A Framework for Assessing the Quality of Online Computer Programming Courses

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INTRODUCTION

Online course delivery (also referred to as E-learning) is a modern trend in education that has grown over the past decade and has opened the doors for a wide variety of learning opportunities. One very attractive characteristic of such delivery mechanism to both students and educators is the flexibility of such offerings. Moreover, E-learning usually has a very positive impact on students' enrolment due to the attraction of non-traditional ones. Therefore, many higher education institutions have started to offer several online courses in various majors. At the same time, the exponential spread of such offerings introduces many challenges to be overcome. Additionally, the direct and indirect consequences of the wide-use of such new delivery mechanism need to be carefully investigated and analyzed.

There is no doubt that the introduction of online delivery has many influential impacts on contemporary educational systems and on how the process of knowledge transfer can be achieved. Many top schools have recently initiated online courses and programs with several of them open to public. A recent example is a joint initiative that first started between Harvard University and Massachusetts Institute of Technology called edX (EdX, 2013). EdX is a free Massively Open Online Course system (MOOCs) that allows students from all over the world to take free courses offered by several renowned universities. These are indicative that online delivery is on the rise in both traditional college course offerings and the open education domain. Moreover, such attempts make use of some inherit and powerful features of online delivery such as having no geographical boundaries.

The popularity of online course offerings, although presenting unique opportunities, casts many questions and/or challenges at the same time. For instance, some traditional course offerings in technical fields are already designated by groups of students as being difficult. One question/challenge is that what are the consequences of converting such offerings to hybrid or even fully online ones? Another question is related to the suitability of such offerings for various student groups. How higher education institutions particularly those involved in MOOCs generate revenue from such offerings to sustain such trend? How do students perceive such course delivery mechanism? How can academic integrity be enforced in fully online classes? A very central question is that how effective these offerings compared to traditional ones? The last question can be re-stated as: do students taking these online courses achieve the same learning outcomes compared with traditional classes? These offerings definitely pose many other questions but the above list is just a representative set not meant to be comprehensive. Rather, it just highlights some of these issues that need to be carefully addressed.

The wide-spread use of online courses along with the questions and challenges it poses (as described above) places high weight on the need for independent assessment of these offerings. Thus, this article emphasizes the importance of properly assessing such offerings to its continual success. It also describes a framework that has been used to analyze and evaluate the effectiveness of online course delivery in teaching computer programming courses. Moreover, the article summarizes the results of applying such framework to conduct a comprehensive, in-depth research study with the objective of evaluating the effectiveness of

delivering computer programming courses online and researching practical techniques for enhancing the quality of such offerings. In this research study, several important sets of performance metrics have been investigated. The first one focuses on measuring students' perception of the effectiveness of the online course. The second set assesses students' satisfactions with online course elements in comparison with the hybrid course. The third set is used to measure the levels of achievement of the Intended Learning Outcomes (ILOs) in fully online classes and to compare these levels with those obtained when teaching the same class using the hybrid delivery model. Lastly, a number of other success and involvement factors are also measured and analyzed in this study then compared with the same factors measured in hybrid offering. Large data sets have been collected over several years to ensure the significance of the statistical findings and the accuracy, applicability, and generalizability of the given conclusions. Such study not only presents a reliable evaluation of the effectiveness of online programming courses using several dimensions but also reports on interesting and significant findings.

A brief summary of the main objectives of this article is given below:

- Increase the awareness of various issues and challenges presented by the adoption of online course delivery particularly when used in delivering computer programming contents.
- Present a framework for evaluating the effectiveness of delivering computer programming courses online and researching practical techniques for enhancing the quality of such offerings.
- Report on the results of a direct assessment study that measured the learning outcomes and other success factors in online classes and compared them to corresponding values obtained when teaching the same course via hybrid format.
- Report on the results of measuring a number of indirect assessment factors such as students' perception and satisfaction in online courses and comparing them with the same measurement in hybrid course.

BACKGROUND

Given the focus of this article, the evaluation of online computer programming course, this background section briefly reviews representative attempts to deliver programming courses online. In addition, it succinctly presents a number of online systems and environments introduced to support such offerings. Lastly, it expounds some attempts to evaluate such offerings.

The past decade has seen attempts to deliver programming courses online by a number of academicians and a selected set of these trials is presented in this section. (El-Sheikh, 2009) reported on delivering an introductory programming course online and various techniques and tools used to promote student engagement in the class. In addition, that paper presented some of the lessons learned from such experience. Another attempt to convert a traditional course to Web delivery was presented in (Karsten, Kaparthi, & Roth, 2005). In that research, a traditional Visual-Basic programming business applications course was taught via the Web and other assisted software. The study presented simple analysis of the student satisfaction and concluded that the positive feedback received from the students is an indicative of the effectiveness of delivering the course online. (Pears et al., 2007) presented an interesting collection and classification of various research attempts on teaching introductory programming courses across various disciplines. This article not only reported best practices and lessons learned from successful attempts but also identified limitations and describes a number of active research areas. The details of offering an online object oriented course along with the course content, assessment, resources, and different delivery activities were described in (Unuakhalu, 2007).

Simultaneously, a number of online environments designed to support the development of programming skills began to gain popularity to cater for the needs of online offerings. These environments focuses on developing automated tools used to instill numerous programming skills on students while taking online programming classes. (Choy & Ng, 2004) addressed the issues associated with providing integrated programming environment, supplying timely feedback on programming exercises, and the efficient managing and handling of programming assignments. The environment provided focused mainly on asynchronous delivery of course contents. CodeLab is a Web-based

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