

IT Enabled Blended Learning for Imparting Practical Education: An Empirical Study

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Summary

Information technology is transforming the landscape of almost every sphere of mankind's daily life and education is no different. Modern trends in education in general and higher education in particular are pointing towards increased use of Information Technology and Communication tools (ITC) on a global scale. Online education, virtual education and blended learning have been some of the concepts which have entrenched themselves in academic environments all over the world in 21st century. IT is quickly becoming the cornerstone of imparting good education at all levels with provision of effective and purpose oriented tools and technologies. However a lot of questions have been raised over efficacy and efficiency of these emerging IT applications in imparting education for scientific and applied sciences domains. In this paper, the data collected over the last three years at Saudi Electronic University for Programming related courses in blended learning environment has been presented and analyzed with special emphasis on performance of IT tools being deployed. The results show the efficacy and efficiency improvements gained in delivering technical and practical education such as programming knowledge when taught with the help of IT technologies.

Key words:

Information Technology, Blended Learning, Collaborative Education, Learning Management Systems, Saudi Electronic University, Programming.

1. Introduction

Information technology is striving to revolutionize the way teaching is carried out. Blended Learning is one of the recent advancements in the education and learning domains and relies heavily of ICT technologies. Since the start of 21st century, new innovations in the domain of Information technology and leap frogging improvements in communication technology have made it possible to impart distance learning to almost every corner of the world thereby enabling mass populations of youth with skills, tools and technologies of our times. The academia has experienced with distance learning, online learning and virtual learning over the last few decades with mixed results. Online blended learning has evolved as a middle ground solution which encompasses the strengths of both traditional and virtual education while minimizing the difficulties and disadvantages of both models. Information

and communication technologies have played a great role in improving the methods of blended learning.

In blended learning the contact hours for teaching are divided in an appropriate ration between traditional class room based learning and virtual learning using a learning management system and other related tools and software. This ensures that students have the very important element of a physical teacher available physically to educate and guide them. But the presence of teacher is not limited to the class room or physical boundaries of academia. Blended learning ensures that using various software tools available such as learning management system, assessment tools, grading and evaluation tools and other software, the instructor is also available to the students even when the students are not required to be on campus. Just like teaching, the assessments are also blended with examinations essentially to be held on physical academic hounds while other assessments can be divided in online and traditional manner. In this way with the vital support of IT, blended learning ensures availability of instructors to the students on almost round the clock basis while at the same time making sure that student is connected to the academia in a traditional physical manner as well which has been found to be essential for overall grooming of the students. This combination of both traditional and virtual learning has made blended learning a favorite medium of education for increasing number of colleges and universities all across the world.

Kingdom of Saudi Arabia embarked on ambitious program of blended learning when it established Saudi Electronic University in 2011. Selection of modern IT support and software acquisition was the first major consideration in this regard. After its establishment, the university expanded with an amazing speed having branches in ten major cities of kingdom with colleges of IT, Health Sciences, Management, Basic Sciences and Linguistics, These colleges are currently delivering education and undergraduate and graduate levels. Within four years of commencement of regular classes, the number of students today has crossed five thousand all over kingdom. The university implements strict quality standards in delivering education and development of academic content. In this regard, SEU has several collaboration agreements with leading LMS developers such as Blackboard and Banner system. The university collaborates actively with several

leading universities from United States in development of academic contents, professional development of its faculty members and preparation of assessment tools. These collaborations are also managed using state of the art IT applications guaranteeing 24 hours error free accessibility on both ends. The learning process is divided into traditional class based and virtual learning in equal proportions (50% of time is allocated to traditional learning with remaining 50% for virtual education).

The paper attempts to answer one of the most frequently asked questions about efficiency and efficacy of using virtual or blended learning with extensive IT support when imparting education for lab intensive practical courses. To measure the quality of learning model adopted by SEU for such kind of courses, the college of computing and informatics (CCIT) at Saudi electronic university gathered and analyzed the data for programming courses. The data is presented and analyzed in this paper which highlights that in most areas, the blended learning model was not only able to impart education in a very good manner but it also performed exceptionally excellent in many of these aspects. The paper is divided in such a way that after this introduction, a small literature review is presented to highlight the current developments in academic research in section II. Section III gives an overview of programming teaching methods at CCIT in SEU. Section IV describes the results and analyzes them which is followed by a conclusion and future work.

2. Blended Learning and Information Technology: A Literature Review

Virtual education has gained mass acceptance in last three decades. Since the beginning of 21st century leading researchers have been writing about the scope and potential of virtual education. Tapsall and Ryan in 1999 wrote from an Australian perspective and described the evolution of future learning models in terms of three phases: distance education, open learning and flexible learning which later transformed into blended learning [1]. As early as in 2000, Stephen Ehrmann [2] had declared that, "Many institutions are searching for a unifying vision to guide their investments in teaching, learning and technology. Some of them hear a thundering herd of innovations collectively referred to as distance education and learning anytime anywhere for anyone and are wondering if their campuses even have a future." Although later developments demonstrated very well that there is no substitute of traditional learning which needs to be preserved while reaping the benefits of virtual learning tools. However these later developments also demonstrated that the future of a vibrant successful education system lies in effective integration of IT systems most notably LMS with traditional teaching methods. In

2013, Taras et al. evaluated the effectiveness of global virtual examination using IT systems by analyzing the data coming from 43 countries [3]. However, their research didn't answer the question about its efficiency in specific lab oriented courses and programs. Ton De Jon et al. in 2013 defined the basic requirements to develop effective IT based virtual labs for imparting education for such courses in virtual environment [4]. In 2014, Xi Zhang listed and defined the cultural effects needed to be taken care of when delivering practical education in virtual environment [5]. In 2014 and 2015, several studies appeared in leading research journals which highlighted the importance of study of effects of virtual learning in lab oriented programs [6, 7, 8, 9].

In 2006, Bonk and Grahm proposed that it is imperative to blend virtual education with traditional learning to overcome the problems being faced with virtual academic environments [10]. The proposed this new model as blended learning and their work gained a lot of prominence. Lim et al. in 2014 performed a quantitative survey to demonstrate the effectiveness of blended learning for imparting technical education as compared to pure traditional as well as online learning [11]. Mikealsson et al. in their work also discussed the importance of various factors to be considered when using blended learning for engineering and other lab intensive courses [12]. In their work Garrison and Vaughn highlighted the management structure for effective utilization of blended learning for engineering and IT programs [13] while U Matzat in his paper squarely established through empirical survey the qualitative advantage of blended learning over purely traditional education [14].

This small literature review is aimed at highlighting very briefly the current state of affairs in the domain of virtual as well as blended learning. The literature amply highlights the need to experimentally validate the performance of blended learning for lab intensive programs such as engineering and programming. In this paper, the same effort has been made. 3. Paragraphs and Itemizations.

3. Computer Programming Education at SEU: Salient Features

Computer Programming has a very significant portion in the academic program of BSIT is CCIT in Saudi Electronic University. At the beginning level the students are taught computer programming in their second year of BS program in two consecutive semesters as Computer Programming 1 and Computer Programming 2. In these courses, the students are taught both procedural as well as object oriented programming. The platforms for teaching are C and Java programming languages. Later in third as well as final year, the students study some further

advanced courses to hone their professional programming skills. These courses include web technologies, enterprise systems and mobile application development. All of these courses are 3 credit hour courses. In this paper, we would present and analyze data about the first two courses i.e. Computer Programming 1 and Computer Programming 2. The teaching of these courses though carried out in traditional and blended environment is highly IT enabled. Salient features of teaching these courses are:

1. Teaching for each of these courses is divided equally into class room based and virtual based learning.
2. All the contents developed for these courses are developed under the collaboration of faculty members at SEU and faculty members at Franklin University, USA. These contents include study notes, test banks, lecture slides, online assignments, quizzes and discussion boards etc.
3. Blackboard is used as learning management system to host the course contents. All the contents are organized in weekly manner.
4. Blackboard collaborate is used as collaborative tool to conduct virtual class sessions as well as assignment and project demonstrations.
5. The participation of students in classroom as well as virtual session is mandatory. The attendance of students in virtual session is automated by blackboard collaborate itself (though course instructor can conduct the attendance manually as well)
6. The quizzes are first integral part of student assessment. Quizzes are prepared by the course instructor which can comprise of MCQ, True/False and Fill in the Blanks kind of questions. Tools provide flexibility of juggling questions from one student to the other. Tool provides option of multiple attempts to encourage students to learn and practice more however; the questions would change in every attempt.
7. The assignments are second important assessment tool which relied heavily on blended learning tools. The assignments include both academic and analytical involving coding assignments. In each semester, students are required to attempt 5-8 assignments with at least 60% assignments mandatory to be analytical and practical.
8. Class projects are third and probably most significant practice as well as assessment tool. In computer programming 1, the projects are group based whereas in computer programming 2, the projects are mandatory to be individual.
9. Students are required to participate in discussions via discussion boards provided by blackboard learning management system. The learning materials provide mandatory reading materials for

the students to study and give required input on discussion boards.

10. The system provides asses to thousands of scientific databases with the help of Saudi Digital Library for the students to make use of when preparing for their assignments and projects.
11. Instructors are required to be in contact with students on round the clock basis. Some tools employed by university in this regard include announcements, E-mails and Blackboard Instant messenger.
12. The policies of the university stipulate that instructors not only deliver learning material with the help of blackboard collaborate but they also make use of whiteboard as well as application and desktop sharing to practically demonstrate the programming activities.
13. It is mandatory for the student to demonstrate the work they performed on their projects on blackboard by providing assess to the students to share their desktop and perform execution of their developed project and show the coding carried out by them. They also use whiteboard to write their comments. The instructors as well as peers can ask questions to the demonstrating group which they need to answer.
14. The blended learning tools including blackboard provide support to the students to record learning sessions for future reference. Students can also raise questions in writing, in chat conversation and with audio-visual support which the instructors need to answer.
15. On traditional side, instructors guide the student about each week learning material with reference to specific learning outcomes defined for material on weekly basis. At least 50% of contact hours for each course are allocated to class room based learning.
16. Instructors are asked to display and follow their office hours when they are required to be present in their offices and answer queries of students.
17. The midterm examination and final examination is strictly traditional model based. The examinations are prepared in consultation with all involved instructors and their active contribution. The examinations are properly vetted to be in conformance with learning outcomes of the courses. Each examination is required to have defined percentage of analytical and practical questions.
18. With the help of online tools and analytics, students remain informed of their current academic performance, attendance, grading and shortcomings.

As is evident from the salient features embedded in the learning of practical programming courses at Saudi Electronic University, the support of tools in blended learning ensure valuable support to traditional learning. The application of these tools not only ensures better learning but these prove valuable in enhancing the performance of academic activities manifold. In the next section, the analysis of experience gained over past three years of application of these tools is described and analyzed.

4. Application of Blended Learning Tools: Analysis and Discussion

The data as used in this paper was accumulated from three academic years spanning 2013, 2014 and 2015. The statistical tool used was average % which was collected by combining the values for both Programming 1 and Programming 2 in progress during that semester. In table 1, various parameters recorded by Saudi Electronic University for programming courses discussed in this study are presented. These parameters present several interesting aspects about academic activities carried out with respect to practical oriented courses.

Some interesting findings of the experiment include:

1. As the data suggests, one important highlight is that class performance increases if the section strength is maintained in mid-twenties. With the increase in number of students, class participation gets affected adversely. Second interesting finding of the data is that average student participation in virtual hours is significantly higher than traditional learning. These trends are highlighted in figure 1.
2. The statistics show that students have shown constant upward trend in their assignment, quiz and project submission. However, the student performance in quizzes as assessment tool has slight edge over assignments. However, the results show a much superior project submission rate than traditional learning environment. These trends are shown in figure 2.
3. The results show that average satisfaction of students as well as instructors is quite high in blended learning environment. This is much better than the one we usually encounter in traditional learning environment. The results also show that Instructor satisfaction with the teaching imparted by them is significantly very good. The compliance with learning outcomes defined prior to start of academic session is almost 100%. The results highlight enhanced level of student attention retention in virtual sessions which is a

very strong advantage of blended learning environment. These results are shown in Figure 3.

Table 1: Learning Parameters for Programming Courses in SEU

Academic Parameters	Fall 2013	Spring 2014	Fall 2014	Spring 2015	Fall 2015
Avg. # of students per section	24	22	28	25	29
Avg. % Class Participation (Traditional)	81	87	83	83	84
Avg. % Class Participation (Virtual)	91	98	96	97	95
Avg. % Assignment Submission Trend	88	86	90	92	92
Avg. % Project Submission Trend	92	95	95	95	97
Avg. % Compliance with Learning Outcomes	98	97	100	100	99
Avg. % Student Satisfaction	82	83	87	86	90
Avg. % Teacher Satisfaction (%)	94	97	98	97	95
Avg. % Student Attention Span in Virtual	77	81	79	80	77
Average Discussion Posts per Student	3	5	4	3	3
Avg. Hours for Instructor to reply Email	19	24	22	18	19
Avg. % of Quiz Participation Trend	96	99	98	98	99
Avg. Quiz attempts per Student	2	4	3	2	3
Avg. % Plagiarism committed in Assignments and Projects	14	13	15	17	17

4. The results show that students on average attempted each quiz multiple times. This helps in better learning for the students as they are subjected to different questions every time they make a new attempt.
5. The results show that use of blended learning tools enable instructors to cater for student's collective as well as individual academic needs on a more efficient basis. As results show. The programming instructors were able to answer each student email with one day on average.
6. One worrying factor as highlighted in the data is prevalent plagiarism rate. There is a need in the academic environment to make students consciously aware of the menace of plagiarism. However, this also goes to the credit of application of blended learning tools that they helped the instructors in capturing the plagiarism committed by the students in timely manner thus encouraging healthier academic practices.

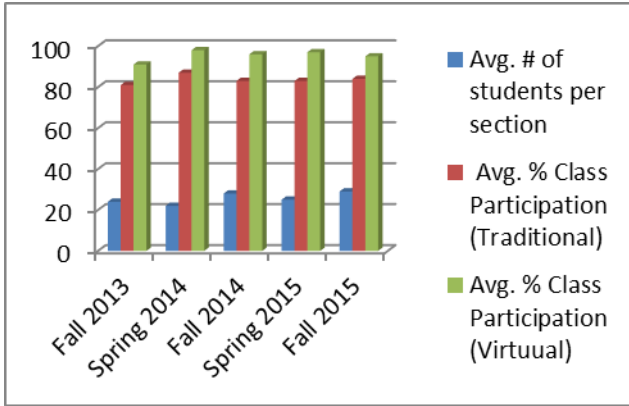


Fig. 1 Class Participation Trends in Traditional and Virtual Environments

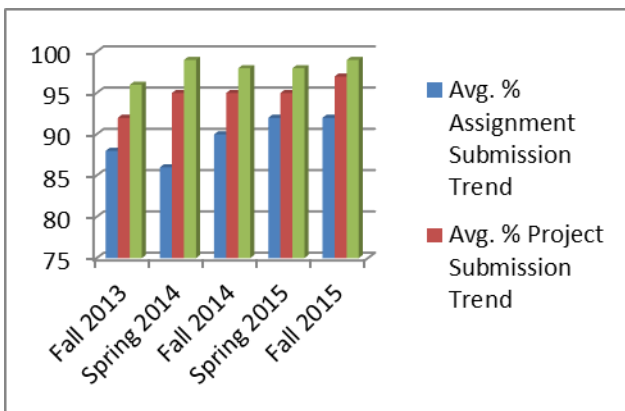


Fig. 2 Avg. % Trends for Assessment Tools in Blended Learning

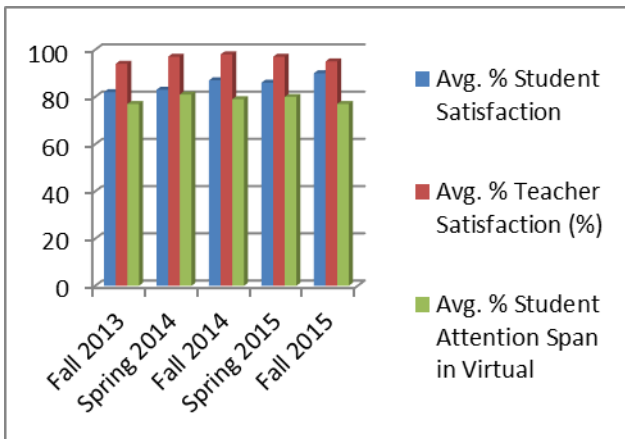


Fig. 1 Stakeholder Satisfaction and Attention Span

5. Conclusion and Future Work

In this paper, an empirical study has been presented to highlight the effectiveness of using IT enabled blended learning for lab and practical intensive courses. Blended

learning has emerged as one of leading models of learning in 21st century. This medium of study relies heavily on application of IT tools and techniques. There was a need to empirically measure the effectiveness of using blended learning for applied and lab intensive courses. In this paper, data regarding several academic parameters for Programming courses taught at CCIT in Saudi Electronic University has been presented and analyzed. The data was compiled over the period of last 3 years from 2012 to 2015. The results clearly show that using blended learning for teaching such technology oriented courses not only delivers satisfactory results but in several dimensions, performs much better than traditional learning. Blended learning has shown to encourage students to attempt more assessments, increase attention span, help instructor in maintaining effective communication with students and several other aspects.

In future, work should be done to gather similar data in several other academic disciplines to determine if the same trends hold for other lab intensive programs such as engineering, medicine etc. This will immensely help in identifying further scope and application of ICT technologies to strengthen education. There is a need to include more academic parameters to make the findings more comprehensive.

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