

**THE CHINESE UNIVERSITY OF HONG KONG**

**Micro-Module Courseware Development Grant**

**Scheme 3: eLearning Pedagogy Research**

**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](mailto:mmcd@cuhk.edu.hk)

**PART I**

Project title: [Evaluation of the teaching and learning effectiveness of the use of flipped classroom pedagogy for Biochemistry courses](#)

Principal supervisor: [Dr Patrick Ngai, Dr FH Lo, Prof Shannon Au, Prof SK Kong, Prof PC Shaw, and Prof KB Wong](#)

Co-supervisor(s)

Department / Unit: [School of Life Sciences](#)

Project duration: From December 2017 to October 2018

Date report submitted: 31 Oct 2018

**1. Project objectives**

*Is the project on track to meet its objectives?*

*Have the objectives been changed as a result of the experience of working on your MMCDG project?*

*Has the project created any impact as expected?*

[This project is a pedagogical study of the teaching and learning effectiveness of the e-learning for Biochemistry education. The project objectives include 2 dimensions.](#)

**Quantitative Analysis**

- i. [User experience: the number of access and the duration of each access of the e-learning materials by the students have been collected; the data will then be analyzed to study the behaviors and usage patterns of the students.](#)
- ii. [Student performance: students were asked to complete a questionnaire at the beginning and at the end of each teaching Term to evaluate if the access of the e-learning materials can improve their study performance.](#)
- iii. [Correlational study: Meta-analysis of the correlation between students' academic performance and flipped-classroom pedagogy has been conducted in selected](#)

biochemistry courses. Preliminary data reveals a positive impact of flipped-classroom pedagogy on students' learning. The results will be further analyzed and concluded at later stage.

#### Qualitative Analysis

- iv. Student motivation: several surveys were conducted at the end of each Term to study if the e-learning materials can promote the motivation of learning. The data were collected for further analysis.
- v. Focus group study: focus group were conducted on a monthly basis; where some feedbacks related to the use of flipped classroom and e-learning materials were collected from the students.
- vi. Interview: an informal interview session with students was conducted to investigate their learning difficulty achieving the Learning Outcomes of individual courses. Some comments were noted to further enhance the effectiveness of students' learning.

## **2. Process, outcomes or deliverables**

*Please specify the number of micro modules produced, and the course(s) (with course codes and titles) that have used the micro modules in Part IV, and provide more detailed descriptions in here. Must specify duration of each micro-modules (in terms of students online contact hours), total duration time of all deliverables and style. (With reference to the "Summary of video presentation styles" developed by CLEAR)*

*Have the research design, methodology and timeline been changed/adjusted?*

*Overall, was the project completed satisfactorily?*

Process & Outcome: Three study approaches were adopted in this project to investigate the effectiveness of e-learning pedagogy in biochemistry courses.

*(i) Record of students' learning:* Quantitative and qualitative data were collected through a variety of sources and databases for analysis. These include course-evaluation surveys, focus-group meetings, performance in course assessments, teacher-student consultation sessions, academic advisory meetings, etc. The data collected were used to holistically analyze the in-class learning and self-learning experience of students in the courses that adopted e-learning pedagogies. All e-learning materials were centrally organized and delivered via the LEARNBIOCHEM platform of the Biochemistry Programme. [Figure 1]

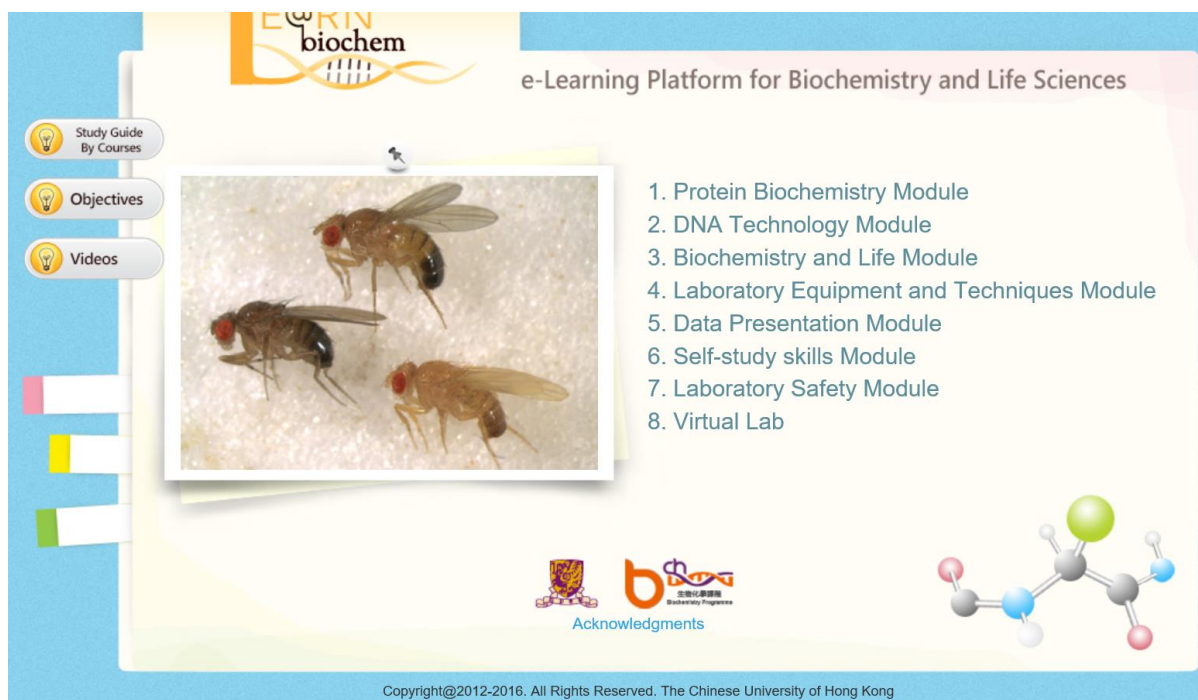


Figure 1 Website of e-learning modules of Biochemistry Programme  
(*LEARNBIOCHEM* website: <http://www.bch.cuhk.edu.hk/learnbiochem/index.html>)

The e-learning materials were organized into eight modules. It covers basic biochemical techniques, advanced topics in biochemistry, presentation skills and critical thinking skills. Each e-learning module was associated with one or more biochemistry courses that may demand the domain knowledge covered in the e-learning platform. [Table 1]

Table 1 Summary of Undergraduate Courses and Related Modules in the E-learning Platform

<u>Course Aim</u>	<u>Course Title (Name of Teacher)</u>	<u>Related Modules</u>	<u>Proposed Duration of Self-study (Hour)</u>
Courses for familiarizing with the basic concepts of Biochemistry	-Basic Lab Techniques in Life Sciences	1, 2, 3,4,7,8	1.5
Courses for general biochemistry and techniques	-Bioenergetics and Metabolism	1,2,	2
	- Methods in Biochemistry	1,2,4	0.5
	-Molecular Biology and Recombinant DNA Techniques/Laboratory	1,2	0.5
Courses for advanced biochemistry	-Immunology and Hematology Laboratory	1,2,4,7	1
	-Medical Biochemistry Laboratory	1,2,4,7	1
Courses for self-learning, critical thinking and capstone courses	-Self-study Modules in Biochemistry	5,6	1.5

(ii) *Action research*: In addition to the traditional multimedia materials such as video clips and animations, a set of e-learning materials on “Mass Spectrophometry (MS)” using the next-generation virtual reality (VR) technology was developed in this project. In comparison with the older versions of VR technology, this newly adopted VR console from HTC allow users to navigate in the immersive learning environment and interact with the mobile app. It was found that the motivation of learning was substantially increased and the efficiency in concept construction was also enhanced. This mobile app, entitled “MS-VR”, was developed in collaboration with ITSC (Mr. Ray Lee) of the University. With this e-learning module, a pilot study was conducted to evaluate users’ learning experience and effectiveness using interactive VR technology. [Figure 2]

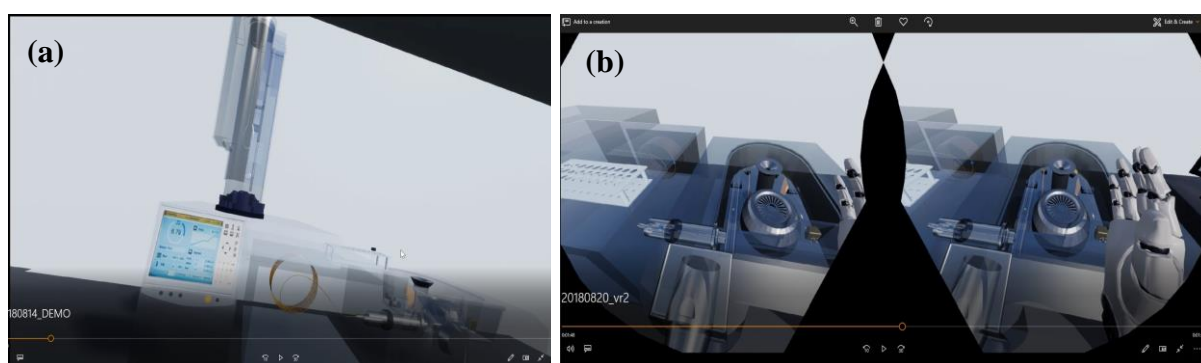


Figure 2 Snapshots of e-learning module on “Mass Spectrometry (MS)”

(a) Layout of the MS equipment set-up in a virtual laboratory. (b) An immersive view of the MS operation with virtual user hands. The view is to be displayed through an in-built goggles and a portable backpack PC.

(iii) *Investigative video documentary*: In order to study the effectiveness of students’ collaborative learning experience in group projects, an investigative study with production of video documentary was conducted. The documentary was produced with the professional support from ELITE (Mr. Eddie Kwok) of the University. A group of undergraduate students from the School of Life Sciences had teamed up with engineering students to participate in a scientific research under the guidance of CUHK teachers and tutors.

This project team had studied the process of their project work, visited their laboratories and interviewed the participants including their veteran student members. Focus of the continuous study was placed on the learning effectiveness and the implementation of group projects with e-learning technologies. With video clips taken in the face-to-face interviews and lab visits, this investigative study was summarized and concluded in the form of a 30-minutes video documentation. [Figure 3]



Figure 3 Snapshot of documentary video production. The executive director of the documentary production (white T-shirt) and guest interviewee (blue shirt) are shown.

### Deliverables

#### (i) Publication in International Education Conference

The design, development and implementation the e-learning pedagogies in Biochemistry Programme were presented in international educational conference as shown below.

Lilly Education Conference: Designing Effective Teaching”, Bethesda, USA, 29 May 2018 – 3 June 2018.

Topic 2: Development of a virtual laboratory for the teaching of immunohistochemistry  
(Presented by Dr. FH Lo)

Topic 1: Implementation of Flipped Classroom in Undergraduate Biochemistry Courses  
(Presented by Dr. Patrick Ngai)

The experience in the implementation of e-learning pedagogies were disseminated among teachers in the Biochemistry Programme. The statistics of course evaluation and focus-group surveys were also shared with course teachers.

#### (ii) E-learning Module with VR technology

A set of e-learning module on “Mass Spectrometry” was developed in this project. The module was delivered together with a mobile app. In an immersive learning environment, students were able to learn about the principles of mass spectrometry and the skills of operating the machine.

#### (iii) Video Documentary

A piece of video documentary on students’ learning effectiveness in collaborative project was produced. After final editing and copyright application, the documentary will be shared with course teachers. The project team also aims to publish the documentary video in international film festival in Mid-2019.

### 3. Evaluation Plan

*Have you altered your evaluation plans?*

*Does your evaluation indicate that you have achieved your objectives?*

Several indicators were expected to serve as the evidence of success, they are listed as follows,

I. Percentage of students with absolutely no access to the e-learning materials indicates the popularity of the courseware: small percentage indicates high popularity.

II. Improvement of a test taken before and after the access of the e-learning materials indicate the achievement of the learning outcomes, which is a promising sign.

III. Positive student feedbacks collected in the questionnaire serve as the indicator of learning motivation and satisfaction.

IV. Specific positive comments obtained from the students during the focus group interview indicate strength of the teaching method.

V. Positive correlation between student performance, learning motivation and satisfaction with the usage time of the e-learning materials also serve as the indicators.

There was one alteration of the evaluation due to the time constraint of the project; a survey at the end of the Term instead of a pre-test was used to study the improvement before and after the access of the flipped classroom e-learning materials.

Overall, our data collected indicated most of the objectives were met.

### 4. Dissemination, diffusion and impact

*Please provide examples of dissemination: website, presentations in workshops or conferences, or publications.*

*Please provide examples of impact: how the research results/outcomes/findings can be extended to other disciplines.*

*Please describe how the research results/outcomes/findings may support the University's strategic aims in promoting eLearning.*

A video for e-Learning activities, including the present virtual laboratory, in the Biochemistry Programme has been produced. Moreover, the present flipped classroom pedagogy project has been presented in overseas conference in the United States\*.

\* Details of the presentation

Conference name: Designing Effective Teaching Lilly Conference

Date: 31 May to June 3 2018

Venue: The Bethesda Hyatt Regency, Bethesda, Maryland, United States

Abstract title: Implementation of Flipped Classroom in Undergraduate Biochemistry Courses

In addition to overseas dissemination, the project team would also like to share the experience in designing and implementing e-learning modules within the CUHK campus. In this regard, an abstract on the use of virtual reality (VR) technology for flipped-classroom design has recently been submitted to the CUHK Teaching and Learning Expo 2018#.

# Details of the presentation

Conference name: Teaching and Learning Innovation Expo 2018

Date: 7 December 2018

Venue: Lee Shau Kee Building, Central Campus, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong

Abstract title: Application of Virtual Reality on the Teaching and Learning of Mass Spectrometry

The findings of the present project are expected to provide some useful implications of the application of the flipped classroom pedagogical approach in other disciplines. As CUHK is currently promoting eLearning, where one of the strategy is through the flipped classroom approach, our research findings may provide some valuable insights for us to further improve the Teaching and Learning (T&L) effectiveness through flipped classroom for eLearning.

## PART II

### Financial data

Funds available:

Funds awarded from MMCDG	\$ 150,000
Funds secured from other sources (please specify _____)	\$ 0
Total:	\$ 150,000

Expenditure:

Item	Budget as per application	Expenditure	Balance
Part-Time Research Assistant ( <i>Project coordination, clerical support &amp; data analysis</i> )	65100	65100	0

Student Helper (conducting survey & invigilation)	7975	7975	0
ITSC service (Collection and analysis of user access data of e-learning platform)	50,000	50,000	0
Notebook computer (Used by the research assistance) Model: Lenovo ThinkPad T570 Notebook, Microware, CUHK Tender #17011412	6698	6698	0
Conference publication and dissemination	12,000	12,000	0
Surveys, logistics, stationeries & printing	8227	8227	0

### PART III

#### Lessons learnt from the project

*Please describe your way forward.*

*Please describe any of the following item(s) accordingly:*

- *Key success factors, if any*
- *Difficulties encountered and remedial actions taken, if any*
- *The role of other units in providing support, if any*
- *Suggestions to CUHK, if any*
  - *Example: what should be done differently?*

From the present project, we gained some better understanding and more insights about the flipped classroom pedagogical approach. Based on the findings of the project, we will continue to promote eLearning through the flipped classroom approach and to improve the overall T&L effectiveness.

After the completion of the project, we learnt about the key success factor: it could be to welcome the challenge of new technology and its associated pedagogy. From the findings and our experience acquired, the major difficulty, if any, was the integration of new technology and innovations in classes; where, the flipped classroom was essentially a revised learning format via the implementation of new technologies. Although all the difficulties were not solved within 11 months, we started to notice the key ingredients, for example, the expectations of our students, for the improvement of T&L effectiveness through the flipped classroom approach. We would like to thank ELITE for their professional support to conduct a series of highly informative documented interview study.



If there is a suggestion to CUHK, we wish CUHK could provide us with sufficient support and time until we have overcome most of the challenges of the implementation of the flipped classroom pedagogical approach.

## 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.*

Science Technology Engineering and Mathematics (STEM) is the future direction of innovative science education in Hong Kong. As Biochemistry is the core discipline of life sciences, the education of Biochemistry is particularly important for the development of life sciences and other relative innovations. In the past few years, Biochemistry Programme has initiated the use of e-learning, including flipped classroom and virtual reality, for the education of Biochemistry. In particular, Biochemistry Programme has developed a comprehensive e-learning platform 'LEARNBIOCHEM' to support the flipped-classroom pedagogy.<sup>[1]</sup> It is the first comprehensive e-platform for a major undergraduate programme in CUHK and among local life sciences departments for teaching and learning biochemistry. Currently it provides a variety of e-learning materials (e.g. video clips, animations, virtual labs, etc.) which are organized into eight modules.

It started with a simple idea of employing internet technology to facilitate the teaching of laboratory techniques in 2008 and now has developed into a fully-fledged e-learning platform for more than 200 students. Over the years, the activity has attracted the involvement of more Biochemistry teaching staff and covered the teaching of more than 70% of the major courses offered by the Biochemistry Programme, with influence to other life sciences programmes. With the implementation of e-learning pedagogy in biochemistry education for almost 10 years, this project is conceived to (i) evaluate its teaching and learning effectiveness, (ii) identify new educational technologies for content development, and to (iii) consolidate the experience for future pedagogical design.

### **1. Keywords**

*Please provide five keywords (in the order of most relevant to your project to least relevant) to describe your micro-modules/pedagogies adopted.*

(Most relevant)      Keyword 1: Flipped classroom

Keyword 2: eLearning

Keyword 3: Pedagogy

Keyword 4: Innovation

(Least relevant)      Keyword 5: STEM

## 2. Summary

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

<b>Table 1: Publicly accessible online resources (if any)</b>
<p><b>(a) Project website:</b></p> <p><i>If a publicly accessible project website has been constructed, please provide the URL.</i></p> <p><a href="#">NO, it is not publicly accessible.</a></p>
<p><b>(b) Webpage(s):</b></p> <p><i>If information of your project is summarized in a webpage (say a page in the department's or faculty's website), please provide the URL(s) in here.</i></p> <p><a href="https://www.sls.cuhk.edu.hk/index.php/bche">https://www.sls.cuhk.edu.hk/index.php/bche</a></p>
<p><b>(c) Tools / Services:</b></p> <p><i>If you have used any tools or services for the project, please provide names of the tools or services in here.</i></p> <p><a href="#">ITSC courseware development service;</a></p> <p><a href="#">ELITE documented interview study service;</a></p>
<p><b>(d) Pedagogical Uses:</b></p> <p><i>If any flipped classroom activities have been conducted, please provide information in here. If relevant, please indicate how your project output can be used to support flipped classroom activities.</i></p> <p><a href="#">All the laboratory courses offered by Biochemistry Programme have adopted the flipped classroom pedagogical approach; where the present virtual laboratory will be integrated to the syllabuses of the courses.</a></p>

<b>Table 2: Resource accessible to a target group of students (if any)</b>			
<i>If resources (e.g. software) have been developed for a target group of students (e.g. in a course, in a department) to gain access through specific platforms (e.g. Blackboard, facebook), please specify.</i>			
<u>Course Code/ Target Students</u>	<u>Term &amp; Year of offering</u>	<u>Approximate No. of students</u>	<u>Platform</u>
<i>Eg1. DEPTXXXX</i>	<i>1<sup>st</sup> term 2015</i>	<i>50</i>	<i>Blackboard</i>
<i>Eg2: Dept of xxx</i>	<i>All 1<sup>st</sup> year students</i>	<i>40</i>	<i>facebook</i>
<i>BCHE4760</i>	<i>Term 1, since 2015</i>	<i>25</i>	<i>Blackboard</i>



education of Biochemistry. In particular, Biochemistry Programme has developed a comprehensive e-learning platform 'LEARNBIOCHEM' to support the flipped-classroom pedagogy.<sup>[1]</sup> It is the first comprehensive e-platform for a major undergraduate programme in CUHK and among local life sciences departments for teaching and learning biochemistry. Currently it provides a variety of e-learning materials (e.g. video clips, animations, virtual labs, etc.) which are organized into eight modules.

It started with a simple idea of employing internet technology to facilitate the teaching of laboratory techniques in 2008 and now has developed into a fully-fledged e-learning platform for more than 200 students. Over the years, the activity has attracted the involvement of more Biochemistry teaching staff and covered the teaching of more than 70% of the major courses offered by the Biochemistry Programme, with influence to other life sciences programmes. With the implementation of e-learning pedagogy in biochemistry education for almost 10 years, this project is conceived to (i) evaluate its teaching and learning effectiveness, (ii) identify new educational technologies for content development, and to (iii) consolidate the experience for future pedagogical design.

- END OF REPORT -