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: An Integration of Virtual Reality Courseware in Handling the Radiation Sources

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Department / Unit

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Project duration: From March 2018 to October 2018

Date report submitted: 31 October 2018

1. Project objectives

With the virtual reality technology (VR), the computer assisted learning by doing has widely applied and acceptable in education, particularly to those with high-risk skill training. The VR is the promising alternative pedagogical method to develop the simulator and teach the biomedical techniques and gain the virtual hands-on experiential experiences.

The primary objective of the project is to build up innovative courseware using VR technology for handling chemicals that are harmful to health. We also aim to investigate whether the VR is helpful in instructing students with limited laboratory experience in managing radioactive chemicals, preventing unpredictable accidental issues, and supporting active and constructive educational sector.

To conclude, our team members are well experienced to plan and organize the development of the MMCD project, the project is on track to meet its objectives.

2. Process, outcomes or deliverables

In this project, we aim to create a learning simulator using VR technology called, "Virtual Radioactive Chemicals Handling **(VHand)**" with the goal to provide educational opportunities in reinforcing knowledge of biomedical techniques. Besides of the innovated simulator 'VHand', our team also set up the micro-module to facilitate the students in understanding of the knowledge in the handling of radioactive materials. The details of the contents are discussed as follows:

Deliverables	Learning Outcomes
Micro module	– This allow students to access the learning content at any time and any place outside the classroom, which increases their learning opportunities without any restriction and limitation. – It can also enhance the slow learner to have other opportunity to access the learning content.
Hands-on activity: VR technology	– Our VR courseware offers substantial benefits in biomedical science education not only by facilitating constructive learning activities but also by supporting different types of learners especially those who are visually oriented. – VHand also stimulate students to learn autonomously with the experiential experience. – In the classroom teaching, the students and teacher can effectively discuss the teaching material interactively, rather than a one-way effort.

Our project has been stuck with the timeline and our team members met the milestones in doing the task as well. Thus, the project is completed in a timely manner with satisfaction.

3. Evaluation Plan

Concerning the VR simulator 'VHand', it cannot be upload to any computer web-based platfor. Our team has determined to do the process evaluation which has been performed the survey for its output to the students' experiential learning. There were seven participants involving postgraduates, undergraduates and teaching staff who may or may not have VR simulated experiences. The 5-point Likert scales has been applied to this pilot study and the participants expressed whether they strongly disagree (1), disagree (2), neutral (3), agree (4)

or strongly agree (5) to the questionnaire statements. The summaries of key questions are documented as below:

	5-point Likert Scale				
	Strong disagree → Strong agree				
	1	2	3	4	5
The immersive VR system gives me the perceptual feeling to manipulate the virtual experiment				5	2
I can get in hands-on experience in operation of gamma irradiator by playing the immersive VR system				3	4
It is amazing by using the VR system for my learning progress				2	5
The VR system can facilitate my learning capability			3	4	0
Overall, I like to play VHand operation Game with fun				5	2

The open-ended comments for the improvement of the game features are also recorded as follows:

- Can be more sensitive to pick up things
- Easy to drop things accidentally
- The narrator's voice can be louder and clearer (subtitles sometimes?)
- More instructions can be given while loading the sample into the steel cylinder& into the machine (i.e. how should the motion/ gesture be like)
- The interface while entering commands (e.g. duration) for the gamma irradiator is a bit blunt
- Pretty limited range of motion
- Would be great if there is an overview of the rooms structure provided before playing the simulation
- Can tell more about the purpose of gamma irradiation, and give more description on the process of irradiation inside the irradiator for example how the machine works and what happens to the cells
- Subtitles- can either appear on screen (like movie subtitles) or appear near objective (to improve game flow
- Instruction/ tutorial- can teach through playing (adding a into screen to let new players familiarize the motion sensitivity of hands) or add a video to instruct players can use indicator to help guide players through the game
- Motion sensitivity counter intuitive sometimes, need instructions/ familiarization to help play game (grabbing stuff is unnatural – keys , cards, etc)

- Geiger counter demonstration could be more interactive- not just press D to play sound.
- Would be better if the narrator's voice is an actual person
- Object keep disappearing after being dropped
- Have to grab & chose objects

From the analysis of primitive data provided, our team can interpret and understand that the VHand gives the virtual experimental experience to train the handling of high-risk procedures and participants can learn with fun in the virtual lab work environment. However, there is room for the improvement of logistic game flow of VHand.

4. Dissemination, diffusion and impact

Even though the dissemination of VHand to participants is in the trial version stage, all the participants agreed/strongly agreed that it is amazing by using the VR system for their learning progress. Moreover, the impact of the VHand in the future pedagogical goals can be discussed in three-folds: (1) the innovative teaching courseware enhance study motivation via e-learning medium and equip their necessities in the future career path; (2) stimulate higher-order critical thinking by discussing clinical scenario case studies among students; (3) reinforce cognitive and foundational knowledge and clinical skills through online quizzes and case scenarios studies exercise. If the feedback is positive, our project team will further dissimulate the courseware to other tertiary institution for the practical training for the usage of radioactive related instrument.

PART II

Financial data

Funds available:

Funds awarded from MMCDG	$	100,000.00
Funds secured from other sources (please specify_____)	$	NIL
Total:	$	100,000.00

Expenditure:

Item		Amount (HK$)	Quotations / Competitive bids
Courseware Development Service			
- 3D model setup - VR development (HTC Vive System) - Leap motion universal VR developer bundle - Poster design - PowerPoint template design - Micromodules (Chromakeyings) - Other expenses, e.g. student helper for preparation of illustrations			ITSC
	Subtotal	70,000	
Hardware support, Survey and Dissemination			
- HTC Vive System and Leap motion devices - Editing, publication, outreaching & other expenses			Not applicable
	Subtotal	30,000	
	Total	100,000	

PART III

Lessons learnt from the project

In teaching the lecture of laboratory safety in the radiation sources of SBMS 2105 Techniques in Biomedical Research, high quality teaching materials and platform are limited. In addition, students may expose to unnecessary risk when handling hazardous materials. There is an urge to develop the tailor-made courseware for both teachers and students. As the VHand has been built-up, our team has launched it for students' access accordingly.

Both teachers and students has attained good experience and benefits from this propose project. On the teachers' side, VHand allows the students to interact with the 3D virtual learning environment and facilitate the students' learning process. On the students' side, our deliverables can conduct their cognitive learning more effectively as the learning materials of the project enhances, enriches and strengthens their knowledge in biomedical techniques, to prevent their exposure in hazardous situation.

PART IV

Information for public access

Starting from 2016 academic year, the School of Biomedical Science has launched a four-year full-time Bachelor Programme in Biomedical Sciences, which offers three concentrations of biomedical research, strategic management and entrepreneurship and

health services and consultation. Knowledge in techniques of biomedical research is a core introductory course of the programme.

The core knowledge of course content of the course of Techniques in Biomedical Research, students are required to learn the principal of radiation sources that are related to the radioactive chemicals; also need to know how to handle and use them in a proper way under the government ordinance, which are still adopted in the protocols of biomedical research and healthcare occupational settings. Concerning the laboratory safety, training the skills in handling of the radioactive chemicals causes difficulty as they are hazardous and harmful to health causing the potential problem with high-risks and impacts. The students may be threatened with fatal if the handling procedures are improper during the practical training. Nonetheless, the concept of "experiential learning" has become hostable to the undergraduates who must be well-trained for good laboratory practice and etiquettes.

In this project, our team has created the innovative learning simulator using virtual reality technology with leap motion device called, "Virtual Radioactive Chemicals Handling **(VHand)**" which can provide good educational opportunities in reinforcing knowledge of biomedical techniques for the experiential learning. Besides of the 'VHand', we also set up the micro-module to facilitate the students in understanding of the knowledge in the handling of radioactive materials.

1. Keywords

(Most relevant) Keyword 1: Virtual Reality Technology

Keyword 2: Biomedical Research

Keyword 3: Biohazard

Keyword 4: Laboratory Safety

(Least relevant) Keyword 5: Experiential Learning

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:** As the project is integrated into the eTips which has also been supported by MMCD grant for the teaching in Biomedical Sciences programme, the link of the website is as follows: http:137.189.27.142/etips/lab-safety.html
(b) **Webpage(s):** Not now.

(c) **Tools / Services:**

Additional tools offered by HTC Vive® immersive system and leap motion device have been incorporated for perceptional and experiential learning.

(d) **Pedagogical Uses:**

Not yet but in the 2nd term of this academic, the flipped classroom activities for the learning context of this project will be launch in the course of BMSB2105 Techniques in Biomedical Sciences.

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

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

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.

Course Code/ Target Students	**Term & Year of offering**	**Approximate No. of students**	**Platform**
BMSB2105	2nd term 2019	30	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)	*NIL*
(b) In workshop/retreat organized for CUHK teachers (e.g. CLEAR workshop, workshop organized by other CUHK units) Title for the oral and poster presentation: An Integration of Immersive Virtual Reality Technology in Teaching the Laboratory Skill for Using the Gramma Irradiator	*1*
(c) In CUHK ExPo jointly organized by CLEAR and ITSC	*NIL*
(d) In any other event held in HK (e.g. UGC symposium, talks delivered to units of other institutions)	*NIL*
(e) In international conference	*Please insert no*
(f) Others (please specify)	*Please insert no*

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	*NIL*
(b) Project leaflet	*NIL*
(c) Project booklet	*NIL*
(d) A section/chapter in a booklet/ book distributed to a limited group of audience	*NIL*
(e) Conference proceeding	*NIL*
(f) A chapter in a book accessible internationally	*NIL*
(g) A paper in a referred journal	*NIL*
(h) Others (please specify)	*NIL*

3. A one-page brief write up

The core knowledge of course content of Techniques of Biomedical Research in the Biomedical Sciences Programme, students are required to learn the principal of radiation sources that are related to the radioactive chemicals; also need to know how to handle and use them in a proper way under the government ordinance, which are still adopted in the protocols of biomedical research and healthcare occupational settings. Concerning the laboratory safety, training the skills in handling of the radioactive chemicals causes difficulty as they are hazardous and harmful to health causing the potential problem with high-risks and impacts. The students may be threatened with fatal if the handling procedures are improper during the practical training. Nonetheless, the concept of "experiential learning" has become hostable to the undergraduates who must be well-trained for good laboratory practice and etiquettes.

The primary objective of the proposed project is to build up innovative courseware using VR technology for handling chemicals that are harmful to health, entitled as VR-Handling Radioactive material (VHand). We also aim to investigate whether virtual reality (VR) technology is helpful in stimulating students with limited laboratory experience in managing radioactive chemicals, preventing unpredictable accidental issues, and supporting active and constructive educational sector.

After the data analysis from the process evaluation, the impacts of the VHand can be discussed in three-folds: (1) the innovative teaching courseware enhance study motivation via e-learning medium and equip their necessities in the future career path; (2) stimulate higher-order critical thinking by discussing clinical scenario case studies among students; (3) reinforce cognitive and foundational knowledge and clinical skills through online quizzes and case scenarios studies exercise.

The widely use of VR in the application of education is now popular as the immersive virtual three-dimensional world makes the learning process more effective and active than the traditional one. Significantly, our project team will further dissimulate the

courseware to other tertiary institution for the practical training related with the usage of radioactive materials.

The short video provided is for the exposure of the advantage of our courseware in the education.
https://gocuhk-my.sharepoint.com/personal/rayl_cuhk_edu_hk/Documents/Project/radiation/video/VHand-final-report.mp4?e=4%3a3f65136d5f5e4ebcb28d55fd65cb27ea&at=9