THE CHINESE UNIVERSITY OF HONG KONG

Micro-Module Courseware Development Grant

Final Report (August 2015)

Report due 31 August 2015.
Please return by email to The Ad hoc Committee on Planning of eLearning Infrastructure
mmcd@cuhk.edu.hk

PART I

Project title: SEEM2460 Introduction to Data Science
Principal supervisor: Prof. Helen Meng
Co-supervisor(s): N/A
Department / Unit: Department of Systems Engineering and Engineering Management
Project duration: From January 2015 to August 2015
Date report submitted: 31 August 2015

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 project is on track to meet its objectives. We have produced a series of micro-modules to support the teaching of the captioned course, which has been newly designed as a course in the Faculty of Engineering Science Package and was offered for the first time in Term 2, 2014-2015.

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.
Have the nature of the deliverables been changed?
Have you adjusted your timeline?
Overall, was the project completed satisfactorily?

We have produced 25 micro-modules from all 13 lectures. Each lecture has at least a micro-module. 23 of them were edited out from video footages recorded during the lectures. Another 2 were produced by Office Mix, a free add-in for PowerPoint. The 25 micro-modules are listed in the following table and are available from the following webpage hosted by the Department of Systems Engineering and Engineering Management with the access right restricted to CUHK network:

http://course.se.cuhk.edu.hk/SEEM2460-1415-T2

MM#	Length (mm:ss)	Micro-module Title, by Presenter
		Lecture 1: Introduction
1	09:46	**Why is Data Science Important?** by Professor Helen Meng
		Lecture 2: Statistics
2	16:00	**Statistical Inference - Probability Distribution**, by Professor Xuefeng Gao
		Lecture 3: Data Visualization
3	16:29	**Data Visualization**, by Professor Helen Meng
		Lecture 4: Large Data Processing
4	19:13	**Query Language and Query Processing**, by Professor Jeffrey Yu
		Lecture 5: Machine Learning
5	22:53	**Introduction to Linear Programming**, by Professor Anthony So
		Lecture 6: Optimization
6	11:59	**Bisection Method**, by Professor Shiqian Ma
		Lecture 7: Data Mining
7	08:33	**Decision Tree Induction**, by Professor Hong Cheng
		Lecture 8: Pattern Recognition
8	08:32	**Overview of Clustering**, by Professor Wai Lam
		Lecture 9: Case Study – Social Network Analysis
9	15:17	**Properties of Social Networks**, by Professor Hong Cheng
10	15:16	**Community Detection**, by Professor Hong Cheng
		Lecture 10: Case Study – Operations Management
11	12:59	**Newsvendor Problem**, by Professor Xiting Gong
12	06:05	**Control Charts**, by Professor Xiting Gong
		Lecture 11: Case Study – Health Care
13	09:26	**What-if Analysis**, by Professor Daniel Long
14	16:09	**The 2003 SARS Epidemic**, by Dr. Dorbin Ng
15	17:06	**SARS Outbreak Control Effort & Possible Roles of Data Science**, by Dr. Dorbin Ng
16	06:22	**Pilot Study of People & Equipment Tracking in Hospital Wards**, by Dr. Dorbin Ng
17	08:17	**Tracking Data & Their Spatio-temporal Characteristics**, by Dr. Dorbin Ng
18	10:24	**Visualizing Tracking Data**, by Dr. Dorbin Ng
19	14:52	**Computing Contact Tracing Data from Tracking Data**, by Dr. Dorbin Ng
		Lecture 12: Case Study – Transportation
20	09:40	**Finding a Shortest Path in a Network**, by Professor Janny Leung
		Lecture 13: Case Study – Finance
21	19:01	**Mean-Variance Analysis**, by Professor Lingfei Li
22	17:24	**Sensitivity Analysis**, by Professor Lingfei Li
23	04:02	**Introduction to Financial Engineering**, by Professor Qi Wu
24	05:45	**Practices of Quantitative Finance**, by Professor Qi Wu
25	15:51	**Quantitative Investment - Pairs Trading**, by Professor Qi Wu

Students of SEEM2460 Introduction to Data Science can use the micro-modules for reviewing the course content. The nature of the deliverables has been unchanged. In addition,

the process of making the deliverables progressed according to the timeline set out at the beginning. Overall, the project was completed 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?

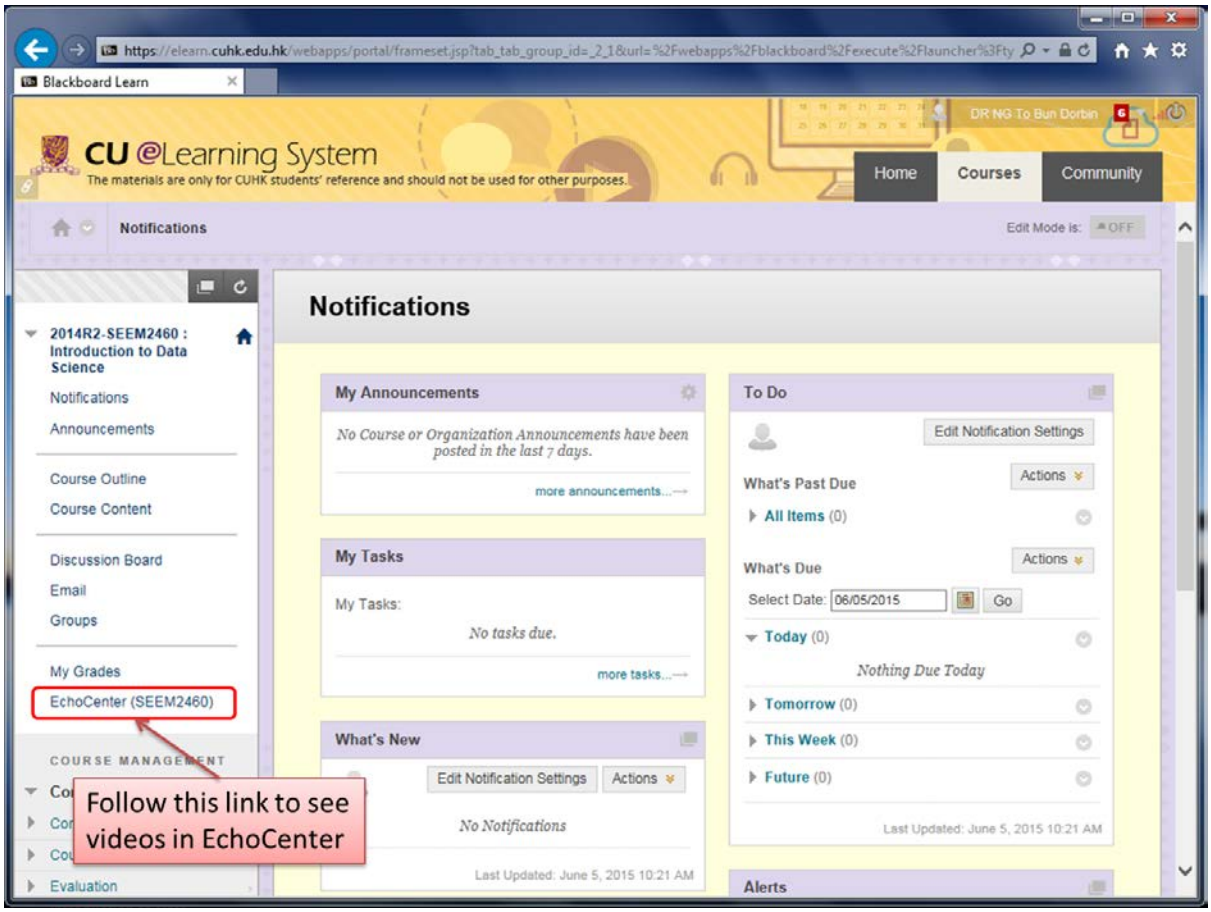
The evaluation plan, which is using the number of micro-modules that are produced by a number of different colleagues to indicate the adoption level, has not been altered. As the outcome, we have produced 25 micro-modules from all 13 lectures, which form a comprehensive list to cover some of the key concepts taught in the course. The Project Supervisors has arranged for group meetings where faculty members have shared their experiences and lessons learned in making micro-modules.

4. Dissemination, diffusion and impact

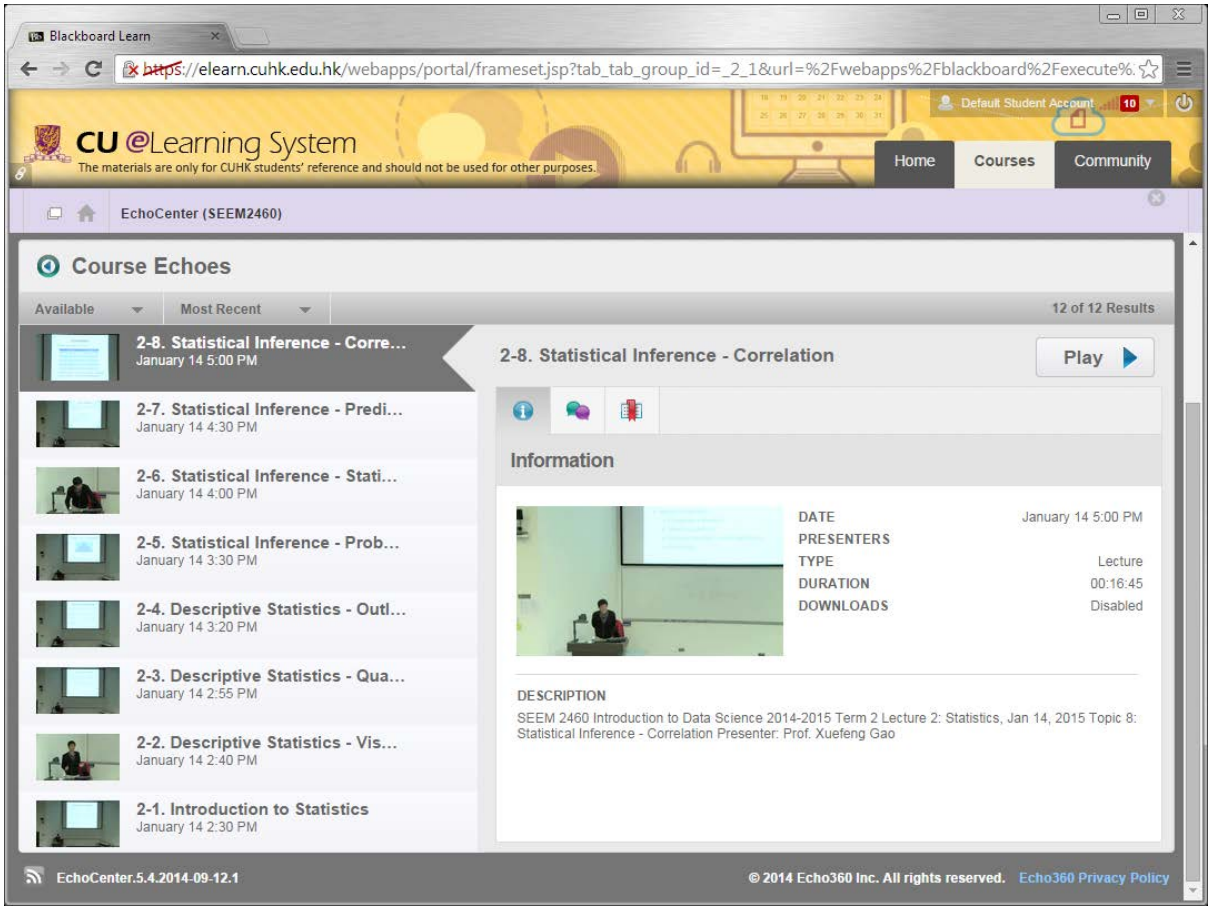
Please provide examples of dissemination: website, presentations in workshops or conferences, or publications.
Please provide examples of diffusion: how the project results/process/outcomes/deliverables being used in your unit and other parts of CUHK or other institutions?
Please provide examples of impact: how the project results (micro modules) can be adapted to other disciplines.

Dissemination

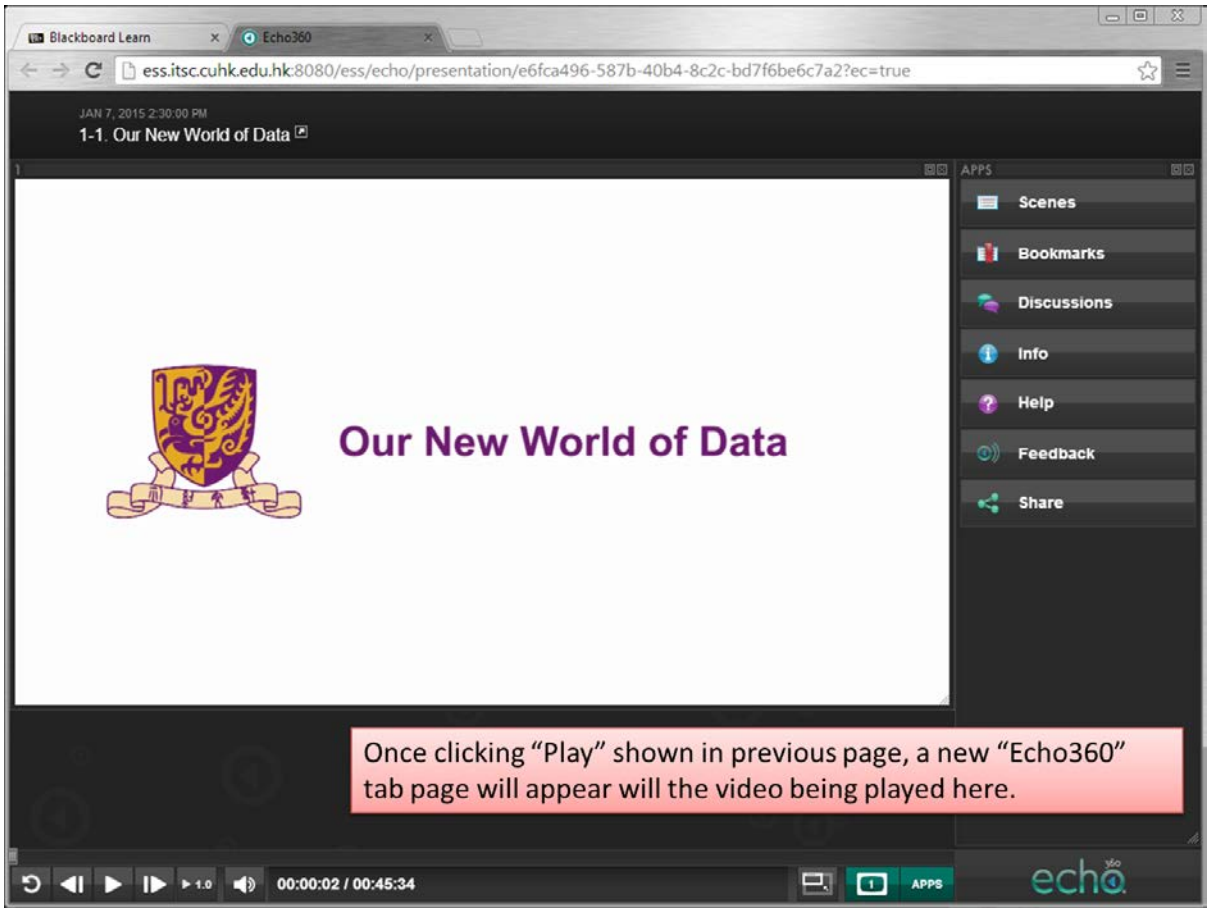
The micro-modules have been uploaded to and disseminated through the course's EchoCenter under CUHK Elearn system. The following three figures illustrate the access to EchoCenter via SEEM2460 Elearn site, the listing of available videos (micro-modules) in EchoCenter, and the viewing of a chosen video.



EchoCenter under SEEM2460 Elearn site



List of videos available under EchoCenter



Playing a video (micro-module) in EchoCenter

Diffusion

The process of making micro-modules has been diffused among colleagues in the Department of Systems Engineering and Engineering Management. The experience and knowledge of making micro-modules have been shared and discussed in departmental meetings and in work groups.

The micro-modules can not only be used in the teaching of SEEM2460, they can also be used in teaching other, related subjects. Please refer to the description of the micro-module "Decision Tree Induction" below as an example.

The micro-module gives a fundamental introduction to decision tree induction, which is a very important topic in classification. This micro-module can let students get an initial idea of the topic before attending class, and help the instructor to teach the topic by giving in-depth technical details and leading interactive discussions. It is also useful for students to review the material after class. This micro-module can also be used for the E-learning practice in a related course SEEM4630 E-Commerce Data Mining.

Impact

In preparing micro-modules, instructors structured the material in a way that promotes students' critical thinking on the subject and leads them to further exploration of the topic. These are achieved by relating the material to what they have learned in the past, asking questions that lead them to think deeper on the technical issues at hand, and explaining how the techniques can be used to solve a host of practical engineering problems. The micro-modules help students review the material and catch important points that they may have missed during the lecture.

The micro-modules provide a more effective way in teaching and learning. A micro-module provides a short video on a focused topic. Whenever students want to study a particular topic, they can watch the micro-module, which is an efficient means of delivery.

We find that micro-modules are very useful for both students and instructors. From the students' perspective, they can watch the micro-modules as many times as they need to completely understand the key concepts and skills taught in the micro-modules. From our (the instructors') perspective, we watched our own teaching as audiences and found some drawbacks of our teaching, which we can improve in the future. Junior colleagues can also invite some senior colleagues to review their micro-modules and help them make improvement. In the future, we plan to encourage students to watch these micro-modules before they attend lectures. In this way, we can teach the content covered by the micro-modules more effectively and allocate more time for discussion.

PART II

Financial data

Funds available:

Funds awarded from MMCDG	$	94,000.00
Funds secured from other sources (please specify_____)	$	-
Total:	$	94,000.00

Expenditure:

Item	Budget as per application	Expenditure	Balance
Other Expenses	94,000.00	-	94,000.00
Stationery	-	2,608.00	-2,608.00
Express Charge	-	22.00	-22.00
Service Charge	-	52,000.00	-52,000.00
Total:	94,000.00	54,630.00	39,370.00

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?*

The experience of making micro-modules we gained through this project can facilitate progression to the next stage of utilizing micro-modules for e-learning. Different combinations of micro-modules can be tailored to provide a context-rich teaching material on a specific topic or subject area.

A key success factor of the project is to create a collaborative environment for colleagues to explore and share experience of making micro-modules together. The collective effort in the Department of Systems Engineering and Engineering Management on planning and making micro-modules has helped the colleagues understand the concept of using micro-modules for learning and easily find the means to produce and share micro-modules.

Originally, the CUHK Audio Visual Services Unit (AVSU) was considered as a candidate for

providing video recording and editing services. However, after discussion with AVSU, its current capacity is not ideal for providing regular weekly services to serve the objectives set out in the project. Therefore, we have relied on an external media production service.

It is worth noticing that it would be helpful to have a designated TA or staff to work with staff from the media service. This will help maintain the video recording consistency by providing setup information to different staff coming to lecture hall for doing media recording.

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.

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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: Data science

Keyword 2: Statistics

Keyword 3: Data visualization

Keyword 4: Large data processing

(Least relevant) Keyword 5: Data mining and Machine 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:** *If a publicly accessible project website has been constructed, please provide the URL.* CUHK eLearning site for SEEM 2460 Introduction to Data Science and its associated EchoCenter for storing the micro-modules
(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) in here.* The 25 micro-modules are available from the following webpage hosted by the Department of Systems Engineering and Engineering Management: http://course.se.cuhk.edu.hk/SEEM2460-1415-T2 Note that the current access is restricted to CUHK network.
(c) **Others (please specify):**

Table 2: Resource accessible to a target group of students (if any)			
If resources (eg. software) have been developed for a target group of students (eg. in a course, in a department) to gain access through specific platforms (eg. Blackboard, facebook), please specify.			
Course Code/ Target Students	**Term & Year of offering**	**Approximate No. of students**	**Platform**
SEEM 2460 Introduction to Data Science	*2nd term 2014-2015*	*30*	*Blackboard + EchoCenter*

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 (eg. department, faculty)	*2*
(b) In workshop/retreat organized for CUHK teachers (eg. CLEAR workshop, workshop organized by other CUHK units)	*0*
(c) In CUHK ExPo jointly organized by CLEAR and ITSC	*0*
(d) In any other event held in HK (eg. 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 publications 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 an 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 or a short video (~2 minutes) (preferred).

With the support of the Micro-Module Courseware Development Grant, we have produced 25 micro-modules to support the teaching of SEEM2460 Introduction to Data Science in Term 2, 2014-15 and its future offering. The micro-modules cover some of the key concepts in the course. Through the project, we have gained experience in making micro-modules and using them for e-learning.

In preparing micro-modules, instructors structured the material in a way that promotes students' critical thinking on the subject and leads them to further exploration of the topic. These are achieved by relating the material to what they have learned in the past, asking

questions that lead them to think deeper on the technical issues at hand, and explaining how the techniques can be used to solve a host of practical engineering problems. The micro-modules help students review the material and catch important points that they may have missed during the lecture.

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A key success factor of the project is to create a collaborative environment for colleagues to explore and share experience of making micro-modules together. The collective effort in the Department of Systems Engineering and Engineering Management on planning and making micro-modules has helped the colleagues understand the concept of using micro-modules for learning and to develop a workflow in producing and sharing. This collective experience that we gained through this project can facilitate our progression the next stage of incorporating more micro-modules in our future course offerings and increase the utilization of micro-modules for e-learning.