Implementing Blended Learning through Studio Courses

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Abstract—The Studio Model is one of the more popular approaches to achieve student centered learning. A studio course integrates theory with demonstrations and underscores the importance of collaborative and active learning on the part of students. While the student plays a more active role and participates in a number of face-to-face and computer assisted learning activities, the instructor assumes the role of facilitator of learning rather than a presenter of knowledge. Several studies have been carried out to establish the effectiveness of the studio approach. In this paper, we review the current international practices of studio classroom as means of achieving student centered learning; and share our initial experience of partially applying Technology Enhanced Active Learning (TEAL) approach to an undergraduate software engineering course. We also present some recommendations to design and implement studio courses at universities who plan to adopt studio courses as part of blended learning approaches.

Keywords—educational institutions; educational technology; computer aided instruction; electronic learning; computer science education

I. INTRODUCTION

Recently, there has been a strong push towards blended learning which is an approach that combines the traditional face-to-face classroom methodology with other types of computer assisted learning activities [1]. In fact in 2003, the American Society for Training and Development identified blended learning as one of the top ten trends to emerge in knowledge delivery industry [1]. One of the main reasons for the popularity of blended learning is that it leads to student-centered learning, as students get more freedom and shoulder greater responsibility for what and how they study [2]. There is significant evidence to suggest that student centered approach to learning, if implemented properly, is more effective compared to the teacher-dominated approach [3].

However, these new approaches are not without their challenges [4]. For instance, one of the common mistakes is to convert a traditional course into a blended learning course [5] instead of developing one from scratch. Therefore, a careful methodology must be followed in developing and implementing blended learning courses.

Studio course is one of the latest methodology to achieve student centered learning. The term was coined by Jack Wilson who used the name “studio physics” for his physics classroom at Rensselaer Polytechnic Institute [6]. A studio courses focuses on integrating lecture and laboratory material to facilitate active, collaborative and inquiry based learning.

Over the last few years, the number of studio courses has grown rapidly in a variety of disciplines such as physics, engineering, mathematics, humanities, social studies and management science. Several studies have been carried out to establish the effectiveness of the studio approach. However, there is still a need for a broad range study that draws on the experience of a significant number of studio implementations to understand the merits, pitfalls and organizational difficulties of introducing studio classrooms in universities.

Like all premiere universities in the world, King Fahd University of Petroleum and Minerals (KFUPM), Saudi Arabia has been actively exploring avenues to incorporate blended and student centered learning in its curricula. This paper analyzes one of the steps taken in the same direction. We present an overview of the literature on exiting studio courses and their influence on student learning. Furthermore, we share our initial experience of partially applying Technology Enhanced Active Learning (TEAL) concept, which is a popular studio methodology, at an undergraduate elective course at KFUPM. Moreover, we outline some concrete suggestions for the development of studio courses and how this concept can be customized for possible implementation in the Middle Eastern universities.

The rest of this paper is organized as follows. Section II presents the review of existing studio implementations. Section III discusses our experience of partially using the studio approach at KFUPM. We discuss some recommendations in Section IV and propose directions for future research.

II. OVERVIEW OF EXISTING STUDIO APPROACHES

Lately, the studio concept has gained acceptance in courses of theoretical as well as experimental nature. Perkins [7] defines a studio course as follows:

“A studio course seamlessly integrates the lecture and laboratory courses into a single course, devoting much of the class time to active, collaborative, inquiry-based learning. Concepts presented in the lecture can be explicated and reinforced by immediate hands-on laboratory experiences. The
characteristics of a studio course include: integration of lecture and laboratory courses, longer and fewer class meetings, increase in student activities emphasizing collaborative and cooperative learning, and shifts in instructor’s role from presenter of knowledge to facilitator of learning.”

The basic idea is that students are given something interesting to investigate. While they work in teams on these hands-on measurements or observations; and complex problems, the instructor is free to roam around the classroom – asking questions, sending one team to help another, or asking why someone else got a different answer. There is no separate lab class and most of the “lectures” are actually class wide discussions. The groups are carefully structured and provide students many opportunities to interact.

Student Centered Active Learning Environment for Undergraduate Programs (SCALE-UP) and Technology Enhanced Active Learning (TEAL) are the two popular strategies for transforming traditional classrooms into learning environments that support active and engaged learning for students [6].

Figure 1 shows an example layout of a TEAL classroom. A typical TEAL (or even SCALE-UP) classroom consists of an instructor’s desk, round tables, whiteboards and multimedia projectors. A table has nine students arranged in three groups of students. Each group is formed by mixing students with different levels of knowledge to facilitate peer learning. Furthermore, each team has access to internet to view lecture slides, supporting materials and collect/document group activities. The original design calls for 11 to 13 tables, but many academic departments have smaller classes while a few have even larger ones.

![TEAL Classroom Layout](adapted from [8])

Several individual case studies have been carried out to measure the effectiveness of studio classrooms [6, 9, 10]. However, all these studies have limited scope and usually discuss the experience acquired during the delivery of a single course [11–13]. In addition, the evidence provided for the success of studio approach is mostly in terms of student and teacher satisfaction and better attendance rates. There is still a need for a broad range study to understand the benefits and difficulties of studio approach across different subjects. Table I presents examples of studio courses offered at various international universities.

<table>
<thead>
<tr>
<th>Institution Name</th>
<th>Course(s)/subject areas</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Clemson University</td>
<td>Calculus and Differential Equations</td>
<td>[14]</td>
</tr>
<tr>
<td>2. Georgia Southern University</td>
<td>Physics</td>
<td>[10]</td>
</tr>
<tr>
<td>3. Griffith University, Australia</td>
<td>Introductory Planning</td>
<td>Course Website</td>
</tr>
<tr>
<td>4. Harvey Mudd College</td>
<td>Engineering Design</td>
<td>[12]</td>
</tr>
<tr>
<td>5. Illinoi State University</td>
<td>Geology, Microscopy Courses</td>
<td>[15]</td>
</tr>
<tr>
<td>6. Kansas State University</td>
<td>College Algebra, Statistics</td>
<td>KSU Website</td>
</tr>
<tr>
<td>7. Massachusetts Institute of Technology</td>
<td>Technology Enabled Active Learning (TEAL) courses</td>
<td>[10]</td>
</tr>
<tr>
<td>8. Massachusetts University</td>
<td>Software Design</td>
<td>[16]</td>
</tr>
<tr>
<td>9. Mercer University</td>
<td>Ergonomics and Human Factors</td>
<td>[17]</td>
</tr>
<tr>
<td>10. National College of Ireland, Ireland</td>
<td>BSc in Software Systems</td>
<td>[18]</td>
</tr>
<tr>
<td>11. New Jersey Institute of Technology</td>
<td>Biomedical Engineering</td>
<td>[19]</td>
</tr>
<tr>
<td>15. University of Western Ontario, Canada</td>
<td>Aircraft Design</td>
<td>[13]</td>
</tr>
<tr>
<td>16. Washington State University</td>
<td>Algorithms (Computer Science)</td>
<td>[20]</td>
</tr>
</tbody>
</table>

The institutions are located in the United States of America unless otherwise stated.

http://www.math.ksu.edu/math100studio/fall-2011/

III. STUDENT COURSE EXPERIENCE AT KFUPM

In this section, we share our experience of applying the concept of studio to an undergraduate software engineering course being taught at KFUPM in the spring semester of 2012–
2013. The course SWE 487 – Software Processes and Process Improvement is a fourth year Bachelor of Software Engineering technical elective course with an enrollment of twelve students.

The TEAL approach was selected to teach SWE 487 because software processes and process improvement concepts are abstract and lack usual visualization associated with software models developed using languages such as Unified Modeling Language (UML). Hence, using lectures as a sole method of delivery had the potential of rendering the course passive. This could potentially have led students to lose interest in the course material. Furthermore, we aimed at incorporating assignments and project based learning as fundamental tools to teach the course.

Since we did not have a custom-built TEAL classroom available, we adapted the TEAL approach according to our logistic constraints.

A. Learning Objectives

In studio SWE 487, class activities are designed to develop conceptual understanding of software process maps and enhance problem solving skills for identifying the risks associated with existing processes in an organization. The fundamental learning objective is to facilitate students in gaining hands-on experience of dealing with different process areas and practices suggested in popular software process models such as CMMI, six sigma etc. The additional objectives are to develop collaborative learning and communication skills in students.

B. Logistics

During a class activity, the traditional class room is transformed into a TEAL room by rearranging student chairs into two team stations. Each team station has six students which are further divided into two groups that work collaboratively for a given task.

Each student is encouraged to use his laptop/tablet or smart phone to access SWE 487 teaching materials from Blackboard. Furthermore, Google Drive is used as a cloud service to store and share the solutions created by individual groups for a given activity.

C. Delivery

SWE 487 has two weekly lectures and duration of each lecture is seventy five minutes. For a given TEAL activity, the instructor delivers a 15 minute recap lecture on the topic followed by discussion questions and pen-and-paper or computer based exercises. Students are encouraged to discuss among themselves to help each team station prepare and share their solutions.

The instructor also joins each team for discussions, raising conceptual questions to facilitate better learning for the given topic.

D. Assessment

It is important to note that this is the first instance of implementation of a studio course at KFUPM. We therefore decided against including TEAL-based class activities towards the final letter grade assessment of students. Instead, these activities were counted towards the class work grades of the students.

E. Evaluation

The course is still in progress and only informal evaluations have been done to judge the usefulness of adopting TEAL methodology. Students have indicated that they are able to better understand the software process concepts by discussing and answering conceptual questions and case studies. Furthermore, they also have highlighted the benefit of peer learning and consultation.

IV. RECOMMENDATIONS AND FUTURE WORK

We believe that blended learning through studio courses has a lot of potential to enhance student learning by focusing on group interactions that facilities knowledge sharing, peer instruction and overall better understanding of topic’s core concepts. Based on our experience, we recommend consideration of the following matters for successful adoption of blended learning through studio courses.

- **Faculty Awareness** – Training sessions should be arranged to increase awareness of TEAL, SCALE UP and other studio teaching approaches among instructors. Faculty members can only paint a clear picture for students after they understand the idea completely.

- **Selecting Suitable Courses** – Studio methodology requires a cultural shift in teaching methodology. Hence, careful selection of courses is fundamental to its success. We recommend identifying technical elective senior year courses to run pilot offerings.

- **Curriculum Development** – There is a need for university wide initiative to develop curricula for studio courses from scratch. A simple modification of traditional teaching materials can be detrimental to studio courses.

- **Logistics** - We believe logistics in terms of lack of custom-built studio classrooms should not be considered as a show-stopper.

This paper discusses our initial experiences of introducing studio approach in an undergraduate software engineering course. The course is still in-progress and will run till the end of May, 2013. We are currently planning a survey to seek student input on studio methodology. The survey will be targeted at understanding student perceptions of studio, their preference between studio and traditional courses and their feedback on studio SWE 487 in particular. We believe the findings of the proposed survey will help us in improving studio SWE 487 to provide greater benefit to students. It is also hoped that these findings will lead to a feasible studio model that would be extendable to other courses at KFUPM.

The studio approach, though gaining in popularity, is relatively young and there is a lot of room for further investigation. It is important to learn from the experiences of
others while keeping in mind that what works in one place or subject area will not necessarily work in another.

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