THE CHINESE UNIVERSITY OF HONG KONG

Micro-Module Courseware Development Grant

Scheme 1: Basic Scheme

Final Report (2017-18)

Report due 31 October 2018
Please return by email to The Ad hoc Committee on Planning of eLearning Infrastructure mmcd@cuhk.edu.hk

PART I

Project title: Flipped classroom teaching: molecular biology laboratory techniques
Principal supervisor: Dr. Lam SIOW
Department / Unit: School of Life Sciences
Project duration: From December 2017 to October 2018
Date report submitted: 31 Oct 2018

1. Project objectives

The project is to create a series of videos of mini-lecture and experimental techniques and to facilitate students in learning basic concepts and laboratory techniques of molecular biotechnology in MBTE4033 (Methods in Molecular Biotechnology Laboratory I) by flipped-classroom approach.

2. Process, outcomes or deliverables

Fourteen micro-modules in the form of voice-over mini-lectures with PowerPoint slides and 3 micro-modules that shows laboratory techniques were produced. They were used for the course, MBTE4033. The theme and duration of each micro-module are as follows:

1. Cloning using restriction enzymes (4:03)
2. Primer design (6:35)
3. DNA extraction (4:25)
4. Polymerase chain reaction (7:46)
5. DNA gel electrophoresis (3:26)
6. Ligation (1:33)
7. Competent cell and transformation (2:59)
8. Preparation of plasmid DNA (3:32)
9. DNA sequencing (5:46)
10. Protein expression in bacteria (2:48)
11. Protein gel electrophoresis and protein transfer (7:32)
12. Protein detection (6:17)

13. DNA analysis utilities Part I - sequence alignment (supplementary information, 5:34)
14. DNA analysis utilities Part II - RE map (supplementary information, 2:42)
15. Aseptic Techniques (experiment video, 2:28)
16. Transformation (experiment video, 4:19)
17. DNA gel electrophoresis (experiment video, 2:50)

These micro-modules were produced and released on time according to the teaching schedule in Term 1, 2018-19. They were uploaded to the Panopto video platform on the CUHK Blackboard eLearning system. These micro-modules, together, offered 75 minutes of online contact time. Slides used in the micro-modules #1-12 were also uploaded to Blackboard as part of the pre-lab notes. Announcements were made in class in the first introductory session and on Blackboard reminding students to watch the micro-modules and read the lab manual before each lab session (once every week, 8 lab sessions per semester). Pre-lab quiz covering the content of the micro-modules and pre-lab talk was done in each session to assess student's preparation. Answers will be discussed after the quiz. 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 (mcro-modules #15-17) demonstrate how the experiments actually work. Students can acquire the experiment techniques so that they can successfully conduct the experiment. Two supplementary Micro-modules were produced (micro-modules #13-14), basic techniques of bioinformatics were introduced. These are basic soft skills in molecular cloning. Exercises were given in lab reports to access students whether they have acquired the soft skills. With these flipped classroom activities, students are able to prepare for the lab session beforehand and overruns of lab sessions can be avoided. The micro-modules will be also important for students to prepare for the term-end written and practical examination, and the basis for the students in doing experimental research and post-graduate study. Since the micro-modules were implemented according to the teaching schedule of this term, statistics from Blackboard eLearning can be only done for the modules posted up to Week 8 of the term (micro-modules #1-9 and #15-16). From the tracking statistics, on average, >80% of the students watched the micro-modules, indicating a high participation rate. Therefore, we believe the project is completed satisfactorily.

3. Evaluation Plan

Since the micro-modules were just finished and are still being implemented at the moment. I would like to show the up-to-date Blackboard tracking statistics of the micro-modules Blackboard from Week 2 to Week 8 of MBTE4033 in Term 1, 2018-19. In addition, pre-la quizzes in short questions format were done. There are total 24 students in the class. The number of students watched the videos and results of pre-lab quizzes are show below.

Micro-modules	**No. of students watched the videos**	**Watched 2 times or more**
1. Cloning using restriction enzymes (4:03)	24	13
2. Primer design (6:35)	23	11
3. DNA extraction (4:25)	16	5

4. Polymerase chain reaction (7:46)	15	3
5. DNA gel electrophoresis (3:26)	20	4
6. Ligation (1:33)	18	7
7. Competent cell and transformation (2:59)	21	7
8. Preparation of plasmid DNA (3:32)	17	5
9. DNA sequencing (5:46)	23	10
15. Aseptic techniques (experiment video)	21	4
16. Transformation (experiment video)	20	5

Results of pre-lab quizzes

Quiz	Average marks (out of 10)
1	6.40
2	5.75
3	8.25
4	5.13
5	6.90
6	8.26

The average % of students watched the mini lecture micro-modules is ~82% while the average % of students watched the experiment video is ~85%. Range from 12-54% students watched the videos twice or more. 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. Further evaluation can be done at the end of the semester. Feedback survey can be carried out to further evaluate the usefulness of the micro-modules.

4. Dissemination, diffusion and impact

All the micro-modules have been uploaded to the Panopto video system for sharing. The micro-modules are made freely accessible and easily searchable by anyone at CUHK on Panopto so any colleague who finds the teaching materials useful are free to use them. I will share the experience and knowledge gained from this project with colleagues, to encourage them to produce micro-modules for use in their own courses.

PART II

Financial data

Funds available:

Funds awarded from MMCDG $ 100,000

Funds secured from other sources $ N/A

(please specify_____)

Total: $ 100,000

Expenditure:

Item	Budget as per application	Expenditure	Balance
Staff costs (eg. Student Helpers, Part time RA)	$30,000	$29,972.25	$27.75
Production of videos, includes video taking and editing (CUAV)	$60,000	$60,000.00	$0
Purchase of software and hardware for image and video editing; consumables for setting up the experiments and other miscellaneous items.	$10,000	$10,027.75	$-27.75
Total:			$0

PART III

Lessons learnt from the project

The final report cannot fully reflects the final outcomes since it is submitted before the competition of the project. Evaluation was done in the middle of the semester. Longer project period is preferred. It was grateful that we have a team of excellent student helpers, they are UG and PG students from the School of Life Sciences who assist in producing high quality micro-modules. We would like to thank CUAV team for their advices, and professional support for video recording and editing.

PART IV

Information for public access

Summary information and brief write-ups of individual projects will be uploaded to a publicly accessible CUHK MMCDG website. Please extract from Part I the relevant information to facilitate the compilation of the publicly accessible website and reports.

1. Keywords

(Most relevant) Keyword 1: DNA

Keyword 2: PCR cloning

Keyword 3: Ligation

Keyword 4: Transformation

(Least relevant) Keyword 5: Protein

2. Summary

Please provide information, if any, in the following tables, and provide the details in Part I.

Table 1: Publicly accessible online resources (if any)
(a) **Project website:**
(b) **Webpage(s):** 1. cloning using restriction enzymes https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=791bb3e6-f01f-4a80-af32-a94d00f94248 2. Primer design https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=ced40183-fc7b-4285-94ae-a94d00f94e0b 3. DNA extraction https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=bdec07d7-fcbe-4ca8-bd7c-a94d00f95ab0 4. Polymerase chain reaction https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=d62ad49e-9ad8-4817-a156-a94d00f963b8 5. DNA gel electrophoresis https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=0e4d4fbf-af42-4a73-971e-a95900a092ad 6. Ligation https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=bee5475f-c45b-4d0e-8710-a962008536da 7. Competent cell and transformation https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=01563918-4e52-4d4a-b35c-a96700a6ea02 8. Preparation of plasmid DNA https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=361b0af2-9999-4881-9e6b-a97000a6d0f3 9. DNA sequencing https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=8d4a0e0f-fab8-470a-80b5-a98000f47df7 10. Protein expression in bacteria https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=d36fe2b3-5e90-4daf-a5c3-a98700a53e83 11. Protein gel electrophoresis and protein transfer https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=28574d6a-29a5-47cf-93b8-a98700abff86 12. Protein detection https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=70df366b-238a-436f-a686-a9880044ccd1

13. DNA analysis utilities Part I - sequence alignment
https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=8ebfa03e-1e84-42f8-a164-a98000f87a7a
14. DNA analysis utilities Part II - RE map
https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=97e60da4-5071-42d0-a162-a98000fd365c
15. Aseptic techniques (experiment video)
https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=ad9f51ef-b95c-42e2-af62-a96700a40100
16. Transformation (experiment video)
https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=66ff871e-ac05-4a30-8a8b-a96700a40133
17. DNA gel electrophoresis (experiment video)
https://panopto.cuhk.edu.hk/Panopto/Pages/Viewer.aspx?id=9c0007e1-f95e-40bc-8e84-a9880023d37c

(c) **Tools / Services:**

Camtasia studio screen recording & video editing software
CUHK's Panopto Video Platform
Blackboard eLearning system
CUAV at CU

(d) **Pedagogical Uses:**

Flipped classroom approach is used. Students were asked to watch the micro-modules available online before attending laboratory sessions. The Micro-modules cover basic knowledge related to the experiments and videos showing experimental techniques.

(c) **Others (please specify):**

Table 2: Resources accessible to a target group of students (if any)

N/A

Course Code/ Target Students	**Term & Year of offering**	**Approximate No. of students**	**Platform**
MBTE4033	*1st term 2018*	*24*	*Blackboard*

Table 3: Presentation (if any)	
Please classify each of the (oral/poster) presentations into one and only one of the following categories	**Number**
(a) In workshop/retreat within your unit (e.g. department, faculty)	*N/A*
(b) In workshop/retreat organized for CUHK teachers (e.g. CLEAR workshop, workshop organized by other CUHK units)	*N/A*

(c) In CUHK ExPo jointly organized by CLEAR and ITSC	*N/A*
(d) In any other event held in HK (e.g. UGC symposium, talks delivered to units of other institutions)	*N/A*
(e) In international conference	*N/A*
(f) Others (please specify)	*N/A*

Table 4: Publication (if any)	
Please classify each piece of publication into one and only one of the following categories	**Number**
(a) Project CD/DVD	*N/A*
(b) Project leaflet	*N/A*
(c) Project booklet	*N/A*
(d) A section/chapter in a booklet/ book distributed to a limited group of audience	*N/A*
(e) Conference proceeding	*N/A*
(f) A chapter in a book accessible internationally	*N/A*
(g) A paper in a referred journal	*N/A*
(h) Others (please specify)	*N/A*

3. A one-page brief write up

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.

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