Using VisMOOC as a Learning Analytics Tool for MOOCs

T.C. Pong
Senior Advisor to the Executive Vice-President & Provost
Director of Center for Engineering Education Innovation
Professor of Computer Science & Engineering
Hong Kong University of Science & Technology

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Outline

• Overview on recent trends and development in education
• HKUST’s experience in MOOC and blended learning
• Learning Analytics for MOOC and blended courses using VisMOOC
• Concluding remarks
Trends and Convergence

**Pedagogy**
- Greater understanding of learning and learners
- Focus on outcomes and mastery
- Emphasis on active and collaborative learning

**Technology**
- Internet and Web Technologies
- Big Data and Knowledge Mining
- Argument and Virtual Reality tools

**Blended Learning Style Teaching**
- Traditional Lecture Teaching
- Flipped Classroom Teaching
- MOOCs
Criticism of Lecture Style Teaching

The criticisms of lecture style teaching can be summarized by a quote attributed to Mark Twain:

- College is a place where a professor’s lecture notes go straight to the student’s lecture notes, without passing through the brains of either.

- How to make teaching and learning more effective?

- Chinese proverb (Xun Zi 荀子):
  Tell me and I will forget (闻之不若见之),
  Show me and I will remember (见之不若知之),
  Involve me and I will understand (知之不若行之).
Active Learning

A massive open online course (MOOC) is a type of online course aimed at large-scale participation and open access via the Internet.

- In addition to online video lectures, learners are involved actively in the learning process.
- MOOCs go beyond just offering courses and content. Learning analytics allow us to understand how students learn and how teachers can improve their teaching.
VisMOOC Demo

http://vis.cse.ust.hk/vismooc/

In the USA Students from the Top Half of the Income Pool Comprise 80 to 85 Percent of the Elite University Student Population
MOOC Platforms

Major MOOC platforms:
– Coursera and edX in the US
– FutureLearn in the UK
– France Université Numérique (France Digital University) in France
– Iversity in Germany
– Open2Study in Australia
– XuetangX & CNMOOC in China
– JMOOC in Japan
– KMOOC in Korea
– HKMOOC in Hong Kong
HKUST’s MOOC Experience

HKUST joined Coursera in 2012 as one of the first partners from Asia.
HKUST's MOOC Experience

HKUST joined edX in 2013 as one of the first partners from Asia.
Massive Open Online Program (MOOP)

Specializations
Master a skill with a targeted sequence of courses

Data Science
Johns Hopkins University

Entrepreneurship: Launching an Innovative Business
University of Maryland, College Park

Digital Marketing
University of Illinois at Urbana-Champaign

Data Mining
University of Illinois at Urbana-Champaign
Coursera issued Request for Proposals (RFPs) in topics of high demand among learners:

- Software Development with Google
- Full Stack Web Development
- Professional Sales
- Product Management
- Social Media Marketing
- People Management
- Business Strategy
- Data for Managers
- Introduction to Analytics (Business Analytics)
- Data Analysis Fundamentals
- Video Game Design
- iOS Application Development and Design
HKUST’s MOOC Experience

Around 1,000,000 learners have registered for 24 MOOCs offered by HKUST

The Hong Kong University of Science and Technology

HKUST - A dynamic, international research university, in relentless pursuit of excellence, leading the advance of science and technology, and educating the new generation of front-runners for Asia and the world.
Massive Open Online Degree (MOOD)

The Story
The Georgia Institute of Technology, Udacity and AT&T have teamed up to offer the first accredited Master of Science in Computer Science that students can earn exclusively through the Massive Open Online Course (MOOC) delivery format and for a fraction of the cost of

The Buzz
- Presidential Double-Down: Obama Praises OMS CS for 2nd Time - Georgia Tech College of Computing
- Ga Tech's MOOC Master's Degree Program Off to Solid Start - WABE Atlanta
MIT proudly announces two new programs that offer learners around the world new ways to learn with MIT. Supply Chain professionals who seek a residential program can still apply to MIT’s 1-year masters degree in SCM. In addition, the same program and the SCM degree are now available through a new additional path: half online, half on campus.
Blended Learning and MOOC at HKUST: Introduction to Computing with Java

• Offered as a flipped course in Spring 2014
  – The course is divided into two sections of 45 and 65 students.
  – Students watch online lecture videos and participate in online quizzes before class.
  – Classes start with Q&A and then redo some of the online quizzes.
  – Students then participate in group discussions and activities.
Classroom for Active Learning
Total number of videos = 44
Average video hit counts per student per video

<table>
<thead>
<tr>
<th>Student groups</th>
<th>No. of students</th>
<th>Total views</th>
<th>Average views</th>
</tr>
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<tbody>
<tr>
<td>Midterm score &gt;= 90</td>
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<td>Midterm score &gt;= 80</td>
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<td>15</td>
<td>607</td>
<td>0.92</td>
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### Student Performance vs Video Views

Total number of videos = 44  
Average video hit counts per student per video

<table>
<thead>
<tr>
<th>Student groups</th>
<th>No. of students</th>
<th>Total views</th>
<th>Average views</th>
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</thead>
<tbody>
<tr>
<td>Final score &gt;= 90</td>
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<tr>
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<tr>
<td>Final score &gt;= 50</td>
<td>82</td>
<td>4231</td>
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<tr>
<td>Final score &lt; 50</td>
<td>25</td>
<td>1138</td>
<td>1.03</td>
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## Comparing Online and In-class Activities

<table>
<thead>
<tr>
<th></th>
<th>Correct (L1)</th>
<th>Correct (L2)</th>
<th>Correct (Overall)</th>
<th>L1-L2 (Online)</th>
<th>PRS Correct (L1)</th>
<th>PRS Correct (L2)</th>
<th>PRS Correct (Overall)</th>
<th>L1-L2/PRS</th>
<th>Improvement (L1)</th>
<th>Improvement (L2)</th>
<th>Improvement (Overall)</th>
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<tbody>
<tr>
<td>Online Quiz</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Online 3-1</td>
<td>36.2%</td>
<td>38.7%</td>
<td>37.6%</td>
<td>-2.5%</td>
<td>PRS 3-1</td>
<td>55.3%</td>
<td>54.8%</td>
<td>55.0%</td>
<td>0.5%</td>
<td>19.1%</td>
<td>16.1%</td>
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<tr>
<td>Online 3-2</td>
<td>63.8%</td>
<td>61.3%</td>
<td>62.4%</td>
<td>2.5%</td>
<td>PRS 3-2</td>
<td>83.0%</td>
<td>75.8%</td>
<td>78.9%</td>
<td>7.2%</td>
<td>19.1%</td>
<td>14.5%</td>
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<tr>
<td>Online 5-1</td>
<td>40.4%</td>
<td>43.5%</td>
<td>42.2%</td>
<td>-3.1%</td>
<td>PRS 5-1</td>
<td>61.7%</td>
<td>53.2%</td>
<td>56.9%</td>
<td>8.5%</td>
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<td>9.7%</td>
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<tr>
<td>Online 5-2</td>
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<td>90.3%</td>
<td>89.9%</td>
<td>-1.0%</td>
<td>PRS 5-2</td>
<td>89.4%</td>
<td>87.1%</td>
<td>88.1%</td>
<td>2.3%</td>
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<tr>
<td>Online 5-3</td>
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<td>87.1%</td>
<td>86.2%</td>
<td>-2.0%</td>
<td>PRS 5-3</td>
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<td>83.9%</td>
<td>88.1%</td>
<td>9.7%</td>
<td>8.5%</td>
<td>-3.2%</td>
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<tr>
<td>Online 6-1</td>
<td>78.7%</td>
<td>66.1%</td>
<td>71.6%</td>
<td>12.6%</td>
<td>PRS 6-1</td>
<td>85.1%</td>
<td>74.2%</td>
<td>78.9%</td>
<td>10.9%</td>
<td>6.4%</td>
<td>8.1%</td>
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<tr>
<td>Online 6-2</td>
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<td>67.7%</td>
<td>67.0%</td>
<td>-1.8%</td>
<td>PRS 6-2</td>
<td>76.6%</td>
<td>69.4%</td>
<td>72.5%</td>
<td>7.2%</td>
<td>10.6%</td>
<td>1.6%</td>
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<tr>
<td>Online 6-3</td>
<td>74.5%</td>
<td>58.1%</td>
<td>65.1%</td>
<td>16.4%</td>
<td>PRS 6-3</td>
<td>74.5%</td>
<td>72.6%</td>
<td>73.4%</td>
<td>1.9%</td>
<td>0.0%</td>
<td>14.5%</td>
</tr>
<tr>
<td>Online 8-1</td>
<td>83.0%</td>
<td>74.2%</td>
<td>78.0%</td>
<td>8.8%</td>
<td>PRS 8-1</td>
<td>89.4%</td>
<td>75.8%</td>
<td>81.7%</td>
<td>13.6%</td>
<td>6.4%</td>
<td>1.6%</td>
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<tr>
<td>Online 8-2</td>
<td>76.6%</td>
<td>79.0%</td>
<td>78.0%</td>
<td>-2.4%</td>
<td>PRS 8-2</td>
<td>80.9%</td>
<td>69.4%</td>
<td>74.3%</td>
<td>11.5%</td>
<td>4.3%</td>
<td>-9.7%</td>
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<tr>
<td>Online 9-1</td>
<td>46.8%</td>
<td>54.8%</td>
<td>51.4%</td>
<td>-8.0%</td>
<td>PRS 9-1</td>
<td>80.9%</td>
<td>67.7%</td>
<td>73.4%</td>
<td>13.1%</td>
<td>34.0%</td>
<td>12.9%</td>
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<tr>
<td>Online 9-2</td>
<td>48.9%</td>
<td>56.5%</td>
<td>53.2%</td>
<td>-7.5%</td>
<td>PRS 9-2</td>
<td>80.9%</td>
<td>61.3%</td>
<td>69.7%</td>
<td>19.6%</td>
<td>31.9%</td>
<td>4.8%</td>
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<tr>
<td>Online 11-1</td>
<td>44.7%</td>
<td>30.6%</td>
<td>36.7%</td>
<td>14.0%</td>
<td>PRS 11-1</td>
<td>55.3%</td>
<td>35.5%</td>
<td>44.0%</td>
<td>19.8%</td>
<td>10.6%</td>
<td>4.8%</td>
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<tr>
<td>Online 11-2</td>
<td>76.6%</td>
<td>71.0%</td>
<td>73.4%</td>
<td>5.6%</td>
<td>PRS 11-2</td>
<td>85.1%</td>
<td>67.7%</td>
<td>75.2%</td>
<td>17.4%</td>
<td>8.5%</td>
<td>-3.2%</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>65.0%</strong></td>
<td><strong>62.8%</strong></td>
<td><strong>63.8%</strong></td>
<td><strong>2.3%</strong></td>
<td><strong>Average</strong></td>
<td><strong>78.0%</strong></td>
<td><strong>67.7%</strong></td>
<td><strong>72.1%</strong></td>
<td><strong>10.2%</strong></td>
<td><strong>12.9%</strong></td>
<td><strong>5.0%</strong></td>
</tr>
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  – Students then participate in group discussions and activities.

• Offered as a MOOC on edX started in June 2014
MOOC on edX: Introduction to Computing with Java

How it works | Courses | Schools & Partners | Register Now

Introduction to Computing with Java

Designed to equip students with the fundamental elements of programming and data abstraction using Java.

About this Course

Do you wish to become a better problem solver?

This course aims to provide you with a good understanding of basic Java programming elements and data abstraction using problem representation and object-oriented frameworks. As the course progresses, you will gain hands-on practical experience.
Education Metrics

- 32.7% High School Diploma or Less
- 41.2% College Degree
- 23.0% Advanced Degree
# Top Students with almost perfect scores

<table>
<thead>
<tr>
<th>#</th>
<th>grade</th>
<th>gender</th>
<th>level_of_education</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>100.00% m</td>
<td>m</td>
<td>Master Degree</td>
<td>Beograd, Republic of Serbia</td>
</tr>
<tr>
<td>2</td>
<td>100.00%</td>
<td>NONE</td>
<td>NONE</td>
<td>Brisbane, Australia</td>
</tr>
<tr>
<td>3</td>
<td>100.00% m</td>
<td>m</td>
<td>Junior High School</td>
<td>New Delhi, India</td>
</tr>
<tr>
<td>4</td>
<td>100.00% m</td>
<td>m</td>
<td>Bachelor Degree</td>
<td>Caracas, Venezuela</td>
</tr>
<tr>
<td>5</td>
<td>100.00% NONE</td>
<td>NONE</td>
<td>NONE</td>
<td>Brzezce, Poland</td>
</tr>
<tr>
<td>6</td>
<td>100.00% m</td>
<td>m</td>
<td>High School</td>
<td>New Delhi, India</td>
</tr>
<tr>
<td>7</td>
<td>99.50% f</td>
<td>f</td>
<td>Master Degree</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>8</td>
<td>99.33% m</td>
<td>m</td>
<td>Bachelor Degree</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>9</td>
<td>99.20% m</td>
<td>m</td>
<td>Junior High School</td>
<td>Polska, Poland</td>
</tr>
<tr>
<td>10</td>
<td>99.20% m</td>
<td>m</td>
<td>Bachelor Degree</td>
<td>Tombolo, Italy</td>
</tr>
<tr>
<td>11</td>
<td>99.20% None</td>
<td>None</td>
<td>None</td>
<td>Sao Paulo, Brazil</td>
</tr>
<tr>
<td>12</td>
<td>99.10% m</td>
<td>m</td>
<td>High School</td>
<td>Hyderabad, India</td>
</tr>
</tbody>
</table>
Learning Analytics on MOOCs

VisMOOC: A visual analytics tool for MOOC developed by Prof. Huamin Qu’s research group
Learning Analysis on clickstream patterns

Data Abstraction

Data Abstraction: To separate what can be done with the data from how it is represented.
ABSTRACTION

We have just introduced the concept of data abstraction in the video above. Abstraction helps us to focus on “what” features are provided for an object rather than “how” those features are represented/implemented. Taking an elevator as an example, the control panel provides an abstraction of the functionalities of the elevator. Pressing on the floor buttons will move the elevator to certain floors, but how the mechanical parts work to position the elevator is completely concealed.
Think about Google search engine. You type in something you want to find, press enter or GO, and it brings you back several links, listed out nice and separate for easy viewing. There is code behind your search that runs all that to display the results a certain way.

Hope that helps you.

posted 2 months ago by Hanger-Terri

I got it.. thanks.

posted 2 months ago by Prateekkk

Nice explanation. I Got it. Thanks.

posted 2 months ago by khabbubhilai

Nicely said! Using Google is a perfect example. How many of us have viewed our browsers and Google as some sort of 'magic box'? Ask it (google) it anything and it will reveal everything you need to know.

posted 2 months ago by MFpeg

Very nice example. We take it for granted, without thinking of the real implementation of how Google implements the search algorithms to give us what we need.

posted 2 months ago by netdost
Learning analytics example: Square apple problem

Square Apple Problem

Starting from the middle cell, would it be possible for the worm to finish eating all the apples?

Rules:
- The worm can only move into another cell that shares a common wall; and
- a cell that has not been previously visited.
Science of Gastronomy

The Science of Gastronomy

This course will introduce you to some of the science behind food preparation, cooking methods, and generally, the enjoyment of food. The ultimate goal is to inspire you to apply scientific principles in your everyday cooking, including the principles of manipulating the human perception of food.

About the Course

This course introduces a number of basic scientific principles underpinning the methodology of cooking, food preparation and the enjoyment of food. All topics covered have a strong basis in biology, chemistry, and physics applications. Among others, they include the consumption of cooked food, the physiological and evolutionary implication of the senses, geographic and cultural influences on food, and the rationale behind food preparation. We will also discuss issues such as coupling of senses to improve sense stimulation; altering flavor by chemical means; and modification of the coloration to improve the appearance of dishes. Following the video demonstrations of the scientific principles of cooking, you will learn to recognize the key ingredients and their combinations for preparing good healthy food. At the end of this course, you will be able to:

Sessions

| July 10, 2013 - August 21, 2013 |

Course at a Glance

- 6 weeks of study
- 3-4 hours/week
- English

Instructors
Science of Gastronomy

Which senses will be involved in the enjoyment of food?

Light travels the fastest.

Sight:
- visual appearance such as colors, size, shape, smoothness of the surface, blemishes, defects....
Learning Analysis on Video Temporal Hotness
Learning Analysis on Discussion Forum

Forum Sentiment analysis

The date is Monday, 19 Aug, 2013
I am sorry if I have confused anybody with my logic. I was so sure about my approach and that 40% was right. Unfortunately I was wrong. Actually don't know why.
Extending MOOCs for Asynchronous Flipped

A pilot trial was conducted in Spring / Summer 2015-16 on the Java programming course:

• Students from outside HKUST:
  – Complete the MOOC in the Spring semester
  – Take an assessment to confirm participation
  – Enroll in a 2-week face-to-face Summer session
  – Take an exam to earn academic credits for the course

• A model to use MOOCs for expanding the international student exchange program and outreach to secondary school students
Student Feedback Questionnaire

COMP1022P – Introduction to Computing with Java Summer 2016

5-level answers to each question: Strongly agree - 100  Strongly disagree - 0

- The course has been well designed to help me learn. 90
- The online materials have stimulated my interest in this subject, and encouraged me to think. 85.2
- I was provided with clear instructions and adequate support to help me self-study the online components. 87.5
- The online content and activities prepared me well for the face-to-face sessions. 92
- The online platform has helped to support my learning in this course. 93.2
- The instructor facilitated the face-to-face activities well, stimulated my interest and encouraged me to think. 93.2
- In the face-to-face discussions and activities, there have been a lot of opportunities for me to apply/practice the concepts and theories I have learnt from the online components. 90.9
- There have been a lot of opportunities for me to interact with the instructor, TA(s) and other students which has deepened my learning. 93.2
Research and Development in E-learning

- A Data Science and E-learning Research Cluster established under the HKUST–MIT Research Alliance Consortium which leverages Hong Kong Innovation and Technology Commission’s ITF 9:1 matching fund. Two projects have been funded for a total of HK$16M:
  - An Open Learning Design, Data Analytics and Visualization Framework for E-Learning
  - A Personalized E-Learning Platform

- A Joint Hong Kong MOOC Platform for Hong Kong’s Tertiary Education Sector led by HKUST funded by the UGC for a total of HK$10M.

- The Learning and Assessment for Digital Citizenship project in partnership with HKU funded by RGC’s Theme-based Research Scheme for a total of HK$20M.
MOOC as a Catalyst for Enhancing Learning Experience

MOOC as a catalyst for improving teaching and learning on campus:

• Using MOOCs as bases for developing blended / flipped courses

• Using the data collected to derive learning analytics for improving the learning experience of students.

• Outreaching to prospective undergraduate/postgraduate students around the world and expanding our student exchange program

• Packaging MOOCs into curriculum programs – Massive Open Online Program/Degree (MOOP/MOOD)

• Using MOOC as a platform for inter-institutional collaboration through student/faculty exchange and joint programs such as MicroMaster.
Thank you!