THE CHINESE UNIVERSITY OF HONG KONG

Micro-Module Courseware Development Grant

Scheme 1: Basic Scheme

Final Report (2015-16)

Report due 31 December 2016
Please return by email to The Ad hoc Committee on Planning of eLearning Infrastructure
mmcd@cuhk.edu.hk

PART I

Project title: Interactive Micro-Modules for Students' Self-learning in Remote Sensing
Principal supervisor: Wong Kwan Kit, Frankie
Co-supervisor(s): Nil
Department / Unit: Department of Geography and Resource Management
Project duration: From January 2016 to December 2016
Date report submitted: 31 December 2016

1. Project objectives

Four interactive micro-modules were developed for students' understanding and self-learning about the basic concepts of remote sensing. In order to help students who have a limited science background to understand the basic principles of energy interaction, four micro-modules were developed (with support from a Micro-Module Courseware Development Grant), to facilitate their learning of remote sensing. The four modules include: (i) A general introduction about the process of remote sensing; (ii) electromagnetic radiation; (iii) the interaction of energy with the atmosphere; and (iv) the interaction of energy at various features of the earth. These are all fundamental topics that are relevant to remote sensing. The contents of micro-modules are supplemented with narration, animated graphics and videos as planned. Interactive activities are designed for students to explore more on the concepts. Short quizzes are used to test students' understanding at the end of each modules. The design of the micro-modules achieved the objectives as planned.

2. Process, outcomes or deliverables

The production of individual micro-modules is divided into five stages shown in the timeline below. The first three months were used for planning and drafting, followed by the production of the micro-modules in the next six months. The implementation and evaluation was conducted in October 2016. The comments from the evaluation exercise was used to improve and fine-tune the micro-modules in November. I worked closely with the part-time

research assistant who specialized in graphic designs and completed all the stages in November 2016. The timeline has been slightly adjusted due to extra time was required in the production stage, which cause a delay for about a month (compared with the planned schedule). Because of the delay, the micro-modules were distributed to the students in mid-October. While the contents of the micro-modules were already taught in class in September, the modules were sent as supplementary information to the students as free trial during the implementation stage. As the evaluation results showed no major criticisms and problems, no major improvements were made to the modules in the improvement stage. Overall, the project was completed successfully.

2016											
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Plan and draft			Production						Implementation and Evaluation	Improvement and fine-tune	

A total of four micro-modules were produced. The title and the corresponding objectives and contents of each module are listed in the table below.

	Micro-module	Objective and Contents
1	The process of remote sensing	Provide an overview of what remote sensing is about. This acts as the foundation of the subsequent modules and the contents includes: ▪ Definition and Introduction ▪ Energy Interaction in the Atmosphere ▪ Energy Interaction with Earth Surface ▪ Platform and Sensor ▪ Data Transmission, Reception and Processing ▪ Interpretation and Analysis ▪ Applications and Products
2	Understanding The electromagnetic (EM) spectrum	Understand the energy source of which remote sensing relies on and the contents covers: ▪ Understanding our Sun ▪ Stefan-Boltzmann Law ▪ Nature of Electromagnetic Radiation ▪ The Electromagnetic Spectrum ▪ Planck's Quantum Theory

3	Energy interaction with the atmosphere	Explore how atmosphere affects EM radiation transfer and the contents include: - Understanding Our Atmosphere - Atmospheric Composition - Atmospheric Interaction - Atmospheric Scattering - Atmospheric Absorption
4	Energy interaction with the Earth's Surface	Explore how energy interacts with different features on terrestrial surface and the contents include: - Understanding Earth Energy Budget - Energy interaction with Earth Surface - Color and Spectral Reflectance - Factors Affecting Reflectance: Materials - Factors Affecting Reflectance: Surface roughness

All the modules include elements of 2D visual graphics and animation presentation, narration, interactive activities and quiz questions. The duration of each module is about 20 minutes. The modules were distributed to the students in two courses with 80 students in total. One course is a university general education course while another one is in the master taught program as shown below:

- UGEB2132A Earth as Seen From Space
- GISM5022 Digital Remote Sensing Image Analysis

3. Evaluation Plan

A simple questionnaire survey was conducted to collect feedbacks from students in both open- and close-end questions (The questionnaire is attached in *Appendix I*). The survey was conducted in November 2016 as planned after the students explore the modules and 21 replies were received. The questionnaire contains two parts. The first part focuses on students' learning experiences on the contents and the interactive activities. It tries to understand a range of learning objectives from the basic role of micro-modules as supplementary course materials to enhancing students' interests or even motivate them to learn more. All of them found the contents are easy to understand and more than 80% found the materials are interesting and the level of difficulty is appropriate. Over 95% believed the micro-modules provide materials supplement to lecture. And 86% thought the micro-modules enhance their understanding of remote sensing. More than 80% believed the interactive activities facilitated their learning and enhanced their learning experience. 71% thought that

their interest in remote sensing has been raised by the micro-modules and over 86% believed that they are motivated to learn more. And 76% would like to use the micro-modules in their future learning. The second part is about their satisfaction in different areas of the modules including length, speed, graphics and animation, narration, interactive activities and quiz questions. Among all areas, students' satisfaction ranked high in the interactive activities, quiz questions and graphics and animation. Students were also satisfied with the length, speed and narration of the micro-modules, but the percentages were comparatively lower. These were also reflected in the open-end questions. Some students thought the interactive activities raised their interests and enable them to pay more attentions to the topics. Some students complained the speed of narration is too fast and they can't control the speed while the modules were playing. But over 95% would recommend the modules to others. All the results are attached in *Appendix II*. Based on the results of the evaluation, the various objectives have been achieved.

4. Dissemination, diffusion and impact

The four modules were distributed to the students using both web links and QR codes as shown below:

Module 1: The Process of Remote Sensing
http://www.grm.cuhk.edu.hk/~kkit/elearn/m1/story.html

Module 2: Understanding the Electromagnetic (EM) Spectrum
http://www.grm.cuhk.edu.hk/~kkit/elearn/m2/story.html

Module 3: Energy Interaction with the Atmosphere
http://www.grm.cuhk.edu.hk/~kkit/elearn/m3/story.html

Module 4: Energy Interaction with Earth's Surface
http://www.grm.cuhk.edu.hk/~kkit/elearn/m3/story.html

The micro-modules can be used in desktop, laptop and mobile devices. For viewing using mobile devices, students are advised to download an app for better viewing.

For android OS, search the Google Play Store for Articulate Mobile Player, or click here to open the store directly to the app.

For Apple IOS, search the app store for Articulate Mobile Player, or click here to open the store directly to the app.

The use of developed modules are not limited to the course in our department, they can also be used in other departments or programs such as Earth System Science Program, MPhil-PhD in Earth System and GeoInformation Science. The materials can be accessed by all the units in CUHK.

PART II

Financial data

Funds available:

Funds awarded from MMCDG $ 88,248

Funds secured from other sources $ 0

(please specify_____)

                           Total: $ 88,248

Expenditure:

Item	Budget as per application	Expenditure	Balance
Hardware: MacBook Pro	22,820	21,564	1,256
Software: Articulate Storyline 2	7,828	7,746.33	81.67
Research assistant (Part-time)	57,600	60,480	(2,880)
Total:	88,248	89,790.33	(1,542.33)

PART III

Lessons learnt from the project

The feedback received will be used to enhance the current set of micro-modules and they also shed the lights on the future development of micro-modules. In the questionnaire survey, over 80% of respondents believed the interactive activities facilitated their learning and enhanced their learning experience. From this point of view, students liked the designed activities, which allow them to explore. Besides, among all aspects of the micro-modules, students' satisfaction ranked high in the interactive activities, quiz questions and graphics and animation. And in the open-end questions, some students thought the interactive activities raised their interests and enable them to pay more attentions to the topics. These all reflected that interactive learning materials are mostly preferred. Some of them even wanted to explore more topics about remote sensing in the form of micro-modules. I regarded these three aspects as the key successful components. On the other hand, the other three aspects including length, speed and the narration were ranked comparatively lower (though still have quite high satisfaction). These areas should be considered carefully in the planning stage for the future development of micro-modules.

The developed micro-modules will be incorporated into a few courses in the undergraduate and postgraduate programs through course design. The idea is to adopt pedagogies such as flipped classroom and interactive tutorials inside and outside class. Students' performance

will be assessed to evaluate the effectiveness of e-learning in teaching and learning. In addition, more micro-modules will be produced in the coming two years so as to come up with a more complete set of e-learning materials.

PART IV
Information for public access

Summary information and brief write-ups of individual projects will be uploaded to a publicly Remote sensing is a process by which data are collected and recorded usually in the form of images, either by satellite or by plane. These images are then further processed, analyzed and applied to various aspects of geography. As it is based on the principles of physics, remote sensing is regarded as a being a science subject within the field of geography. In order to help students who have a limited science background to understand the basic principles of energy interaction, four micro-modules were developed (with support from a Micro-Module Courseware Development Grant), to facilitate their learning of remote sensing. The four modules include: (i) A general introduction about the process of remote sensing; (ii) electromagnetic radiation; (iii) the interaction of energy with the atmosphere; and (iv) the interaction of energy at various features of the earth. These are all fundamental topics that are relevant to remote sensing. The designed modules provide animated and interactive learning materials supplemented with narration and daily life examples. Visual elements, including animated graphs, figures and video extracts, are used to enhance the learning experience of students. In each module, students are required to review the material carefully. In addition, for some of the content, students must explore the concept or materials through some interactive activities. The duration of all the modules is approximately 75 minutes, and at the end of each module, there is a short quiz to test the students' understanding of the materials. In the 2016-17 fall semester, the completed modules were sent to students studying remote sensing courses as supplementary self-learning materials. These courses comprised one major course, one general education course and one taught master's course. Altogether, around 80 students have experienced the modules so far. After they completed them all, the students were requested to complete a simple questionnaire, which was designed to find out about their learning experiences and their satisfaction about the micro-modules. The feedback received will be used to enhance the current set of micro-modules and they will also provide valuable information with regards to the development of future micro-modules.

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: Remote Sensing

Keyword 2: Electromagnetic radiation

Keyword 3: Atmosphere

Keyword 4: Energy interactions

(Least relevant)   Keyword 5: Earth

2. Summary

Please provide information, if any, in the following tables, <u>and provide the details in Part I</u>.

Table 1: Publicly accessible online resources (if any)
(a) **Project website:**
If a publicly accessible project website has been constructed, please provide the URL.
(b) **Webpage(s):**
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.
(c) **Tools / Services:**
If you have used any tools or services for the project, please provide names of the tools or services in here.
(d) **Pedagogical Uses:**
The four micro-modules provide detail explanations about the basic concept and theory of remote sensing. Students can learn interactively using the micro-modules to acquire fundamental knowledge about remote sensing before class. The lecture can be designed to provide in-depth discussion and more engagement with students.
(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**
UGEB2132A	1st term 2016-17	50	Website
GISM5022	1st term 2016-17	25	Website

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)	2

(b) In workshop/retreat organized for CUHK teachers (e.g. CLEAR workshop, workshop organized by other CUHK units)	0
(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)	0
(e) In international conference	0
(f) Others (please specify)	0

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	0
(b) Project leaflet	0
(c) Project booklet	0
(d) A section/chapter in a booklet/ book distributed to a limited group of audience	0
(e) Conference proceeding	0
(f) A chapter in a book accessible internationally	0
(g) A paper in a referred journal	0
(h) Others (please specify)	0

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.

Four interactive micro-modules were developed by the Department of Geography and Resource Management for students' understanding and self-learning about the basic concepts of remote sensing. The four modules explains the basic concept and process of remote sensing and covers topics including an overview of the process of remote sensing; understanding the electromagnetic radiation; energy interaction with atmosphere; energy interaction with earth features. Each module lasts for about 20 minutes. The designed modules provide animated learning materials supplemented with narration. Lots of visual elements such animated graphics, figures and video extracts were used to enhance the learning experiences of students. Students can access the materials online using desktop computer or mobile devices and can go through all the materials step by step.

There are two major characteristics of the micro-modules. First, other than watching the

materials passively, interactive activities are designed to involve students to learn actively. After explaining a theory or a concept in the modules, students are required to explore through these activities and to gain a deeper understanding. The short quiz in form of multiple choice questions in the end of each module also allows students to check with their understanding. Second, some real life examples were incorporated in the learning materials to emphasize the prevalence of the technology. Through these examples, students can visualize the abstracts from their daily life. This can raise their interests in remote sensing and they are willing to explore more.

The modules were distributed the students in two courses with 80 students in total. One is a university general education course while another one is in the master taught program. A simple questionnaire survey was conducted to ask for their experiences and satisfaction after using the micro-modules. The first part of the questionnaire is about students' learning experiences on the contents and the interactive activities about the modules. The survey tries to understand a range of learning objectives from the basic role of micro-modules as supplementary course materials to enhancing students' interests or even motivate them to learn more. 21 students sent back their comments and feedbacks. The ratio between undergraduate and postgraduate is around 7 to 3. All of them found the contents are easy to understand and more than 80% found the materials are interesting and the level of difficulty is appropriate. And 76% would like to use the micro-modules in their future learning. The second part is about students' satisfaction in different aspects of the modules. Among all aspects, students are mostly satisfied with interactive activities, quiz questions and graphics and animation. Improvements should be made on aspects including length, speed and narration in the future making of micro-modules. Overall, over 95% would recommend the modules to others.

The micro-modules act as teaching tools to facilitate the e-learning initiatives. The next step is to formulate a comprehensive teaching strategy or plan to effectively deploy the modules in teaching.

Appendix I. Questionnaire

Questionnaire Survey for Interactive Micro-Modules for Students' Self-learning in Remote Sensing
Please shade the most appropriate answer ☞   ☺ ☺ ☻ ☹ ☹   ✎

Please select the option that best matches your experience after using the micro-modules	Strongly Agree				Strongly Disagree
1. The contents of the micro-modules are easy to understand.	☺	☺	☻	☹	☹
2. The contents of micro-modules provide materials supplementary and related to lectures in the course.	☺	☺	☻	☹	☹
3. The contents of the micro-modules are interesting.	☺	☺	☻	☹	☹
4. The level of difficulty of the micro-modules is appropriate.	☺	☺	☻	☹	☹
5. The interactive activities in the micro-modules facilitate my learning.	☺	☺	☻	☹	☹
6. The interactive activities in the micro-modules enhance my learning experience.	☺	☺	☻	☹	☹
7. The micro-modules enhance my understanding of remote sensing.	☺	☺	☻	☹	☹
8. The micro-modules motivate me to learn more about remote sensing.	☺	☺	☻	☹	☹
9. The micro-modules raise my interest in remote sensing.	☺	☺	☻	☹	☹
10. I would like to use micro-modules to assist my learning in the future.	☺	☺	☻	☹	☹

Please rank your satisfaction for each of the areas about the micro-modules	Highly Satisfied				Highly Unsatisfied
11. Length	☺	☺	☻	☹	☹
12. Speed	☺	☺	☻	☹	☹
13. Graphics and animation	☺	☺	☻	☹	☹
14. Narration	☺	☺	☻	☹	☹
15. Interactive activities	☺	☺	☻	☹	☹
16. Quiz questions	☺	☺	☻	☹	☹
17. Would you recommend the micro-modules to other students?	☺ Yes				☹ No

18. What do you like most about the micro-modules?

_____

_____

19. In which area(s) do you think the micro-modules can improve?

_____

_____

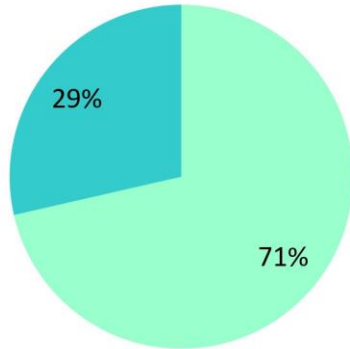### Personal information

20.	Study Programme	☐Undergraduate ☐Postgraduate
21.	Study Year	☐1 ☐2 ☐3 ☐4 ☐Others
22.	Gender	☐Male ☐Female

~End of Questionnaire ~

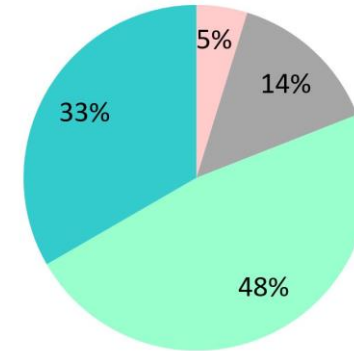## Appendix II. Results of Questionnaire

Q1. The contents of the micro-modules are easy to understand.
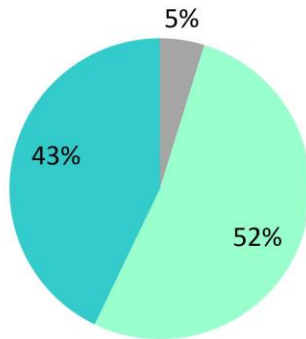
■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

29%

71%

Q3. The contents of the micro-modules are interesting.

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree
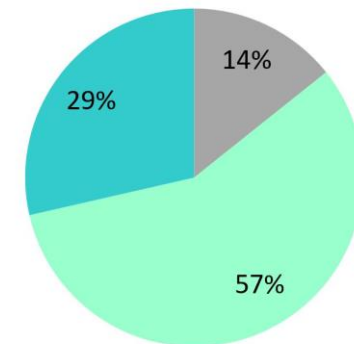
5%

14%

33%

48%

Q2. The contents of the micro-modules provide materials supplementary and related to lectures in the course

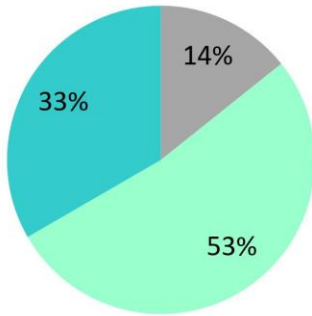■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

5%

43%

52%

Q4. The level of difficulty of the micro-modules is appropriate.

■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree
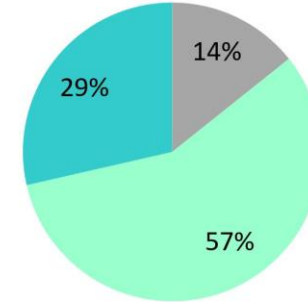
14%

29%

57%

12

Q5. The interactive activities in the micro-modules facilitate my learning.

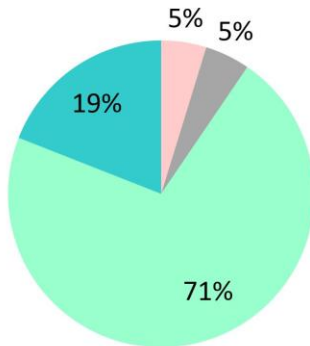■ Strongly Disagree   ■ Disagree   ■ Neutral   ■ Agree   ■ Strongly Agree

14%
33%
53%

Q7. The micro-modules enhance my understanding of remote sensing.

■ Strongly Disagree   ■ Disagree   ■ Neutral   ■ Agree   ■ Strongly Agree
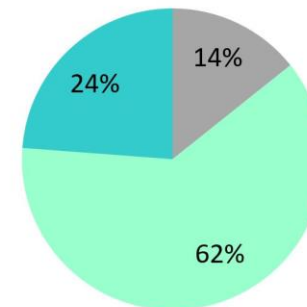

14%
29%
57%

Q6. The interactive activities in the micro-modules enhance my learning experience

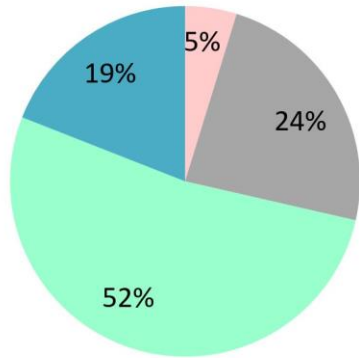■ Strongly Disagree   ■ Disagree   ■ Neutral   ■ Agree   ■ Strongly Agree

5% 5%
19%
71%

Q8. The micro-modules motivate me to learn more about remote sensing.

■ Strongly Disagree   ■ Disagree   ■ Neutral   ■ Agree   ■ Strongly Agree

14%
24%
62%

13

Q9. The micro-modules raise my interest in remote sensing.

Legend: ■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

Pie chart values: 5%, 24%, 52%, 19%

Q11. Length

Legend: ■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied
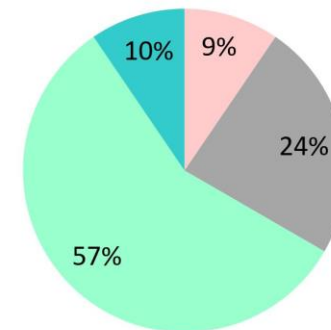
Pie chart values: 14%, 33%, 53%

Q10. I would like to use micro-modules to assist my learning in the future.

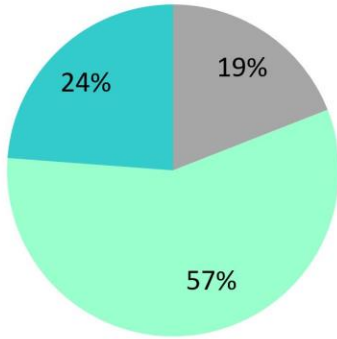Legend: ■ Strongly Disagree ■ Disagree ■ Neutral ■ Agree ■ Strongly Agree

Pie chart values: 5%, 19%, 52%, 24%

Q12. Speed

Legend: ■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied

Pie chart values: 10%, 9%, 24%, 57%
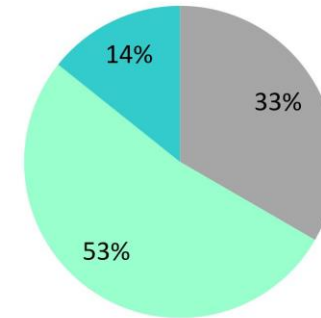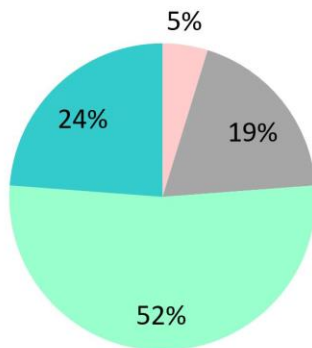
Q13. Graphics and Animation

■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied

19%
24%
57%

Q15. Interactive Activities

■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied

14%
29%
57%
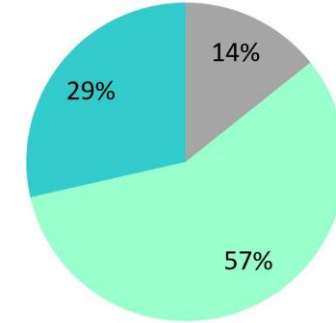
Q14. Narration

■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied

33%
14%
48%
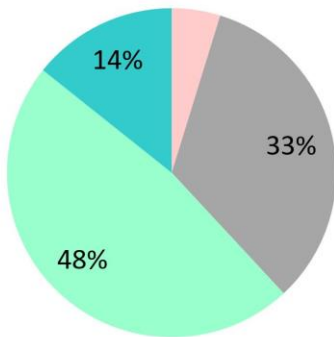
Q16. Quiz Questions

■ Highly unsatisfied ■ Unsatisfied ■ Neutral ■ Satisfied ■ Highly satisfied

14%
24%
62%
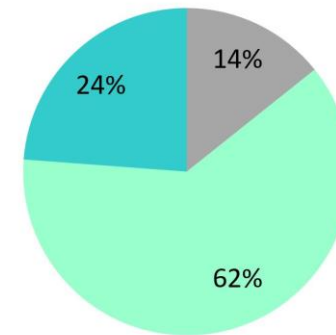
Q17. Would you recomment the micro-modules to other students?

■ Yes ■ No

5%

95%
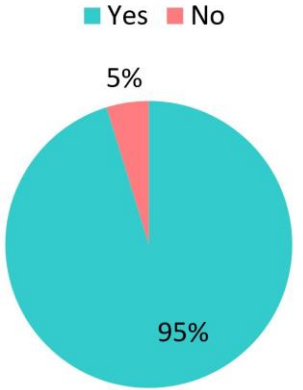
Study Programme

■ Postgraduate ■ Undergraduate

29%

71%