TOWARDS THE DEVELOPMENT OF A MASS CUSTOMIZATION e-COURSE TEACHING MODEL AT SIM UNIVERSITY

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The concept of mass customization (MC) has been well researched and proven to be effective in helping organizations improve its customer-manufacturer interactions especially in the manufacturing industries. The underlying idea of MC is to customize production efforts of an organization to fulfil its customers’ needs with near mass production efficiency. In this paper, we posit that the MC idea is highly appropriate to be applied in the context of e-Course teaching in SIM University, Singapore’s only University specially catering to the continuous educational needs of working adults. We support this assertion by reviewing comprehensively the literature of MC, identifying the drivers and limitations of MC and discuss how these limitations can be overcome. Leveraging upon the findings from the literature, we propose a conceptual e-Course teaching model that is capable of customizing the teaching according to the learning needs of students in a course at SIM University. We discuss the implications of realizing this model and argue how this will improve the students’ conceptual understanding of topics in class, make class engagement more effective, and provide a new insight on how lecturer’s teaching effectiveness can be measured.

Keywords: Mass customization, e-Teaching, Peer Instruction, e-Learning.

INTRODUCTION

The concept of mass customization (MC) was first introduced by S. Davis (1989). Over the last two decades, research on mass customization (MC) has grown significantly and the implementation of MC has been proven to be effective in various industries such as the food (McIntosh, Matthews, Mullineux, & Medland, 2010), electronics (Partanen & Haapasalo, 2004), mobile phones (Comstock, Johansen, & Winroth, 2004), homebuilding (Barlow et al., 2003), the production of foot orthoses (Pallari, Dalgarno, & Woodburn, 2010), personalized nutrition (Boland, 2008), and large engineered products (Lu, Petersen, & Storch, 2009).

The objective behind MC is to allow an organization to develop highly flexible production capability to fulfill a customer’s need with near mass production efficiency (Tseng & Jiao, 2001). This objective seems highly aligned to fulfill a student’s need for higher education in the 21st century. The current teaching of higher education is based on a ‘one-size-fits-all’ model where lecturing is the predominant form of instruction and occupies a large percentage of face-to-face class time (Lammers & Murphy, 2002; Robinson, 2010; Twenge, 2009). Yet, there are mounting empirical evidences that clearly demonstrate that students will learn more, develop better conceptual understanding, increase engagement in class, attend class more often, and are more persistent in learning when a customized teaching method is used instead of the traditional ‘one-size-fits-all’ lecturing (e.g. Armbruster, Patel, Johnson, & Weiss, 2009; Deslauriers, Schelew, & Wieman, 2011; Saville, Zinn, Neef, Van Norman, & Ferreri, 2006).
Consequently, researchers and practitioners in the field of teaching and learning have called for the implementation of customized teaching method to improve the efficiency of classroom teaching (Fried, 2008; Nistor, Dehne, & Drews, 2010; Piller, 2002; Piller, 2003; Waslander, 2007).

In a customized teaching method, the role of a lecturer in a classroom has been significantly transformed (Young, 2005). While lecturers are still expected to help students master the course content, they are also expected to customize the teaching materials in a classroom to: (1) increase students’ academic self-efficacy (Caprara, Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; Marsh & Martin, 2011); (2) improve students’ self-regulatory capability (Boekaerts, 2002; Zimmerman & Schunk, 2011); (3) enhance students’ feelings toward learning (Duncan & Arthurs, 2012); and (4) instil values and skills in students that promote lifelong learning (Aspin, Chapman, Evans, & Bagnall, 2012).

Gone was those days when delivering a highly standardized class will meet the learning needs of students today. The emergence and success of various massive open online course (MOOC) platforms, e.g. Khan Academy and Coursera, are the reflection of students’ needs for customized teaching. SIM University is the only private University in Singapore currently offering part-time degree programmes to predominately working adults. Currently, the teaching pedagogy of almost all e-Courses in SIM University is based on a ‘one-size-fits-all’ lecturing model. We argued that MC is highly appropriate to be applied in the e-Course teaching model of SIM University because: (1) most of the students in SIM University are working adults and MC has been applied successfully in the corporate training of working adults (Nistor et al., 2010). Hence, we think that the application of MC will likely benefit SIM University in similar way; and (2) the current SIM University’s e-Course teaching model, while has its shortcomings, has all the necessary foundations to support the effective implementation of MC. This will be elaborated further in the later part of this paper. Drawing inspiration from these successful MOOC platforms and the literature of MC, the focus of this paper is to propose and present a MC e-Course teaching model capable of providing customized teaching according to the identified learning needs of students in a course at SIM University.

**LITERATURE REVIEW**

The teaching of a course in a University can be viewed as a manufacturing system. This system is designed to provide a teaching service to meet learning needs of a student. The current teaching model in a University is predominately based on a ‘one-size-fits-all’ model despite various studies indicating that a customized teaching method is more superior in meeting the learning needs of students (e.g. Armbruster et al., 2009; Deslauriers et al., 2011; Freund, 2004; Saville et al., 2006). To enable the customized teaching in a course, we postulate that the literature of mass customization (MC) can help to shed some important insights.
Why Mass Customization is Highly Applicable to a University’s Teaching

The essence of mass customization (MC) for a manufacturing firm is the “capability to manufacture a relatively high volume of product options for a relatively large market (or a collection of niche markets) that demands customization, without tradeoffs in cost, delivery, and quality” (McCarthy, 2004, pp. 348). Guided by this definition, we see a teaching service in a University as a “product” that should be customized to meet as many learning needs of students as possible without a significant tradeoff in cost, delivery, and quality.

We believe our assertion that a teaching service can be customized through the application of MC strategies in manufacturing is supported by the following reasons. First, the rise of MOOCs demonstrates growing needs to provide customized e-Course teaching to meet diverse learning needs of students around the globe. These MOOCs have given us a proof-of-concept to demonstrate significant teaching pedagogical benefits of customizing e-Course teaching. Second, the challenges faced in a MC implementation in a manufacturing firm is very similar to the challenges in customizing an e-Course teaching. For example, two challenges that a manufacturing firm will face when trying to customize their product are: (1) how to effectively and efficiently capture and process the highly varied and uncertain customer’s preferences; and (2) how to assemble materials to produce a range of products’ options to meet these preferences without incurring a significant amount of costs and/or at the expense of quality (Ahlstrom & Westbrook, 1999; Duray, 2002; Salvador, Forza, & Rungtusanatham, 2001; Tu, Vonderembse, & Ragu-Nathan, 2001). This is very similar to the challenges faced by any University when trying to customize their course’s teaching according to learning needs of its students. Transforming from a ‘one-size-fits-all’ teaching model to a customized one will require an effective and efficient system to capture and process the varied learning needs of students and to create the customized teaching materials and delivery to meet those needs. As a result of this similarity in challenges, we believe that solutions developed to address the challenges of customizing a product in a manufacturing context will be highly applicable in customizing an e-Course teaching in a University’s context.

This idea of applying MC into the education context has also been supported in part in the literature of teaching and learning. Nistor et al. (2010) incorporated the idea of MC into the design of a MC framework called ‘amit’ and shown how its application leads to time saving in acquiring new knowledge by working adults while achieving a high training efficacy in the delivery of corporate training. Freund (2004) argued how the application of MC teaching model together with Gardner (2011)’s multiple intelligence theory can help education institutions gain a competitive advantage. Piller (2002) discussed the emerging needs of students towards customized teaching and argued how the application of MC can help to overcome the challenge of developing customized teaching with no or little extra cost. He further pointed out that traditional teaching models are either based on a highly standardized teaching that focuses on ‘one-size-fits-all’ delivery or a highly customized teaching fitting the unique needs of each student. The customized teaching enhances the learning experiences of students significantly but at a high cost (Piller, 2002; Piller, Moeslein, & Stotko, 2004). This is in contrast with the low cost in providing mass education in a highly standardized teaching model, which has been the de-facto teaching model since 1892 (Freund, 2004). Piller (2002) went on to argue that the way to overcome this ‘efficiency-cost’ paradox in teaching is to apply the principle of mass customization into the teaching model. Yet, notwithstanding the current researches in the literature, there are very little conceptual and empirical studies that
can shed lights on how this MC can be applied in a University’s context. This gap in the literature motivates us to develop our MC e-Course teaching model in this paper.

The Potential Limitations when Implementing Mass Customization

Before we discussed our proposed teaching model, we wish to highlight the limitations of mass customization (MC) that a University will need to consider when adopting MC to an e-Course teaching. Adapted from limitations of mass customization in the manufacturing field as highlighted by Zipkin (2001), we posit that a University’s success in implementing MC effectively into their teaching model will be limited by the strengths of a number of organization capabilities. They are: (1) a University must have an effective elicitation system that is capable of collecting and analyzing the student’s learning needs of a course accurately and cost effectively; (2) a University must have a flexible process in the development and delivery of e-Course teaching to accommodate the customization requirements of the students, without substantial trade-offs in cost, delivery, and quality in teaching. In this regard, a University will need to carefully consider the extent of this customization effort (i.e. whether the teaching should be customized to the level of an individual, a group, a class, or a course). Obviously, as the customization effort moves closer towards the individual, the cost of delivering the course will substantially increase; (3) a University must have an effective feedback system capable of providing reliable information on whether the identified learning needs of students are fulfilled during the e-Course teaching; and (4) the implementation of MC will involve a significant effort in organizational change. A University must have an effective change management capability to navigate the various hindrance factors, the structural inertia, and the transition hazards involved during such implementation (Rungtusanatham & Salvador, 2008).

PROPOSED MC e-COURSE TEACHING MODEL IN UniSIM

In SIM University, an e-Course consists of three pre-class quizzes and three face-to-face sessions are interlaced in a way as shown in Figure 1.

![Figure 1. SIM University e-Course Structure.](image)

Each pre-class quiz is supposed to test a student’s memory of key definitions, concepts, and terms of a specific topic in the course. It is assumed that when students pass the pre-class quiz, he/she would have acquired sufficient knowledge to allow for his/her active participation in class activities during the face-to-face session. However, this existing approach has two key issues.

First, students being able to remember key definitions, concepts, and terms of a topic do not necessarily mean that they have acquired the necessary conceptual understanding of the topic.
Second, the face-to-face session is still predominately implemented using the traditional ‘one-size-fits-all’ approach. Every teaching material used in class is designed by the Associate Faculty and standardized across the teaching team regardless of the diverse learning needs of each cohort of students for that course.

Despite its shortcomings, the existing approach has several characteristics that make it ideal for the application of mass customization. The existing pre-class quiz provides an elicitation system that allows the learning needs of each of cohort of students in a course to be effectively collected and analyzed at almost no additional cost. With this information, teaching materials can be customized at course level by the teaching team accordingly. We advocate the customization of teaching materials at course level for a number of reasons: (1) customization at individual and group level will inevitably increase the cost of education in SIM University; (2) customization at class level may potentially lead to students claiming that they are being disadvantaged when they are not being taught a specific topic in a course. For these reasons, we feel that it is more appropriate to customize the e-Course teaching at course level.

We also advocate the adaption of peer instruction during the teaching delivery because it has been widely recognized as an effective teaching method in increasing a student’s understanding of concepts in a topic (Lasry, Mazur, & Watkins, 2008). We do this because the proposed peer instruction teaching method will provide a feedback system that not only allows us to determine the effectiveness of the customized teaching efforts, but will also shed insights about the effectiveness of the lecturer’s teaching. This is an important element that we need to address in order to realize the full benefits of mass customization as advocated in the literature (Zipkin, 2001).

The success of MC in a manufacturing context depends very much on the efficiency of the information transfer from the customers to manufacturers (Turowski, 1999). When the customers’ needs are transferred effectively in a timely fashion to the manufacturer, the manufacturer can customize the construction of its product based on these identified customer’s needs. However, in order for a manufacturer to achieve a mass production efficiency during the customization process, he/she will need to develop a modularized catalog of parts that made up its products. These parts are flexibly combined during construction to deliver the product that is desired by the customers. This is very similar to the student-lecturer interaction in a course. Adapting steps involved in a customer-manufacturer interaction during a mass customization (MC) process (Da Silveira, Borenstein, & Fogliatto, 2001), we present the conceptual underpinnings that will govern the student-lecturer interaction in the teaching of an e-Course and they are highlighted in Table 1.
Table 1

*Mass Customization in Delivering Personalized Teaching*

<table>
<thead>
<tr>
<th>Step</th>
<th>Mass Customization Steps in Manufacturing Personalized Services/Products (Da Silveira <em>et al.</em>, 2001)</th>
<th>Mass Customization Steps in Delivering Personalized Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Building the product catalog</td>
<td>Build a catalog of teaching materials for each identified topics in an e-Course. The catalog should consist of conceptual questions, problem-based learning questions, case studies, and videos. It should also consist of a set of questions that can be used to test the conceptual understanding of topics by the student which will be used in Step 4. The idea is to develop a comprehensive set of modularized teaching content and test questions that can be readily used in class.</td>
</tr>
<tr>
<td>2</td>
<td>Configuring customer orders</td>
<td>Configure a set of specially designed pre-class quiz and questionnaires to uncover the student’s learning needs of topics in an e-Course. The quiz and questionnaires should include questions that test the conceptual understanding of students on a specific topic and questions that ask the student to express which topic is particularly difficult to learn.</td>
</tr>
<tr>
<td>3</td>
<td>Transferring orders to manufacturing</td>
<td>Transfer student learning needs uncovered in Step 2 into the development of a set of customized teaching materials by mixing and matching contents from the catalog developed in Step 1.</td>
</tr>
<tr>
<td>4</td>
<td>Manufacturing customized orders</td>
<td>Deliver the customized course contents in class. For every topic that is being taught, lecturers will conduct a post-topic assessment to assess students’ level of understanding of a topic. More details on how this can be done is elaborated in the next section of this paper.</td>
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The proposed approach that we advocate to enable mass customization teaching in SIM University is discussed in details below.

**Step 1: Build a catalog of teaching materials for each identified topics in an e-Course.** Creating modularized components that can easily be assembled to deliver customized products is one of the most effective way to achieve mass customization in the manufacturing and service industries (e.g. Ahmad, Schroeder, & Mallick, 2010). Hence, we posit that this modularization idea be applied to the development of the teaching materials used in a course. A ‘teaching catalog’ akin to the ‘product catalog’ is created which can be flexibly combined based on the identified student’s learning needs in a course. Such development of teaching materials can be developed through the concerted efforts among the teaching team coordinated by the Associate Faculty of the course. When the teaching materials are systematically modularized based on the topics in a course, the teaching team can customize the course easily with almost ‘mass production efficiency’.

**Step 2: Configure a set of specially designed pre-class quiz and questionnaires to uncover the student’s learning needs of topics in an e-Course.** The difference between this step and the existing pre-class quiz lies in the design of the questions. Questions are designed in this step to emphasize on a student’s conceptual understanding of the topic. It should not be just focused on a student’s memorization of key definitions, terms, and concepts. Instead, for each question, the student will also be asked about the confidence level of his/her answers (e.g. from confident to not confident). The overall quiz score for the student will be dependent upon the correctness of his/her answers. The student will be allowed to attempt the quiz multiple times and only the best score will be captured. Subsequently, the confident level and the correctness of students’ answers will be used to uncover the student’s learning needs in a course. The introduction of the confident level in each question allows us to trace the improvement of the student’s conceptual understanding of a topic after the face-to-face session. It also allows the teaching team to use the information to customize the teaching materials for the course. For this reason, the number of questions in the pre-class quiz and questions that purely test on student’s memorization of key definitions and terms should be minimized.

**Step 3: Transfer the student’s learning needs uncovered in Step 2 into the development of a set of customized the teaching materials that are developed in Step 1.** The quality of the student’s discussion and learning in a classroom depends very much on the quality and the appropriateness of teaching materials used in course. When determining suitability of teaching materials in a course, a lecturer needs to know which topics in a course that students find it difficult to understand. By using the feedback received in Step 2, the teaching team will be able to gain an in-depth understanding about this difficulty and customized teaching materials from the catalog developed in step 1 to be used in the face-to-face session.

**Step 4: Deliver the customized course contents in class and conduct post-teaching assessment.** The teaching delivery will follow the process as illustrated in Figure 2. We draw inspiration from the Peer Instruction teaching process as advocated by Lasry, Mazur, and Watkins (2008) to develop this teaching delivery process in our model. The set of questions developed in step 1 can be used by a lecturer to test the conceptual understanding of a topic by students after conducting the customized teaching activities. This provides a direct feedback to the teaching team which allows the team to customize the next course of actions in class. The scores obtained from these questions can also be captured using IT and can be used for: (1) further post-class analysis by a lecturer; and (2) teaching effectiveness evaluation of a lecturer. The post-class analysis by a lecturer is particularly useful in helping
the lecturer determines the subsequent online activities after the face-to-face session. These online activities can be developed and archived into the teaching catalog for future use.

We propose to implement the MC approach and test its effectiveness in one of the existing SIM University’s e-Course, ‘FIN371 Retirement Planning’ from the Bachelor of Science Finance Programme. We have selected this course because of the following reasons. First, this course was presented as a traditional course with six face-to-face sessions in the previous semester, and it is going to be converted as an e-Course with three face-to-face sessions in the July 2014 Semester. Therefore, it is a good timing to implement our proposed design into this course since it allows us to compare the effectiveness of our design with the traditional teaching method. Second, given that it is a level three course and the nature of this course being focused on retirement planning, students are expected to acquire a good comprehension and application of the course contents. As a result, we believe that a lecturer’s teaching effectiveness and customized teaching will have a significant impact on the students’ performance in this course. Finally, based on the past enrollment data, we anticipate that the class size for this course will be sufficiently large to allow for at least two concurrent classes to be scheduled.

Figure 2. The Mass Customization e-Course Teaching Process (Adapted from Lasry et al., 2008).
IMPLICATION TO SIM UNIVERSITY

There are several potential advantages and disadvantages if our proposed mass customization (MC) e-Course teaching model is implemented in SIM University. The potential advantages of implementing this MC e-Course teaching model in SIM University are as follows. First, we have proposed a model that is capable of customizing the teaching of an e-Course according to the learning needs of our students in a course. This is an essential step to realize the benefits of customized teaching as advocated in the literature (e.g. Armbruster et al., 2009; Deslauriers et al., 2011; Saville et al., 2006). Second, the development of a comprehensive set of modularized teaching materials will allow us to achieve ‘mass production efficiency’ in the development of teaching materials (Nistor et al., 2010). This, not only, has the potential of significant cost savings in our course development, but will also encourage the sharing of teaching approaches and nurture teaching’s creativity in our lecturers. For example, the availability of teaching approaches and materials in a repository can serve as an initial starting point for all new course development. Thus, it helps to reduce the cost and enhance a developer’s creativity during the process of course development. Third, the use of technology in the implementation of the MC e-Course teaching process (see Figure 2), will provide invaluable data where teaching effectiveness of an instructor in class can be effectively assessed. For example, the improvement of the topic’s test score in class can be directly attributed to the efforts made by the lecturer. In contrast to the existing way of measuring the teaching quality of a lecturer, we believe this data is more representative of a lecturer’s teaching capability. Fourth, the scores of the topic’s test that are captured in a class can also be used to guide the development of subsequent online activities during the week that there is no face-to-face session. These online activities can also be customized based on the scores of these topic’s tests. Fifth, we believe the MC e-Course teaching model will help to increase the student’s conceptual understanding of topics and enhance his/her learning. Hence, we postulate that the assessment scores of students for e-Course that adopted our model will likely improve as compared to the traditional way of teaching.

Similar to the application of MC in a corporate training by Nistor et al. (2010), we believe the following potential disadvantages of implementing this MC e-Course teaching model in SIM University may occur. First, the initial development efforts for the teaching catalog may be significant. This may go against the ‘mass production efficiency’ that MC is supposed to achieve. However, these efforts will become significantly lesser if the same teaching catalog is being reused across the semesters (assuming that the course contents do not change significantly over this period) (Nistor et al., 2010). Second, there may be an increase of stress among the teaching team to customize the teaching materials in time for the classes since the end of the pre-class quiz and the face-to-face session is probably only separated by two to three days. This may lead to ‘resistance’ from the teaching team in the change effort as advocated by Rungtusanatham and Salvador (2008).

CONCLUSION

This paper discusses the application of the mass customization (MC) concept used in the manufacturing and service industries into the teaching of a SIM University’s e-Course. We review the literature of MC and argue why it is suitable in an e-Course teaching context and provide some discussion on the limitations of MC. The justifications on why the existing e-Course approach in SIM University have all the required characteristics to overcome the
limitations of MC identified in the literature are presented. Using the extant literature, a proposed step-by-step e-Course teaching model is discussed. We argue why our proposed model should be and can be implemented in SIM University and offer our views on the implications to SIM University if our model is applied to an e-Course teaching.

We believe this implementation of our MC e-Course teaching model in SIM University will increase our students’ conceptual understanding of topics taught in course. It will also help lecturers become more effective and efficient in the delivery of their teaching. Finally, we believe the data obtained during class will provide a more objective assessment of the teaching effectiveness of a lecturer as compared to the current teaching evaluation mechanism.

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