

The project aims to facilitate students in learning basic concepts and laboratory techniques of molecular biotechnology by flipped classroom approach. A series of micro-modules were developed, including videos of mini-lectures and experimental techniques. They are to 1) introduce theories and principles addressed in the lab procedure; 2) demonstrate equipment or experimental techniques. With this flipped classroom approach, students could be well-prepared before the lab sessions. It can also reduce the time of the pre-lab lectures in the laboratory sessions, so the students can complete the experiments within the time allotted.

The themes of the micro-modules are chosen to align with topics covered in an undergraduate laboratory course (MBTE4033 - Molecular Biotechnology Laboratory I) offered by the School of Life Sciences, which target upper-class undergraduate students in their 3rd or 4th year of studies. Students will 1) acquire the knowledge and concepts of molecular cloning and protein expression; 2) be familiar with the required experimental techniques before doing the experiment. Seventeen micro-modules are produced:

1. Cloning using restriction enzymes
2. Primer design
3. DNA extraction
4. Polymerase chain reaction
5. DNA gel electrophoresis
6. Ligation
7. Competent cell and transformation
8. Preparation of plasmid DNA
9. DNA sequencing
10. Protein expression in bacteria
11. Protein gel electrophoresis and protein transfer
12. Protein detection
13. DNA analysis utilities Part I - sequence alignment
14. DNA analysis utilities Part II - RE map
15. Aseptic Techniques (experimental techniques)
16. Transformation (experiment techniques)
17. DNA gel electrophoresis (experiment techniques)

Topics covered in these micro-modules replace the scope of knowledge delivered during lab session before doing experiment. This flipped classroom approach greatly reduced the

time in doing the pre-lab talks during the lab session. The three experiment videos (micro-modules #15-17) demonstrate how the experiments actually work. Students can acquire the experiment techniques so that they can successfully conduct the experiment

Tracking statistics from the Panopto video platform were analyzed and the average % of students watched the mini-lecture micro-modules is ~82% while the average % of students watched the experimental videos is ~85%. Student's performance was also reflected from the results of pre-lab quizzes, the average marks of the 6 quizzes are 6.77 out of 10. From the high view rates and high average marks for the quizzes, it indicates that our objective is achieved.