Blended Learning Approach for Engineering Education –An Improvement Phase of Traditional Learning

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Abstract
Engineering education is so complex to understand when teaching by teacher face-to-face (F2F) with the students in conventional education system. To overcome this problem of conventional teaching of engineering education we demonstrate architecture of blended learning (BL) that helps learners to bring their experiences and ideas to the intellectual conversion.

Keywords
Blended learning, face-to-face interaction, Conventional teaching, Self regulated learning.

1. Introduction

Blended learning approach for engineering education system enriched the learners learning capacity than traditional learning system. This paper suggest a cost-effective architecture to transform existing learning spaces into effective spaces that enable better learning and collaboration, given the resource limits of a university setting. A cost-effective infrastructure needs for building ubiquitous collaborative learning spaces. It uses techniques from the Semantic Web and ubiquitous computing to build a learner-centric service-based architecture to transform existing traditional learning spaces (e.g., classrooms, computer labs, meeting rooms, and hallways) into intelligent ambient learning environments. This is achieved by blending a number of inexpensive technologies which are optimally configured to provide services that can perceive a learners' location and schedule, identify current learning activity, recommend learning resources, and enable effective real-time collaboration and resource sharing between learners and their instructors [1]. This paper suggests a cost-effective architecture to transform existing learning spaces into effective spaces that enable better learning and collaboration, given the resource limits of a university setting. Interaction analysis can help understand the practice and development of Self-Regulated Learning (SRL) in Virtual Learning Communities (VLCs). To this end, a set of SRL indicators is proposed to spot clues of self-regulated events within students' messages [2]. Practical experiences acquired in design, realization and implementation of interactive e-learning project located on the educational portal for students called "eLearn central". This portal is permanently being used in the distance and blended learning at Slovak University of Technology University, in the popularization of Science and Technology between kids and young people and for team work in everyday business life [3]. Over the past decade, online learning has become an increasingly popular option among post secondary students. Yet the higher education community still regards fully online courses with some ambivalence, perhaps due to the mixed results of a large (if not necessarily rigorous) body of research literature. On the one hand, research suggests that students who complete online courses learn as much as those in face-to-face instruction earn equivalent grades, and are equally satisfied [4]. On the other hand, online students' are less likely to complete their courses [5]. Online learning adaptation which contains five aspects: online learning environment, online learning motivation, online learning mode, online learning ability, online learning efficacy and achievement. The research takes the example of Guangxi University undergraduates to survey online learning adaptation. The results show that the total level of college students' online learning adaptation was relatively low [6]. In many cases, student learning outcomes in online courses are superior to those in traditional face-to-face courses [7]. To address the issue of quality assurance and online teaching and learning the authors are looking at a two phase process, the first of which is the development often initial audit tool examining online technical aspects followed by the collaborative development of a peer review process centered on pedagogical issues [8].

2. What is Blended Learning

Blended learning is a formal education program in which a student learns at least in part through online delivery of content and instruction with some element of student control over time, place, path, and/or pace. While still attending a "brick-and-mortar" school structure, face-to-face classroom methods is combined with computer-mediated activities. Proponents of blending learning cite the opportunity for data collection and customization of instruction and assessment as two major benefits of this

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approach. Schools with blended learning models may also choose to reallocate resources to boost student achievement outcomes [9]. Blended learning as a formal education program in which a student learns at least in part through online learning, with some element of student control over time, place, path, and/or pace; at least in part in a supervised brick-and-mortar location away from home; and the modalities along each student's learning path within a course or subject are connected to provide an integrated learning experience [10].

3. Background and Related Work

As mobile and wireless technology rapidly advances, new physical and virtual learning spaces are changing the way learner's access and share resources, acquire knowledge, and interact and collaborate with each other. In these modern ubiquitous learning spaces, technology can move beyond the relatively predictable wired classroom computers and dissonant presentation systems. Learning technology expands to include diverse embedded sensors, wireless instructional devices such as handheld computers, and a variety of interconnected technologies. These platform advancements pave the way for context awareness, ubiquitous computing, and semantic web technologies to create innovative learning interactions. These enhancements allow learning to expand beyond the classroom to labs, field-trip locations, meeting rooms, and even hallways and study areas. Thus, offering various cooperative learning opportunities, enabling a higher level of reasoning, a deeper level of understanding, a greater motivation to learn, and greater social competencies [11]. With all these concerns, designing ubiquitous collaborative learning spaces becomes a complex and challenging task that involves many computational and learning paradigms. This paper proposes a solution to some of these challenges, in particular, those related to context perception and management of learner/activity mobility, social and intellectual interactions, and seamless knowledge dissemination and sharing. Before addressing these challenges, we first survey some of the ubiquitous learning systems reported in the literature. There are many existing technologies that have the potential to be developed into powerful learning enhancement tools [12, 13, 14, 15, 16, 17]. The uClassroom [18] project is a more modern ubiquitous computing environment that is designed for school applications, created at Nagoya University of Japan. It uses context to provide optimized educational information via a web interface. While uClassroom mentions location data as part of its context awareness, it is not intended to provide any potential system for attaining this location information. Additionally, it does not involve the communication between individual systems, limiting potential applications in collaborative and peer-to-peer situations. KERIS, a leading e-learning organization in Korea, has developed a ubiquitous smart classroom environment called uClass [19]. Most of the references that have mentioned in this paper describe about the e-learning based education system where they have told about the learning process through only web services. Reference [1] mentioned only about the learning spaces. They described about the spaces of classroom, computers lab, meeting room and hallways and existing research going on blended learning through mobile based services. But these papers don't mention that how the blended learning approach can be applied in the class-room of engineering education? Our proposed idea has mentioned the blended learning approach that combines both F2F interaction and online services through our website. Since it is regulated by teacher so its importance not negligible and also analyzed the percentage of blended learning components that helps to make interesting lecture.

4. Case Studies

To analysis the different engineering courses on the basis of BL we have divided our academic educational system into three categories, such as Arts, Science and Commerce. Under these categories the different subjects (we have analyzed only five subjects) are compared with BL approach by the help of teachers and students. This comparison was done on the basis of how a teacher makes lecture interactive with the help of BL components and how students understand a lecture easily. Here MR represents Maximum required and LR represents less required.

Table 1. Necessity of Blended Learning in Different Courses Under Three Disciplines

Discipline	Subject	F2F	e-learning	Presentation	Audio	Video	White Board
Arts (Humanities)	Political Science	MR	LR				
	Economics	MR		LR			MR
	English	MR			LR		MR
	History	MR	MR				
	Geography	LR		MR		MR	
Science	Physics	MR	LR	MR			LR
	Mathematics	MR		LR			MR
	Chemistry	MR	LR	MR			MR
	Biology	LR		MR		MR	LR
	Computer	MR	MR	MR	LR	MR	LR
Business	Finance	MR		LR			MR
	Accounting	MR		LR			MR
	Management	LR	MR	MR			
	Marketing	LR		MR	LR	LR	
	Banking	MR	LR	MR			

Since traditional learning approach cannot make lecture interactive especially in the discipline of engineering, it is quite impossible to accurately understand the engineering subjects. So we have performed a survey on the ICT discipline of engineering categories with the interviewing of teachers and students. In this table we find that every subject of ICT discipline mostly required BL components to present and understand a subject.

Table 2. Necessity of Blended Learning in Different Subjects of ICT Disciplines

Subject	F2F	e-learning	Presentation	Audio	Video	White-Board
Algorithm	LR	MR	MR		MR	LR
Microprocessor	MR	LR	MR		MR	LR
Operating System	LR	MR	MR		LR	
Data Structure	LR	LR	MR	MR	MR	LR
Database	LR	MR	MR		LR	
Distributed System	LR	MR	MR		MR	
Graphics	LR	MR	MR			LR
Artificial Intelligence	MR	MR	LR	LR	MR	
Computer Architecture		LR	MR		MR	
Networking	LR	LR	MR		MR	LR
Telecommunication	LR	MR	MR		LR	LR

Above table were the engineering categories of ICT discipline. There without BL, subject lecture cannot make interactive to the classroom. From Table-2 and Table-3 we have concluded that the engineering discipline of different departments needs BL approach to presents the class lectures effectively. So traditional learning cannot ensure the possibility of learning capability successfully that already done by our BL approach.

Table 3. Comparison of Different Engineering Discipline on the Basis of Blended Learning

Engineering Discipline	F2F	e-learning	Presentation	Audio	Video	White-Board
EEE	MR	MR	LR			MR
CSE	LR	MR	MR	LR	MR	LR
ECE	LR	MR	MR	LR	MR	LR
MEE	MR	MR	LR			LR
Civil	MR	LR	MR			MR
Textile	MR	MR	LR		LR	LR
Architecture	MR		MR	LR	MR	

5. Methodology

A. Self Regulated Learning (SRL):

SRL helps to the students to improve in engineering education which is cumulative with blended learning. It also guides the student's abilities to plan, monitor, and evaluate their own learning process; these can be investigated by spotting the learner's active contribution to: choosing learning objectives and contents; working out or adapting learning strategies; suitably configuring the learning environment; evaluating learning results by comparing one's outcomes with the outcomes of peers and with models possibly provided.

A. Blended Learning for Engineering (BLE):

$$BL = \frac{(F2F + EL + PPT + AD + VD + WB)}{\text{Total No. BL Components}} 100\%$$

$$f(BL) = \frac{\sum_{i=0}^{n}(BLC)}{N} 100\%$$

F2F→ face-to-face, EL→ e-Learning, PPT→Presentation, AD→ Audio, VD→ Video, WB→ Whiteboard, BL→ Blended Learning

We have identified an equation to find out the required percentages of blended learning approach on the different discipline of our education system. From the above discussion we find that the following tables percentage ratio of blended learning. Where engineering disciplines are required 78% our approach of Blended learning.

Table 4. Percentages of BL approach

	Applied Science	Arts (%)	Business (%)	Engineering (%)
Blended Learning (BL)	65 %	40%	55%	78%

6. Website Development

We have developed a programming tutorial site in Bangla using ASP.NET4.5 MVC4, Entity Framework and Razor view engine and uploaded it on the internet [10].We have developed it to give tutorials on different programming languages so that Bangladeshi students can easily understand the programming problems, get ideas about the problems, generate ideas and implement it in the program [20].

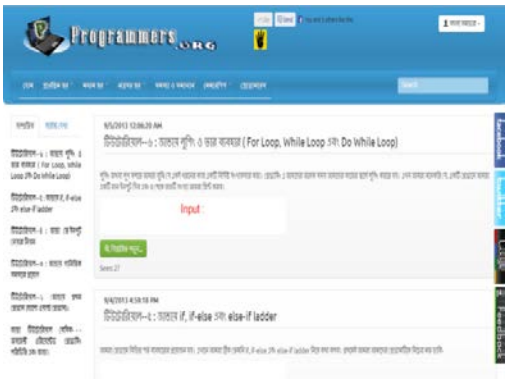

Figure 1. Bangla programming website

7. Data Collection Based on Learning Process and Experiences

We did a survey on the 2nd and 4th semester students of PSTU, CSE on the basis of BL. We provided programming related tutorials to both 2nd and 4th semester students. Video and text-image-animation based tutorials were provided to the students that distributed into two ways. We divided the students into two categories. i) The students whose are going to learn JAVA programming and ii) The students whose already learned JAVA programming.

Firstly video tutorials then text-image-animation were given to the 2nd semester and secondly text-image-animation then video tutorials were given to the 4th semester students. Both levels of student were prefer to video than text-image-animation based tutorial for understanding programming like Java, C/C++. This process was completed by our developed website and also given opportunity to collaboratively learn through social site or group discussion before the class lecture day. They practiced the lecture topic and come to the class room where teacher and students discussed F2F with one another. As a result, the students could be able to giving response quickly and they had understood the lecture topics easily. So idea's identified by F2F interaction of teachers and students in the class room. Problems they faced and solved the problems. Then we tried to find new ideas related to the problems and what can be the solution of those problems. After solving the problems we collected an online survey [21]. Answers of the questionnaire from the respondents are represented by different chart in the following sub-sections. In our survey we selected 100 participants. From the participants both of 2nd Semester and 4th Semester were 50%. They were divided into two groups and attended in two categories. We took the survey in two different times from two groups.

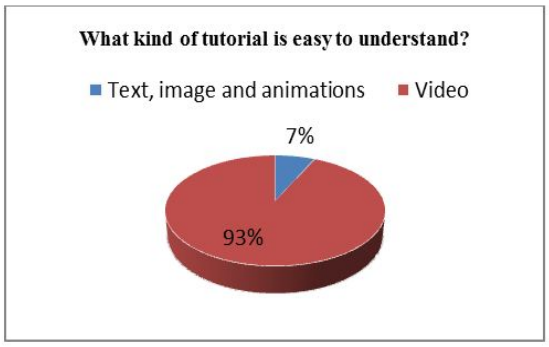

Figure 3. Pie chart of answer of the question

From the above chart we have found that participants can easily understand any problems from video tutorial than website textual format. Only 7% like to see text, image and animation related tutorials.

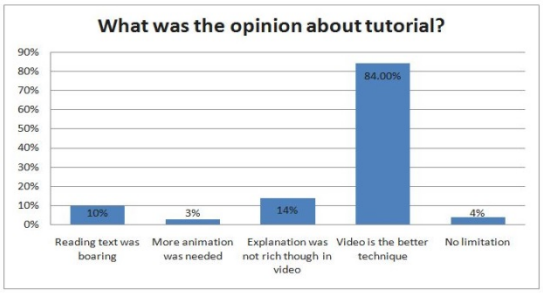

Figure 4. Column chart of answer of the question

We divided our total sample into 5 categories based on tutorial pattern and they have given their opinion where-10% reading text don't like, 3% need to more animation, 14% explanation was not rich, video is better technique and 4% no limitations.

8. Experimental Result

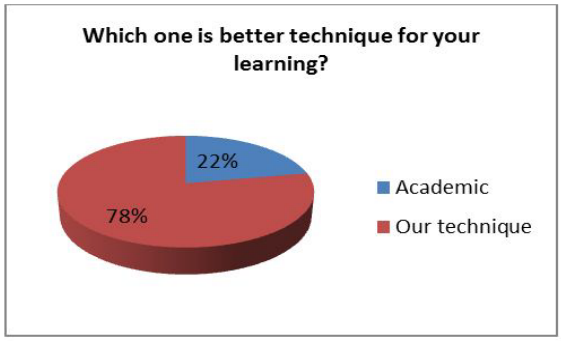

Figure 6. Pie chart of answer of the question

Hopefully, 78% students supported our teaching technique and only 22% students told that the academic learning

technique is better. So we have found a positive sign for our research.

8. Proposed Idea

Face to face teaching system in the class room with only white board and marker cannot make interactive lecture first time of any subject. In engineering discipline's most of the students cannot get more attention to the class lecture because of traditional learning system. To improve the teaching and learning of traditional learning system we have proposed that the teachers' will upload his/her lecture/tutorial with video, audio, presentation or other related resource of a lecture in the university website before the class day. The students will download these resources and see it first then read the text lectures/tutorials; they also share this lecture with group through social media or other process so that they will be more able to understand about topics. After acquisition knowledge on that topic, students will come to the class room. On the next day the teacher and students can discuss with the topic and then the students can ask questions, provide their ideas easily. Therefore the class can be more effective than the traditional
teaching system. This blended learning (BL) approach is indispensable now in the engineering institutions for better understanding in engineering education.

9. Architecture and System Design of Blended Learning

To alleviate the traditional teaching problem of engineering subjects we demonstrate a architecture of blended learning that helps learners to bring their experiences and ideas to the intellectual conversion, the understanding of the other participants is enriched, resulting in active learning. According to our developed system, at first student will download lecture from the website before the class day and after group studying in any location through different online/offline process they will come to the class room on the next day. Teacher and students will discuss about that topic of lecture in the class room through multimedia presentation. Consequently they will able to solve the problem easily and getting attention to the class lecture. Then their idea and implementation will upload to the university server. This process is the continuous process.

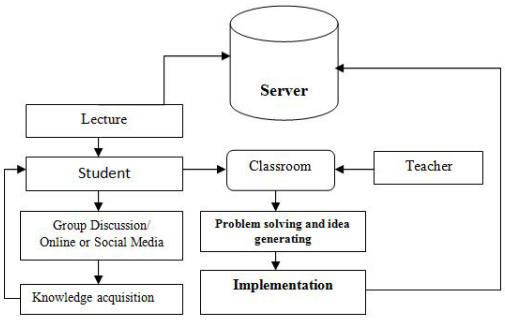

Figure 7. System design of BL for Engineering Education

10. Conclusion

Technology enhances learning capabilities of learners by our proposed work. Blended learning approach helps to understand engineering subject at easier fashion. Our approach can be easily configured to any institutions with existing infrastructure of a class room and also helps to make interactive class lecture content.

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References

[1] K. Scott, Senior Member, IEEE, and R. Benlamri, Senior Member IEEE. "Context-Aware Services for Smart Learning Spaces".
[2] Giuliana Dettori and Donatella Persico. "Detecting Self-Regulated Learning in Online Communities by Means of Interaction Analysis"
[3] Lubica Stuchlikova, Jana Benkovska. "eLearn central- the journey to e-learning".
[4] Jahng, N., Krug, D., & Zhang, Z. (2007). "Student achievement in the online distance education compared to face-to-face education. European Journal of Open, Distance and E-Learning".
[5] Beatty-Guenter, P. (2002, May). Why distance education? Mimetic forces in institutions of adult education. Paper presented at the 21st Annual National Conference of the Canadian Association for the Study of Adult Education, Toronto, Ontario.
[6] ShuanglanLuo, Dept. of Educ. Technol., Guangxi Normal Univ., Guilin, China ; Xueqin Huang," A survey research on the online learning adaptation of the college students"

[7] Shanna Smith Jaggars and Thomas Bailey,"Effectiveness of Fully Online Courses for College Students: Response to a Department of Education Meta-Analysis".
[8] Robert M. Corderoy, Ray Staceand R. Pennell,"Quality assurance and online teaching and learning: first steps".
[9] http://en.wikipedia.org/wiki/Blended_learning
[10] http://www.christenseninstitute.org/blended-learning-3/
[11] J. Barbosa, R. Hahn, S. Rabello, and D. Barbosa, "LOCAL: A Model Geared Towards Ubiquitous Learning," ACM SIGCSEBull., vol. 40, no. 1, pp. 432-436, 2008.
[12] Y. Rogers, S. Price, C. Randell, D.S. Fraser, M. Weal, and G.Fitzpatrick, "Ubi-Learning Integrates Indoor and Outdoor Experiences,"Comm. ACM, vol. 48, no. 1, pp. 55-59, 2005.
[13] Y.E. Shih and D. Mills, "Setting the New Standard with Mobile Computing in Online Learning," Int'l Rev. of Research in Open and Distance Learning, vol. 8, no. 2, pp. 1-16, 2007.
[14] T. Wu, T. Yang, G. Hwang, and H. Chu, "Conducting Situated Learning in a Context-Aware Ubiquitous Learning Environment," Proc. Fifth IEEE Int'l Conf. Wireless, Mobile, and Ubiquitous Technology in Education, pp. 82-86, Mar. 2008. 226 IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES, VOL. 3, NO. 3, JULY-SEPTEMBER 2010
[15] H. Ogata, "Computer Supported Ubiquitous Learning: Augmenting Learning Experiences in the Real World," Proc. IEEE Int'l Conf. Wireless, Mobile, and Ubiquitous Technology in Education, pp. 3-10, Mar. 2008.
[16] T. Chen, C. Chang, J. Lin, and H. Yu, "Context-Aware Writing in Ubiquitous Learning Environments," Proc. Fifth IEEE Int'l Conf. Wireless, Mobile, and Ubiquitous Technology in Education, pp. 67-73, Mar. 2008.
[17] Chen, C. Chang, J. Lin, and H. Yu, "Context-Aware Writing in Ubiquitous Learning Environments," Proc. Fifth IEEE Int'l Conf. Wireless, Mobile, and Ubiquitous Technology in Education, pp. 67-73, Mar. 2008.
[18] S. Kajita, K. Mase, S. Jang, M. Ueda, Z. Yu, and N. Lin, "uClassroom: Expanding Awareness in Classroom to Ubiquitous Teaching and Learning Using Eclipse RCP," Proc. EclipseCon, Mar. 2007.
[19] K. Kim, "Ubiquitous Learning Supporting System for Future Classroom in Korea," Proc. Soc. for Information Technology and Teacher Education Int'l Conf., K. McFerrin et al., eds., pp. 2648-2657, Mar. 2008.
[20] http://programmers.somee.com/
[21] https://docs.google.com/forms/d/1y4SPNEtavZ QZeI9ZPFcH4brzXvtofky8We_JHhjO2A/viewform