Innovation-Driven Teaching and Learning in Internet+ Age

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Abstract. Continuous reform and development in teaching and learning are topics for discussion and research in any higher education institutions. Recent movement in “education rethinking, university reshape and teaching-learning redefinition” has driven reforms in the higher education (HE) into a new level that innovative teaching and learning is an important key indicator in this movement and in response to the environmental changes. This paper reports our trial and practice in innovative teaching and learning following a proposed “improved innovative teaching and learning” (IITL) model. CSE313 “Big Data Analytics” module is used in the trail. Both dual-direction and multi-round dialog-based interaction and scenario-based sense-making are used in the module delivery defined by the proposed model. The success and licences learnt are reported to shed lights on the similar future practices for others.

Introduction

Advancement of modern technology such as Internet, Clouds Computing, Big Data and Mobile technology has a great impact on every forms of live. Higher Education (HE) is facing unprecedented challenges and opportunities [1]. Internet increases information reach and density; Clouds Computing provides seemingly unlimited computation power and vast storage capacity; Big Data generates more information, knowledge and wisdom; Mobile technology has changed the way people obtain knowledge. The university students now equipped with all kinds of new gadgets and tools, their learning behaviours, patterns of study, time used in learning and the sources of knowledge have been changed completely comparing with decades ago [7]. HEIs have to response to these changes [3]. One way of the response is through reform and innovation [2]. A movement called “education rethinking, university reshape and teaching-learning redefine” has been storming globally [4, 5, 6].

XJTLU was fortunate to have been founded at a time of innovation and responding to the challenges. The University is committed to the improvement of higher education and the exploration of new models for higher education in China. The university sets out her vision as to become a research-led international university in China and a Chinese university recognised internationally for its unique features in learning and teaching, research, social service, and education management. The mission of the university are to educate technical and managerial professionals with international perspectives and competitive capabilities; to integrate global economic and social development with expertise in business and technology and to conduct research in areas where humanity faces severe challenges and explore new models for higher education that will exert a strong influence on the development of education in China and the world.

As a new university, XJTLU encourages innovative teaching and learning. Innovation means reform or radical shifting from a standard knowledge transmission model which traditional universities adopt to a new model which teaches “how one comes to know” rather than “what is known”. Innovative teaching and learning cannot be just a teaching model switch, it should include in many levels of teaching and learning engagement and activities. The reforms should include teaching content’s selection, delivery methods and learning outcome assessment. It should also include students’ active participation, working together on a common projects, actively involves and performing tasks in the...
process of understanding and creating knowledge; learn-by-doing rather than learn by memory; gain experience necessary to reason, strategize and make sense of situations that will arise in practice, in their future careers these knowledge will be called upon to think beyond the facts and rules imparted in a typical classroom settings.

The rest of the paper is organised as follows: in the section II, a new improved model of innovative teaching and learning is presented. Section III presents our trail on CSE313 based on the model presented. Section IV is the results analysis where the effectiveness of the model has been confirmed. Section V presents some practical issues and issues related with the adoption of the model for others. A brief conclusion is provided in the last.

**An Innovative Teaching and Learning Model**

How can we progress beyond the predominant transmission model of teaching and enable innovative teaching and learning? A model based on Laurillard’s conversational framework is proposed and illustrated in the Figure 1.

![Figure 1. A New Modified Iterative Teaching and Learning Model.](image)

From Figure 1, the model proposed is based on “scenario-based cognitive model in sense-making” [9] and “interaction and dialog-based knowledge transfer” [8]. It is multi-layer, iterative and interactive conversational framework. The key ideas including:
Two-layer knowledge transfer. The model specifies that the knowledge transfer will occur in two layers, i.e., concept and action. This two-layer model reflects the traditional education model of theoretical and practical education. The model emphasis on the idea that teaching and learning can not only include a theoretical conceptual layer but also a scenario based physical action layer. It is because that the model believes teaching and learning should not only include teach “what we know” but also “how we comes to know”. The most effective way to achieve it is to delivery in both layers where the upper layer focused on concepts and theory and the lower layer focuses on the construction of a representative scenario or situation where the theory or concepts can be reflected upon or being drawn from. This construction of representative situation or scenario may be impossible or costly in the past, but it may no longer the case since the advancement in computing and the Internet technologies.

Dual-directional and multiple rounds interaction between the knowledge holder and the knowledge recipient. Figure 1 indicates there is an iterative dialogue-based interaction occurs between teachers and students in both layers. In the concept layer, rather than a single-directional knowledge delivery from a teacher to students, an iterative interaction happens between teachers and the students. They are indicated in steps 1-4. In step 1, a teacher, based on personal knowledge and teaching environmental factors, constructs an ideal description of conceptual knowledge that needs to be delivered to students, then a most appropriate method may be selected and adopted by the teacher to deliver the concept to the students as in the step 1 in figure 1, in this case may be passive recipients but the students can have their own perceptions of the concept being received. In step 2, the students will reflect on what has been learnt and react on it. In many ways, the students would respond (or by provide explicit feedback) to the teacher. In step 3, the teacher would modify the initial description to accommodate the students’ feedback, and a re-description will be generated and delivered to the students either in time or in the next time as in the step 3. Step 4, the students may receive a modified and improved concept’s description and then use them to modify their perception on the concept. This iterative process can be deployed in many more rounds depending on the subject of teaching and learning, the satisfaction of both parties and the time constraints in practice.

Similarly, in the action layer, the teacher, based on the personal knowledge, technology available and the learning goals, may select and construct a representative scenario or situation, where goals or tasks may be specified explicitly as in the step 6 of the figure 1. The students in this case are represented with the specifically designed tasks and they are expected to be involved and some take some actions. The students’ action (naturally or being told to) will impact on the constructed situation as indicated in the step 7. The results can then be used by the teacher to evaluate against the initial designed tasks, necessary modification on the constructed situation can be carried out and re-delivery may be also needed. Alternatively instruction may be given to the students to guide them for correct actions as indicated in the step 8. Finally, in the step 9, the students can modify their action according to the teacher’s instruction or further understanding of the situation and tasks. Again, this iterative interaction between the teacher and the students can have multiple rounds dependents on the subject and the learning goals.

Complementary and co-evolving between two levels. The innovative teaching and learning model proposed and presented in the figure 1 has a distinctive character that the conceptual level and action level teaching and learning are complementary and co-evolving in the actual teaching and learning process. This is indicated by the step 5 and 12 on the instructor’s side and the step 10 and 11 on the learner’s side. The description and perception of a concept of knowledge on both instructor’s and learner’s mental space can be consolidated, enhanced and deepened by the actual artificially designed tasks in a situation where students’ physical involvements and actions are impacted on and resulted in. On other hand the constructed situation which tasks are specified to represent the process of the concept comes about can be improved by the students’ own actions and further understanding. The model proposed and represented in figure 1 is the minimum for innovative teaching and learning. The innovativeness is buried into the interplay between theory and practice, concept delivery and scenario construction. By doing so, the abstract concept can be made concrete and visible through a
reflective practicum. As the continually iterative dialogue between teacher and student the knowledge transmission can be ensured.

CSE313 Big Data Analytics Module Trial

The newly proposed model only provides an irreducible components and process of innovative teaching and learning. It also indicates that the actual adaptation and implementation can be different depends on the subject and the actual learning outcomes. To test how actual applications can measure up to the requirements and expectation for innovative teaching and learning, a year 4 module CSE313, “Big Data Analytics” is chosen to adopt the new innovative model for two purposes, testing the effectiveness of the model in building students’ innovative instinctiveness and innovative abilities, and providing a sample implementation of the proposed model.

CSE313, “Big Data Analytics” (BDA) is a replacement of previously taught module CSE309, “Semi-structure or web-like databases”. The module has been taught three times so far, the complete knowledge transfer process from the module specification design, to teaching contents selection, from teaching delivery to outcome assessment, have been conducted intentionally by adopting the proposed innovative model. Due to the space constrains, only teaching delivery is presented in this paper.

To adopt new proposed model in practical, a template has been created for organising teaching material and construct concepts representative scenario. The general template is represented in a series of tables. Table 1 is used in the initial teacher’s concept description. It provides a list for consideration on the conception of the knowledge point. The contents are just simplified examples used in the CSE313 teaching. A full contents listed in the table can be delivered in one single lecture or a series of lectures. The granularity is defined by the knowledge unit.

Table 1. Teacher’s Description on Conception.

<table>
<thead>
<tr>
<th>Conception</th>
<th>Data descriptive analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Descriptive Analysis is a data analysis method provides quantitatively describing the main features of a collection of data through analysis. Data descriptive analysis is the first step in BDA. It is also called the “simplest class of analytics”. Descriptive analytics allows users to condense big data into smaller, more useful bits of information or a summary of what happened.</td>
</tr>
<tr>
<td>Methods of delivery</td>
<td>Lecture, slides, lecture notes, Online delivery …</td>
</tr>
<tr>
<td>Expected results</td>
<td>Fully understand, history, typical usage</td>
</tr>
</tbody>
</table>

Table 2. Students’ Feedback on Description on Conception

<table>
<thead>
<tr>
<th>Conception</th>
<th>Data descriptive analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feedbacks</td>
<td>Quantitative? Why not Qualitative? What are the main features? Why first step in BDA? What are the next? It is also called the “simplest class of analytics”. How to Condense big data into smaller, more useful bits of information or a summary of what happened?</td>
</tr>
<tr>
<td>Methods of re-description</td>
<td>Lecture, slides, lecture notes, Online delivery …</td>
</tr>
</tbody>
</table>

Table 2 is used to for students’ conceptual feedback collection. The collection of students’ feedback can take place in many different forms both explicit and implicit, and actively or passively. The important part of the newly proposed model is the construction of scenario or situation to repress concept and let students involve and participants in the situation. It also can be implemented in many
different ways such as building inactive webpages, using interactive teaching and learning platforms such as MOOCs and Moodle. A general template is provided and used to create scenario, situation, projects or practical tasks is illustrated in Table 3.

Table 3. Teacher’s Constructed Situation.

<table>
<thead>
<tr>
<th>Conception</th>
<th>Data descriptive analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goals</td>
<td>Understand the concept of descriptive data analysis</td>
</tr>
<tr>
<td></td>
<td>You are given a month of a company’s Web logging records. You are asked to analyse the data and provide suggestions for next circle of products development and sale strategy.</td>
</tr>
<tr>
<td>Scenery</td>
<td>Describe data you have been given.</td>
</tr>
<tr>
<td>Methods of delivery</td>
<td>On line, Web site. Moodle project.</td>
</tr>
<tr>
<td>Expected results</td>
<td>Lecture, slides, lecture notes, Online delivery, …</td>
</tr>
<tr>
<td>Methods of assessment</td>
<td>Web report, written report.</td>
</tr>
</tbody>
</table>

Table 4. Students’ (re-)Action on Constructed Situation

<table>
<thead>
<tr>
<th>Conception</th>
<th>Data descriptive analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenery</td>
<td>You are given a month of a company’s Web logging records. You are asked to analyse the data and provide suggestions for next circle of products development and sale strategy.</td>
</tr>
<tr>
<td>Tasks</td>
<td>Describe data you have been given.</td>
</tr>
</tbody>
</table>
| Student’s actions | • Check types: categorical or numerical?  
• Minimum and maximum on numerical  
• Number of class on categorical  
• Mean, median  
• Distribution, standard deviations  
• Outliers and abnormally  
• Missing values and human errors  
• Age over 130, date on 30th of Feb  
• User clicks without logins |

The design objective and aspiration is to re-appear the origination of the concept a designed scenario is representing. In the example provided, the descriptive analysis is the concept the constructed scenario is designed to represent. The illustration is to demonstrate that it is the first method anyone should/can use in a possible long and iterative data analysis process. As demonstrated, in a real data analysis situation, initially the given data is not understood and the analytical goal may be also not clear yet. A data analyst will naturally look into the given data to check the data type, format, precision attributes and the range of values and any summary methods such as mean, average, median, minimum, maximum and distribution can be used, etc. To produce a description on given data, one has to understand data to some extents. The cue in the given model is that putting students in a situation which the concept was originally drawn from or a real situation which the practitioners will have to face in practise. Let them to feel, to sense, to react and to learn by doing.

A similar student’s feedback collection form can be used to collect student’s action for the teacher’s deliberately constructed situation. However, this feedback should focus on student’s actions rather than summary. Table 4 is an example table that students’ descriptions are various as illustrated in bullet points.

The students’ natural actions are designed and expected from the design. They are essentially the methods a descriptive data analysis can be used by the definition. As explained by the model that the interaction between teachers and students can be multiple until both side satisfied.
Results

Provide an accurate evaluation for the proposed innovative teaching and learning model is not easy since the complete power of the model and the effect on students’ ability of innovation can only be seen after a long while. However, one thing though can be used to indicate the results of adopting the proposed model is though the trail module CSE313’s delivery where students’ feedback are collected, analysed and compared. A few obvious key indicators are summarised in the following figures. They are in some ways showing promising earlier results. The figures are quoted from university annual statistics (with some students biased opinion).

Figure 2 shows the survey results that 4 basic questions were asked related with the students learning experience. The students can answer in five levels of agreements: strong agreed, agreed, neither agree nor disagree, disagree and strongly disagree. Only the percentage of strongly agree and agree were shown on the column chart and strongly disagree were 0%. The positive feedback, which is strongly agree and agree counted well over 80% in year 15/16. Figure 3 shows the same feedback but in year 16/17.

![Figure 2](image1.png)

Figure 2. Students’ Feedback on the Learning Experience of CSE313 in Academic Year 15/16.

![Figure 3](image2.png)

Figure 3. Students’ Feedback on the Learning Experience of CSE313 in Academic Year 16/17.

Figure 4 shows the comparative scale between module CSE313 with the average scale among the over 20 courses in the same department. The full scale is 0-5 and 5 are the highest score. From the chart it is clearly demonstrated that in both academic year 15/16 and 16/17, CSE313’s score are higher than the department average score and the overall learning experience has been improving. Students’
Feedback clearly demonstrated on the whole the module is satisfactory and better than the department average.

![Figure 4. Comparative Scale between Module CSE313 and the Department Average.](image)

**Conclusion**

Education for innovation rather than transfer knowledge is a tough task for HEs. However research and practise for innovative teaching and learning never stop. There are proposals for innovative teaching models such as iterative dialogue model and five-star education models. In this paper an improved innovative teaching and learning model has been proposed which is based on scenario-based sense-making and iterative dialogue based interaction. The model can be used in many different ways and in many applications such as design a module specification, design a module delivery using web-based tools, etc. It is clear from our trail that developing a course using innovative model proposed in this paper entails a tremendous commitment time and efforts. However, it is unfortunate that current HE system tends to rewards good research far more than good teaching. Therefore it is discouraged for academics to develop course using the model proposed. However, based on our practice, it seemingly suggests that the model is capable of providing and delivering innovative teaching and learning. Although it is earlier to draw a complete conclusion but the students’ feedback on our trial module has shown positive and encouraging results. A possible way forward is to build upon the forms designed in the trail module delivery and improving and enhancing them so generic forms that reflecting the model proposed in other new course design and delivery can be developed. The forms can be used as a generic tools sets that teachers can use them to specify the goals, the contents and ideas appropriate to specific learning activities they want to design to transfer desired knowledge to learners. Then with the help of specialists such as graphical designer, web technologists and video producers, a complete course maximally using Web technologies can be designed and delivered to students and which offers an alternative to the traditional knowledge transforming model that are classroom based teaching and learning.

**References**


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