

**THE CHINESE UNIVERSITY OF HONG KONG**

**Micro-Module Courseware Development Grant**

**Scheme 2: Studies in Foundation Courses**

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

**PART I**

Project title: Consolidation of pre-calculus knowledge with micro-modules

Principal supervisor: Dr. Chan Kai Leung

Co-supervisor(s): N.A.

Department / Unit: Mathematics

Project duration: From January 2016 to December 2016

Date report submitted: 30 Dec, 2016

**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?*

First year calculus courses are required by a large number of science, engineering and business students. Nevertheless, because of the various background of students and the “3+3+4” curriculum reform, it was found that students usually do not equip with sufficient pre-calculus knowledge to study first year calculus courses. This project serves as bridging self-learning material and it aims at conducting and consolidating the pre-calculus knowledge of students via the e-learning environment. This objective remains unchanged during the development of the project.

**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.*

*Has the nature of the deliverables been changed?*

*Have you adjusted your timeline?*

*Overall, was the project completed satisfactorily?*

In total, six micro modules were developed as planned. Each module corresponds to a pre-calculus topic which is a collection of web based materials.

We design the modules by adopting the diagnostic assessment approach. Each of them starts with an entry test, then relevant contents will be recommended to students according to their results so that they can catch up the missing parts in a short time. Geogebra (Mathematics teaching software) materials, intermediate knowledge checking questions and YouTube video clips are designed to provide a step-by-step and interactive guidance for students. Furthermore, students may check their knowledge after finishing the whole module by a revision exercise. Due to technical issues, especially in displaying mathematics symbols and equations, those modules were integrated as a website but not uploaded to Blackboard as planned.

Overall, the project is completed smoothly. In order to implement the micro modules in the project supervisor's courses as a prior scheme, they are finished before the 1<sup>st</sup> semester 2015/16, which is a bit ahead of schedule. Those modules are mainly used by students in MATH1010H (University Mathematics, 43 students) and MATH1510D (Calculus for Engineers, 49 students). The materials are also shared to lecturers in other sessions and lecturers in MATH1520 (University Mathematics for Applications).

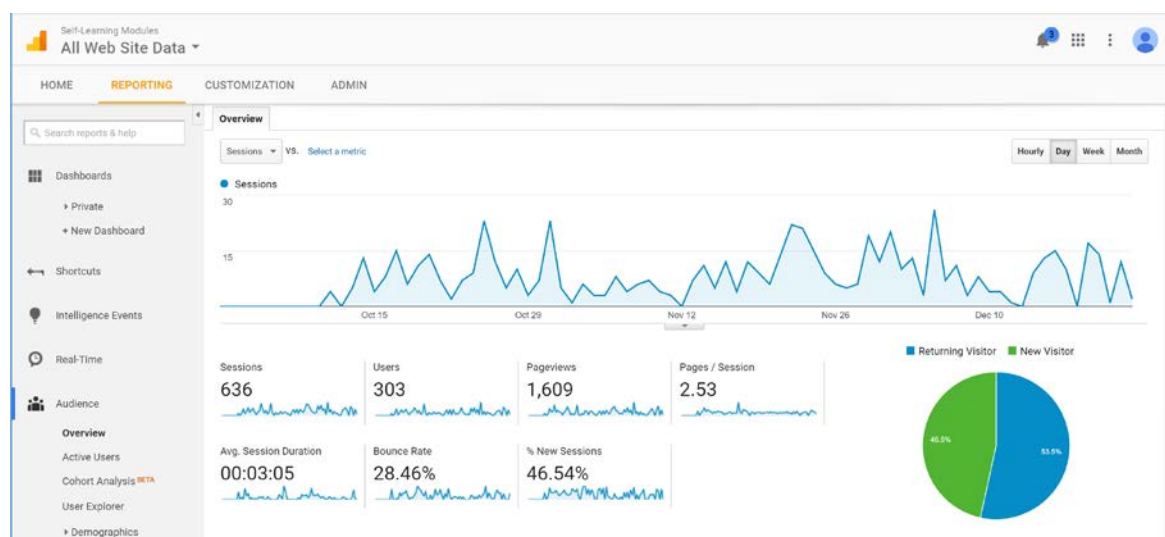
### 3. Evaluation Plan

*Have you altered your evaluation plans?*

*What monitoring data did you collect?*

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

As the micro modules are no longer uploaded to the Blackboard, we use Google Analytics provided by Google to perform statistics on users. Google Analytics was implemented since October 2016, and it shows there has been 303 users (including 53.5% returning users) and 1609 pageviews (up to 24 Dec, 16).



Google Analytics also recorded the number of viewed of each page and it shows that the most interested content to students are “Trigonometric Identities”, “Partial Fractions”, “Trigonometric Functions for a General Angle”, “Inverse Trigonometric Functions” and “Proof of Binomial Theorem”. From our experience, those are exactly contents that students

are not so familiarized.

A survey was also conducted through the Blackboard to collect students' opinions on the project. From the replied students (24 out of 92), half of them finish 3 to 5 modules, 75% students consider entry test of each module is helpful to diagnose their problems. Most of them consider the module "Trigonometry", "Polynomial and Rational Functions" and "Binomial Theorem" are most useful modules, which matches the statistics of pageviews from Google Analytics.

Beyond the original plan, we also tried to implement Facebook Comments Plugins and let students to leave comments on the micro modules. However, it seems that students hesitate to do so for keeping their Facebook accounts private, so there were only few comments which may not be a successful way to collect opinions from students.

#### 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.*

Since contents developed in this project are common foundations for several service courses on calculus, such as MATH1010 (University Mathematics), MATH1510 (Calculus for Engineers) and MATH1520 (University Mathematics for Applications) which intake approximately 1,000 students each year. In a long run, well-established materials can be shared among those courses to lower the teaching burden of colleagues in the department. If this model of self-learning is successful, it can be further extended to other service courses as well.

#### PART II

##### Financial data

Funds available:

Funds awarded from MMCDG	\$ 35,000
Funds secured from other sources (please specify _____)	\$ 0
Total:	\$ 35,000

Expenditure:

Item	Budget as per application	Expenditure	Balance
------	---------------------------	-------------	---------

Tablet computer		\$21,356	(\$21,356)
Hiring student assistant		\$12,100	(\$12,100)
Total:		\$33,456	\$1,544

### 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?*

Further improvement and enrichment of the modules will be carried out according to the experience of actual implementation and students' feedback. They can also be implemented in the course MATH1010J/K in second semester to collect more data. Moreover, adding more micro modules on other pre-calculus topics may also be considered. To have a better stimulation of using the modules, further modifications of the contents will be made so that students would understand better the connection between the micro modules and the calculus courses they are taking, and how they can apply calculus knowledge to their own areas of studies.

From our observation, when it is announced that knowledge of a particular module will be used in the lecture, there is a sudden boost of the number of users. We learned that tight integration of e-learning materials and teaching in lectures is essential, otherwise stand-alone self-learning e-materials may not attract students.

Another observation is that students may be quite assessment oriented. For those contents which are not assessed or not directly relevant, the number of pageviews are significantly lower than those are assessed. How e-learning can motivate students to study before the syllabus should be one of the possible direction to be explored.

### 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: Pre-calculus  
                                  Keyword 2: Diagnostic assessment  
                                  Keyword 3: Bridging material  
                                  Keyword 4: Self-learning  
 (Least relevant)      Keyword 5: Geogebra

## 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="http://www.math.cuhk.edu.hk/~klchan/learn.html">http://www.math.cuhk.edu.hk/~klchan/learn.html</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) here.</i></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>Google Analytics, Geogebra, Youtube, Facebook Comments Plugins</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><b>(c) Others (please specify):</b></p>

<b>Table 2: Resources accessible to a target group of students (if any)</b>
---

*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.*

<u>Course Code/ Target Students</u>	<u>Term &amp; Year of offering</u>	<u>Approximate No. of students</u>	<u>Platform</u>
MATH1010	Year 1 students	450	Website
MATH1510	Year 1 students	500	Website
MATH1520	Year 1 students	100	Website

**Table 3: Presentation (if any)**

<i>Please classify each of the (oral/poster) presentations into one and only one of the following categories</i>	<b>Number</b>
(a) In workshop/retreat within your unit (e.g. department, faculty)	<i>Please insert no</i>
(b) In workshop/retreat organized for CUHK teachers (e.g. CLEAR workshop, workshop organized by other CUHK units)	<i>Please insert no</i>
(c) In CUHK ExPo jointly organized by CLEAR and ITSC	<i>Please insert no</i>
(d) In any other event held in HK (e.g. UGC symposium, talks delivered to units of other institutions)	<i>Please insert no</i>
(e) In international conference	<i>Please insert no</i>
(f) Others (please specify)	<i>Please insert no</i>

**Table 4: Publication (if any)**

<i>Please classify each piece of publication into one and only one of the following categories</i>	<b>Number</b>
(a) Project CD/DVD	<i>Please insert no</i>
(b) Project leaflet	<i>Please insert no</i>
(c) Project booklet	<i>Please insert no</i>
(d) A section/chapter in a booklet/ book distributed to a limited group of audience	<i>Please insert no</i>
(e) Conference proceeding	<i>Please insert no</i>
(f) A chapter in a book accessible internationally	<i>Please insert no</i>
(g) A paper in a referred journal	<i>Please insert no</i>
(h) Others (please specify)	<i>Please insert no</i>

### **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.*

First year calculus courses are required by a large number of science, engineering and business students. Nevertheless, because of the various background of students and the “3+3+4” curriculum reform, it was found that students usually do not equip with sufficient pre-calculus knowledge to study first year calculus courses. This project serves as bridging self-learning material and it aims at conducting and consolidating the pre-calculus knowledge of students via the e-learning environment.

In this project, six micro modules were developed as a collection of web-based materials, namely Sets and Logic, Functions, Trigonometry, Mathematical Induction, Binomial Theorem, Polynomial and Rational Functions, where each of them is a pre-calculus topic.

We design the modules by adopting the diagnostic assessment approach. Each of them starts with an entry test, then relevant contents will be recommended to students according to their results so that they can catch up the missing parts in a short time.

Thanks to the technology, we are able to provide a more interactive learning environment. Geogebra (Mathematics teaching software) materials enable students to perform “mathematical experiments” in a more dynamical way; intermediate knowledge checking questions and YouTube video clips provide a step-by-step guidance which enables students to study according to their individual progress and needs.

Furthermore, students may check their knowledge after finishing the whole module by a revision exercise. Borrowing the idea of flipping classroom, when relevant contents in a micro module will be covered along the progress of the course, announcement is made by the lecturer in advance. Students will have to study by themselves. Problem sets will be given as an assessment and their questions will be followed up in tutorials.

As a prior scheme, the micro modules were implemented in two classes of the project supervisor in the first semester 2015/16. From the primary statistics and comments from students, the micro modules were able to enhance their pre-calculus knowledge. Students also reflected that the micro modules help them to pick up the concepts of trigonometric identities, partial fractions, binomial theorem.

As a matter of fact, contents developed in this project are common foundations for several services courses on calculus which intake a large number of students. Further improvement and enrichment of the contents will be carried out according to the experience of actual implementation and students’ feedback. In a long run, well-established materials can be shared among those courses to lower the teaching burden of colleagues in the department. If this model of self-learning is successful, it can be further extended to other service courses as well.