

THE CHINESE UNIVERSITY OF HONG KONG

Micro-Module Courseware Development Grant

Scheme 1: Basic Scheme

Final Report (2017-18) (Additional Call)

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: 3D Plant Cell Organelles via Virtual Reality (VR) Experience

Principal supervisor: Prof. Jiang Liwen

Co-supervisor(s): N.A.

Department / Unit: School of Life Sciences

Project duration: From March 2018 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?

The original project objectives are 1) To construct 3D models of selected plant cell organelles based on real research data derived from our own research using the most advanced 3D Tomography TEM (transmission electron microscopy) system and the image processing, modeling and display program IMOD; and 2) To develop a mobile VR application for both iOS and android operating systems which students could explore and interact with 3D plant organelles in a stimulating cell environment.

The project follows its original objectives. By August 2018, 3 Micro-modules have been produced by Prof. Jiang, the senior researcher of his group and the technician of ITSC collaboratively. The VR applications have been made available on the iOS and android online application stores and have been put into use for teaching the course *CMBI4001 Protein Trafficking* and *LSCI5012 Advanced Topics in Biological Electron Microscopy and Live Cell Imaging* in September 2018.

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 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)

Has the nature of the deliverables been changed?

Have you adjusted your timeline?

Overall, was the project completed satisfactorily?

3 micro-modules were produced in the project and the corresponding details are shown below:

No.	Micro-module title	Online contact time (minute)	Style
1	Organelles in early stage of a plant cell	10	S12
2	Vacuoles in different stages of plant cells	10	S12
3	ER-Autophagosome contact site	10	S12
	Total online contact time:	30 minutes	

In the proposal, we planned to produce three micro-modules in the project period. The micro-modules will be included in a VR application to supplement students' understandings towards selected plant organelles and their functions. VR eyeglasses will be provided to students during the lectures of *CMBI4001 Protein Trafficking* and lab demonstration sessions of *LSCI5012 Advanced Topics in Biological Electron Microscopy and Live Cell Imaging* for them to view the micro-modules via the application.

Following the original timeline, by the end of August 2018, all of the proposed micro-modules have been produced and ready for use. The VR application that incorporates the micro-modules was made available on the iOS and android online application stores. In addition, we have purchased 25 VR googles for students to view the VR application in the lectures using their own mobile phones. The application and googles have been put into use for teaching the courses of *CMBI4001* and *LSCI5012* in September 2018. After all the lectures finished by early October, we have delivered surveys to students taking the courses for evaluation of the project. The project completed on time and satisfactorily.

3. Evaluation Plan

Have you altered your evaluation plans?

What monitoring data did you collect?

Does your evaluation indicate that you have achieved your objectives?

We have distributed surveys to the students during the lectures of *CMBI4001 Protein Trafficking* and *LSCI5012 Advanced Topics in Biological Electron Microscopy and Live Cell Imaging*. Students reflected that the VR application is a fun and interesting way to learn. They also thought that the application allowed a detail and close observation to the inferior compartments of cell. Some of the students mentioned that this is the first experience for them to use VR in class. They reflected that normally they can only view and learn the organelles in plant cell via 2D and that the micro modules served as a good learning tool to illustrate the organelles as vivid 3D structures. The evaluation indicated that the project has achieved its original objectives effectively and completely.

4. Dissemination, diffusion and impact

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

Please provide examples of diffusion: how the project results/process/outcomes/deliverables have been used in your unit and other parts of CUHK or other institutions?

Please provide examples of impact: how the project results (micro modules) can be adapted to other disciplines.

VR applications are uploaded to the following mobile online application stores for free downloads:

iOS: <https://itunes.apple.com/us/app/3d-plant-cell-organelles-in-vr/id1434049785>

Android: <https://play.google.com/store/apps/details?id=com.itsc.plantcell>

The work in the project will be shared as a Poster in the "Teaching and Learning Innovation Expo 2018" held at CUHK on 7 December 2018. The objective and content in the project will be summarized and introduced to the participants via poster presentation.

PART II

Financial data

Funds available:

Funds awarded from MMCDG	\$ 100,000
Funds secured from other sources (please specify _____)	\$ 0
Total:	\$ 100,000

Expenditure:

Item	Budget as per application	Expenditure	Balance
<i>3D graphic and VR System Development (we will tender this part to ITSC)</i>	90,900	93,350	-2,450
VR glasses	1,800	3,262	-1,462
Audio recording	2,450	0	2,450
Student helper(s)	4,850	3,500	1,350
Total:	100,000	100,112	-112

Remarks: We will settle the deficit amount by other fund source as soon as possible.

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?*

We plan to continue producing new 3D structures of plant cell organelles. We will continue updating new micro-modules into the VR applications.

We would like to thank the Information Technology Service Centre (ITSC) of CUHK for providing professional support for VR application development.

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

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: 3D Plant Cell Organelle

Keyword 2: Virtual Reality

Keyword 3: Vacuole

Keyword 4: Endoplasmic Reticulum

(Least relevant) Keyword 5: Autophagosome

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)
<p>(a) Project website:</p> <p><i>If a publicly accessible project website has been constructed, please provide the URL.</i></p>
<p>(b) Webpage(s):</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) here.</i></p>
<p>(c) Tools / Services:</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>(d) Pedagogical Uses:</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>(c) Others (please specify):</p> <p>VR applications are uploaded to the following mobile online application stores: iOS: https://itunes.apple.com/us/app/3d-plant-cell-organelles-in-vr/id1434049785 Android: https://play.google.com/store/apps/details?id=com.itsc.plantcell</p>

Table 2: Resources accessible to a target group of students (if any)			
<p><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></p>			
<u>Course Code/ Target Students</u>	<u>Term & Year of offering</u>	<u>Approximate No. of students</u>	<u>Platform</u>
CMBI4001	1 st term 2018	21	mobile online application stores

LSCI5012	1 st term 2018	20	mobile online application stores
Table 3: Presentation (if any)			
<i>Please classify each of the (oral/poster) presentations into one and only one of the following categories</i>			Number
(a) In workshop/retreat within your unit (e.g. department, faculty)			
(b) In workshop/retreat organized for CUHK teachers (e.g. CLEAR workshop, workshop organized by other CUHK units)			
(c) In CUHK ExPo jointly organized by CLEAR and ITSC			1
(d) In any other event held in HK (e.g. UGC symposium, talks delivered to units of other institutions)			
(e) In international conference			
(f) Others (please specify)			

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

3. A one-page brief write up

Please provide a one-page brief write-up of no more than 500 words and a short video.

In this project, we have developed 3 micro-modules using the latest technique VR to enhance students' learning experience in new models of plant cell biology. A VR mobile application "3D Plant Cell Organelles in VR" is generated, in which students could explore and interact with 3D plant cell organelles in a stimulating cell environment.

To achieve the aim of the project, we first constructed 3D models of selected plant cell organelles (e.g. the autophagosome and the vacuole) based on real research data derived from our RGC-AoE- and CRF-funded research projects using the most advanced 3D Tomography TEM (transmission electron microscopy) system and the image processing, modeling and display program IMOD. Base on the models, we developed a mobile VR application for both iOS and android operating systems in which students can visualize the real appearances of 3D plant cell organelles at the nm resolution in person. In addition, VR googles are purchased for students to view the VR application in the lectures using their own mobile phones. The application and googles have been put into use for teaching the course *CMBI4001 Protein Trafficking* and *LSCI5012 Advanced Topics in Biological Electron Microscopy and Live Cell Imaging* in September 2018. This is the first such attempt to translate the latest research development into teaching materials for University education, which will be further refined and promoted.