding a particular topic.

In Lipid metabolism, usually students find it difficult to understand the "Shuttling of Acetyl CoA and NADPH from the mitochondrial matrix to cytosol for Fatty acid biosynthesis"[15,16]. The difficulty that the students felt in this topic is to understand the mechanism of shuttling of various components involved in lipid biosynthesis. Understanding the nature of the mitochondrial membrane and the permeability of these components across the membrane.

To explain the concept "Role play" a concept of MILA was utilized in teaching between 2018-19.

The students were initially explained with an overview of the concept. Then placards indicating the key words such as "Acetyl CoA, Pyruvate, NADPH, citrate, mitochondrial matrix, mitochondrial membrane, malate etc are prepared in colourful ways by the students. After the preparation of the placards. Each student holding a placard stood in the allotted place. A big mitochondrial inner membrane was created by a set of students in a hand in hand fashion. Initially the student with Acetyl Co placard standing inside the matrix will try to pass through the membrane. Students who are standing as membrane will resist the entry and try to push the acetyl CoA back into the matrix. Once the Acetyl CoA gets converted to malate, it easily passes through the membrane. The conversion of one compound to another and its permeability across the membrane were enacted by the students enthusiastically.

The same concept when taught in a conventional way, students found it difficult to understand and remember for a long run. To make the understanding easier MILA was introduced. Thus after the Role play, a concept of MILA, students were found to understand the concept and remember it for a long time. Activities such as Role play not only helps in understanding but also increases creative skills and boosts a friendly atmosphere for the students. That is how learning was made in a healthy and enjoyable way. When asked to write a sudden test on the concept, students were confident and wrote well. (Graph 1)). It is not only understanding, remembering what they learn is also important. MILA proves to be the best teaching learning concept.



Graph 1: Comparison of Marks before and after Activity based Learning

MILA in Teaching Carbohydrates

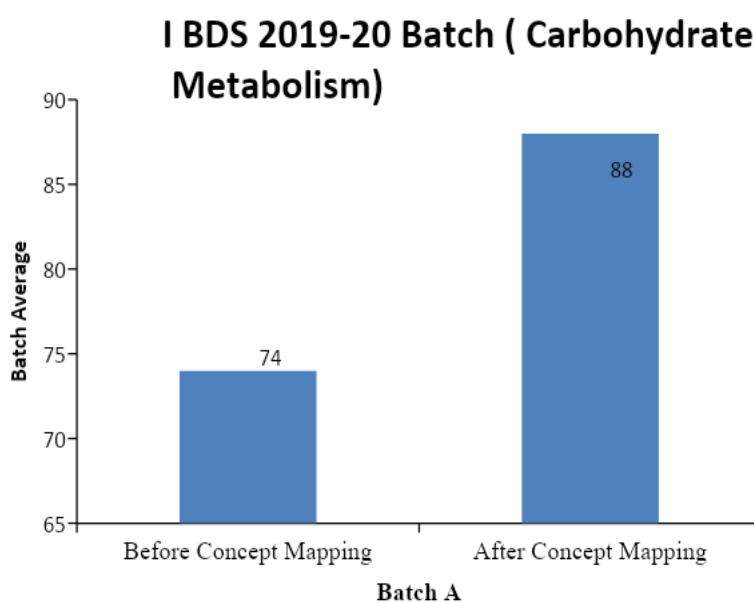
Biochemistry is an interesting subject and it deals with biomolecules required for existence. Biochemistry is a tougher subject for both teacher and student [15]. It involves detailed structure, anabolic pathways, catabolic

pathways, disorders and regulation of biomolecules. Teaching these concepts in an easy and interesting way and making the students retain longer is a challenging task for a teacher. This has been made possible by the introduction of Multiple Interactive Learning Algorithm (MILA). MILA is an activity based learning system where the teaching and learning process is interspersed with activities. Activities such as Jigsaw, POGIL (Process Oriented Guided Inquiry Learning), Concept mapping, game based learning, critical pedagogy, peer-led team based learning, role play and scale up not only keep the students interested in the topic but also understands the concepts well.

Carbohydrates – Chemistry and Metabolism is a very complicated concept. It involves major pathways like oxidation of glucose, glycogen metabolism, Hexose monophosphate shunt, metabolism of sugars. Students have difficulty in understanding these pathways. This has been widely reported in various publications [17]. To simplify Carbohydrate metabolism and make the students understand the concepts better, we utilised Concept Mapping method of pedagogy in a class between 2019 – 2020 for Batch A students. The students were given an overview about the Classification of carbohydrates, its properties, disaccharides, polysaccharides, metabolism of sugars, oxidation of glucose to carbon dioxide and water, glycogen metabolism, hexose monophosphate shunt, metabolic disorders.

The students downloaded a simple mind app on their iPad. They familiarized the app with their family tree. Students with the help of the facilitator initiated the carbohydrate chemistry and metabolism in a stepwise manner. The concept map was highly branched which included the entire chapter in the concept tree. The concept mapping helped the students to break down and easily understand challenging topics and reproduce the concepts easily. This system also helps the teachers to evaluate and assess the understanding of individual students regarding a particular chapter.

The students found it difficult to understand Carbohydrate chemistry and metabolism when taught in a conventional way prior. But on applying the MILA – Concept Mapping method, there was a dramatic increase in the results when they were asked to write a test on the topic (Graph 2). The students were well versed with the topic and it helped to retain the subject for a very long duration. It is very useful to the students and a very powerful study strategy. Concept mapping interlinks concepts in a detailed manner. It helps to clarify and structure the ideas. Biochemistry was made easy with MILA and this was evident with the results.



Graph 2: Comparison of Marks before and after Concept Mapping Method of Learning

CONCLUSION

With the above case studies, it is evident that activity based learning improves students performance. Having in mind the duration of attention if a class is planned ahead with lectures, audio visual components and activities the students will have an everlasting memory. The above two case studies had made it clear with an average difference of about 10 marks and 14 marks increase in MILA teaching methodology compared to conventional lecture based classes. From a teacher's perspective, the students seem to be more attentive in class compared to conventional lecture classes. Also, students develop a social wellbeing. Their confidence, communication and creativity grows enormously which is also essential for being successful professionals.

BIBLIOGRAPHY

- [1] Strong M, Gargani J, Hacifazlioglu Ö. Do We Know a Successful Teacher When We See One? Experiments in the Identification of Effective Teachers. *Journal of Teacher Education* 2011; 62: 367–382. <https://doi.org/10.1177/0022487110390221>.
- [2] Starkweather-Lund AR. Training teachers to give effective commands: effects on student compliance, academic engagement, and academic responding n.d. <https://doi.org/10.31274/rtd-180813-8781>.
- [3] Townsend T, Bates R. *Handbook of Teacher Education: Globalization, Standards and Professionalism in Times of Change*. Springer Science & Business Media; 2006.
- [4] Townsend T, Bates R. *Handbook of Teacher Education: Globalization, Standards and Professionalism in Times of Change*. Springer Science & Business Media; 2006.
- [5] Fabrice H. *Learning Our Lesson Review of Quality Teaching in Higher Education: Review of Quality Teaching in Higher Education*. OECD Publishing; 2010.
- [6] Howard JR. *Discussion in the College Classroom: Getting Your Students Engaged and Participating in Person and Online*. John Wiley & Sons; 2015.
- [7] Self B, Widmann J. Demo or Hands-on? A Crossover Study on the Most Effective Implementation Strategy for Inquir--Based Learning Activities. 2017 ASEE Annual Conference & Exposition Proceedings n.d. <https://doi.org/10.18260/1-2--28101>.
- [8] Durães DA. Attentiveness and Engagement in Learning Activities n.d. <https://doi.org/10.20868/upm.thesis.53795>.
- [9] Hover KM, Muhlhauser M. Classquake: Measuring Students' Attentiveness in the Classroom. 2015 IEEE International Symposium on Multimedia (ISM) 2015. <https://doi.org/10.1109/ism.2015.24>.
- [10] Tecedor M, Perez A. Perspectives on flipped L2 classes: implications for learner training. *Computer Assisted Language Learning* 2019; 1–22. <https://doi.org/10.1080/09588221.2019.1626439>.
- [11] Balan P, Clark M, Restall G. Preparing students for Flipped or Team-Based Learning methods. *Education Training* 2015; 57: 639–657. <https://doi.org/10.1108/et-07-2014-0088>.
- [12] Frímannsdóttir I. DO FLIPPED LEARNING CLASSES COMPARE WITH TRADITIONAL CLASSES? *INTED2016 Proceedings* 2016. <https://doi.org/10.21125/inted.2016.0758>.
- [13] Leese M. Out of class-out of mind? The use of a virtual learning environment to encourage student engagement in out of class activities. *British Journal of Educational Technology* 2009; 40: 70–77. <https://doi.org/10.1111/j.1467-8535.2008.00822.x>.
- [14] Chen D, Faichney J. Flipping a Programing Class to Improve Student Performance and Student Satisfaction. *International Journal of Adult Vocational Education and Technology* 2019; 10: 27–39. <https://doi.org/10.4018/ijavet.2019010103>.

- [15] Wood EJ. Biochemistry is a difficult subject for both student and teacher. *Biochemical Education* 1990; 18: 170–172. [https://doi.org/10.1016/0307-4412\(90\)90123-90126](https://doi.org/10.1016/0307-4412(90)90123-90126).
- [16] Vanderlelie JJ, Alexander HG. Learning-oriented assessment increases performance and written skills in a second year metabolic biochemistry course. *Biochemistry and Molecular Biology Education* 2016; 44: 412–420. <https://doi.org/10.1002/bmb.20962>.
- [17] Chen H, Ni J-H. Teaching arrangements of carbohydrate metabolism in biochemistry curriculum in peking university health science center. *Biochemistry and Molecular Biology Education* 2013; 41: 139–44. <https://doi.org/10.1002/bmb.20695>.