Learning and Evaluation of Blended Learning Approach for ICT Undergraduate Students

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***Abstract*—Present world is the age of computer science and information technology. Technology enhanced learning is the most promising issue of modern day. Blended learning is learning based on various combinations of classical face to face lectures, learning over the Internet, and learning supported by other technologies, aimed at creating the most efficient learning environment. To enrich the learning capabilities and interesting class lecture, only face to face or online learning is not enough. Although online learning has many apparent advantages, personalization, interactivity, immediate feedback, and online assessment, one of the major problems is poor retention of a high student dropout rate. Specially engineering education is complex for that we have proposed a blended learning approach. According to learning process, we also evaluate the student learning knowledge involving online interaction by automated exam controlling system.**

We attempt to find out the process to eliminate the traditional teaching and classroom environment and also propose a blended learning approach for our education system. Our proposed idea ensures students are aware of the expected nature and standards of assessable work and students can readily locate and access all resources when needed as well as readily submit material to peers or teaching team. Online website 'programmers.org' for Bengali programing tutorials and 'automated exam controlling system' website for evaluation of learning have been developed.

Keywords—Blended learning; Face-to-face interaction; Traditional learning; Engineering education; Self regulated learning, Virtual Examination.

I. INTRODUCTION

Information and communication technology (ICT) is an indispensable part of modern education, especially because of the opportunities this technology offers to accomplish the new teaching paradigm. ICT has been used for teaching and learning since the inception of this field. Blended learning approach for engineering education system enriches the learners learning capacity than traditional learning system. 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]. 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]. 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 [5]. In many cases, student learning outcomes in online courses are superior to those in traditional face-to-face courses. 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. Blended learning (BL) is becoming an increasingly popular form of e-learning, particularly suitable for use in the process of transition from traditional forms of learning and teaching towards e-learning. In this model of teaching and learning, significant amounts of f2f elements are

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replaced by technology-mediated teaching. Therefore, fewer f2f class sessions are held nowadays because ICT is increasingly being used to deliver course materials and to facilitate learning.

II. Problem Definition

We have analyzed different e-learning and blended learning system from existing research. They are discussed mainly on the class room environment and e-learning websites, but have no teaching and learning compact package with the help of face to face interaction and distance learning. To evaluate the learning percentage we have examined by automated exam controlling virtual system. The most accepted term today is e-learning; emphasizing that technology in education should be complemented with appropriate pedagogical methods, forms and principles, and particularly with those that encourage active learning. There are various definitions of e-learning as a method of furthering the educational process through the use of ICT. A vital point in making these definitions is not to emphasize the technology to a degree that disregards the importance of high quality learning and teaching, on the other hand Engineering education is so complex to understand when teaching by a teacher face-to-face (F2F) with the students in our academic education system. This traditional teaching approach cannot make interesting the lecture at classroom and student cannot get attention to the class due to the absence of interactive presentation. To overcome the problem of the traditional teaching of engineering education, we demonstrate architecture of blended learning (BL) because only e-learning cannot get more fruitful in the learning system, for that blended learning approach helps learners to bring their experiences and ideas to the intellectual conversion; the understanding of the other participants is enriched, resulting in active learning. Blended learning described various event-based activities, including F2F classrooms, live eLearning, and self-paced learning.

We have proposed a systematic way of BL approach with the existing infrastructure of any institutions and evaluation of learning will be justified by our tutorials website and virtual examiner website. Organizations must use BL approaches in their strategies to get the right content in the right format to the right people at the right time. BL combines multiple delivery media that are designed to complement each other and promote learning and application-learned behavior especially in engineering education. A prototype system is developed and tested using different learning scenarios. The system has also been tested by a group of students.

We think that our proposed idea can solve the present limitations of traditional teaching and exam controlling system and it will be more helpful for all kind of learners in the world.

III. Nature of Blended Learning

Blended learning is learning based on various combinations of classical f2f lectures, learning over the Internet, and learning supported by other technologies, aimed at creating the most efficient learning environment. Blended learning also incorporates other elements such as online and traditional learning environments, technology and media for learning content delivery, different teaching and learning methods (both online and traditional), group and individual learning activities, and synchronous and asynchronous interactions [6].

Blended learning has been referred to as the ‘‘third generation’’ (Phipps & Merisotis, 1999, p. 26) of distance education systems. The first generation was correspondence education which utilized a one-way instructional delivery method, including mail, radio, and television. The second generation was distance education with single technology, such as computer-based or web-based learning. The third generation is blended learning, characterized as maximizing the best advantages of face-to-face learning and multiple technologies to deliver learning [7]. When we looked at the literature on blending, we found a great deal of fuzziness in Table1 which showing hybrid learning is another term which has been used synonymously with blended learning. [8] suggested that blended learning environment vary widely according to the following goals: pedagogical richness, access to knowledge, social interaction, personal agency, cost effectiveness, and ease of revision. According to the literature review, it could be classified into three directions in relative research of blended learning. In this field researchers focused on reaching optimal performance by how to appropriate integrated material, delivery method and technology.

IV. Ontological Relationship in E-learning System

The system is designed to provide a more technologically rich learning environment, but it also takes the experience beyond the lesson. It does this by offering suggestions and related information via a sophisticated rule-based engine. This system runs on the central server of the institution, and combines information from individual courses and lectures into an overall learning ontology (see Figure 3.1). When an instructor or administrator registers a course with the system, he or she may include metadata and keywords to classify the course. The content is uploaded to the server and categorized during the session itself. This categorization is all done using established ontological standards, such a CC/PP Document standard. Finally, as learners connect to a session, their context information is used to update their profile as well. These profiles are also stored in a CC/PP standard, the standard for Consumers. This information is all evaluated using a series of SWRL semantic rules by the server, and relationships between courses, lectures, and learners are inferred. Any time a learner is accessing the system, he or she may request additional information and recommendations. Using their, lecture history and profile, the central server creates a list of recommendations of additional information, lectures, and courses. This information can be specific to a lecture or note that the student is currently accessing, or more general course-level recommendations for planning an academic career.

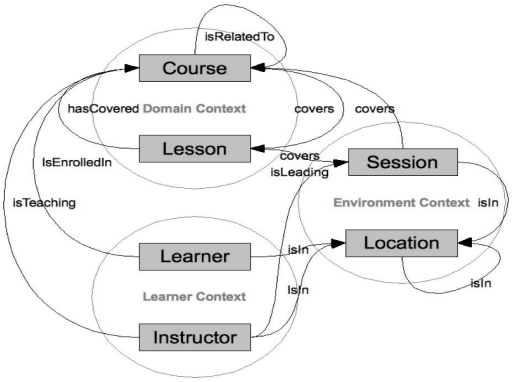

Fig. 1. Sample ontology relationships between resources and recommendations.

V. Comparative Analysis of Blended Learning

Different forms of online education have been examined in the literature. Therefore, it is possible to identify numerous varieties of online education, such as online, web-based, web-enhanced, blended, hybrid and mixed mode online learning. Since the concept of online learning is relatively new and there is no consortium that decides and defines all of these terms, different researchers have different points of view [9]. Smith and Kurthen (2007) described today's distance learning concepts under four categories: web-enhanced, blended, hybrid learning and fully online. They stated that web-enhanced courses includes a minimal number of web-based elements, blended courses incorporate some online learning activities (less than 45%). If online activities are between 45% and 80% then the course can be called hybrid. Classes with 80% or more e-learning are thought fully online. Allen and Seaman (2004) defined web-facilitated courses as those in which the proportion of content delivered online is less than 30%. If the proportion is between 30% and 80%, the course is defined as blended or hybrid. Finally, if the proportion is greater than 80%, then the course is defined as fully online. Bourne, Harris, and Mayadas (2005) and Marsh, McFadden and Price (2003) defined blended learning as an optimal combination of face-to-face and online education that improves learning and satisfaction of instructors and students at a reasonable cost. The concept of blending should help teaching and performance professionals create and manage plans to make the best use of F2F and technological formats, selecting the optimum instructional or non-instructional performance solutions (Yoon & Lim, 2007).

Another emerging idea is that mixing F2F and online delivery options provides the most successful instruction. Schrum, Burbank, and Capps (2007) researched students in introductory teacher preparation courses and stated that the best online teacher preparation courses maybe those that blend virtual and FTF interaction, rather than those that are strictly online. According to Amrein-Beardsley, Foulger, and Toth (2007), instructors reported that the blended course model allows them to accomplish course objectives more successfully than either an online course model or a traditional course model. Most instructors noted increased interaction and contact among their students in a blended learning environment (Smith, 2005). Tang and Byrne (2007) found no significant difference in course achievement between F2F instruction and blended instruction, though they stated that students appeared to be more satisfied with the blended mode of delivery than the F2F mode of delivery.

Since blended learning is a relatively new concept in online education, relatively few studies from the literature of online instruction have looked specifically at blended courses [10]. This study is an empirical study that evaluates the effectiveness of the blended mode of delivery on students' achievement and attitudes towards computers in a computer literacy course.

VI. 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 I. Blended Learning Componests for Different Courses Under Three Disciplines

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

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 II. BLENDED LEARNING COMPONESTS FOR DIFFERENT COURSES UNDER THREE DISCIPLINES

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

Above table are the engineering categories of ICT discipline. There without BL, subject lecture cannot make interactive to the classroom. From Table-I and Table-II, we have concluded that the ICT 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.

VII. PROPOSED METHODOLOGY FOR LEARNING

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.

B. Blended Components for Learning(BCL)

$$BL = \frac{(F2F + EL + PPT + AD + VD + WB)}{\text{Total No. BL Components}} 100\% \quad (1)$$

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

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

From equation (1), we 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.

VIII. ARCHITECTURE AND SYSTEM DESIGN OF BLENDED LEARNING

To alleviate the traditional teaching problem of ICT subjects we demonstrate 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.

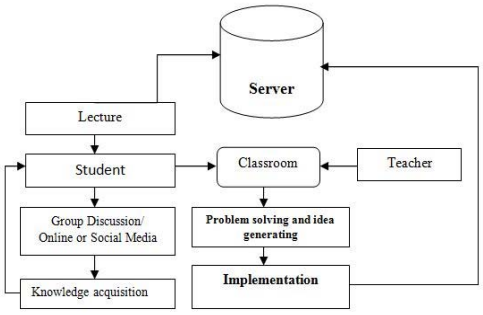

Fig. 2. System design of blended learning for engineering education.

IX. EXPERIMENTAL RESULT OF LEARNING

We did a survey on the 2nd and 4th semester students of CSE, PSTU on the basis of blended learning. 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 who are going to learn JAVA programming and ii) The students who are already learned JAVA programming. 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 [11]. 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.

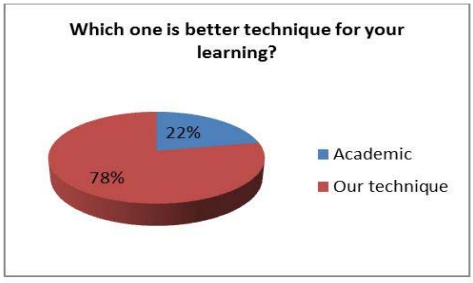

Fig. 3. Pie chart of answer to the question.

Evaluation of Blended Learning Approach Automated exam controlling system is the implementation of our thesis named "Technology Enhanced Learning for Engineering Education- a Blended Learning Approach". This automated exam system is the evaluation part of our research. It is mainly online exam system for java programming.

X. ACTIVITIES FOLLWOED DURING THE COURSE

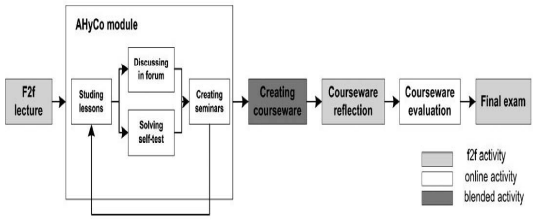

Fig. 4. Activities followed during the course.

At the end of the questionnaire, students were encouraged to give positive and negative comments [12]. AHyCo's advantages, emphasized by the students, included

- The freedom to access tasks and forum at any time.
- The opportunity to learn at one's own pace and following one's own inclination.
- The opportunity to communicate with the instructor in a more efficient manner (if a question is answered on the forum, everyone can read the answer).
- The opportunity to self-evaluate one's knowledge before the official test.
- The equally distributed modules for learning and access to the subject matter at any time.
- The participation in the group work as completely new experience.
- The practical work on the courseware.

XI. EVALUATION STRATEGIES

We have used two techniques for solving the complexity of question distribution and partial marking. Question distribution is made on the basis of three types of questions (Simple, Medium and Hard) according to randomness for first distribution of question. For this result same questions will be not set to the besides of one student to another. Hench, it is evaluation of blended learning approach, there is provided questions for printing some sequence of number or char or text.

A. Question Distribution

Question Distribution (QD) = Id {Simple, Medium, Hard}
Simple_1 = length (simple question) % 2
Medium_1 = length (Medium question) % 3
Hard_1 = length (Hard question) % 4
QD1 = Id {Simple_1, Medium_1, Hard_1}
QD2 = Id {Simple_1 + 2, Medium_1 +3, Hard_1+4}
QD2 = Id {Simple_2, Medium_2, Hard_2}
QD3 = Id {Simple_2 + 2, Medium_2 +3, Hard_2+4}
QD3 = Id {Simple_3, Medium_3, Hard_3}

This process will continue up to total provided questions.
[Note: If questions are large then the distribution percentage will increase]

B. Automated Marking System

Suppose a simple type of question of 20 marks.
If output is correct got 20 marks and If not correct then partial marking

Partial Marking, $$PM = \frac{\text{Actual Result}}{\text{Target Result}} \times Total\ Marks$$

Actual result = count (Max. number of characters that matched sequentially with string of target output)
Target result = Count (The number of characters that should be the output)

Let us consider a programming problem of mark 10, where the students have to print first 10 Fibonacci numbers. Now, considering the followings for a student,

Target output: "1 1 2 3 5 8 13 21 34 55"
Actual output: "1 2 3 4 8 13"

$$\text{Obtained Mark} : \frac{6}{10} * 10$$
$$= 6$$

This is the process of providing partial mark for a problem.

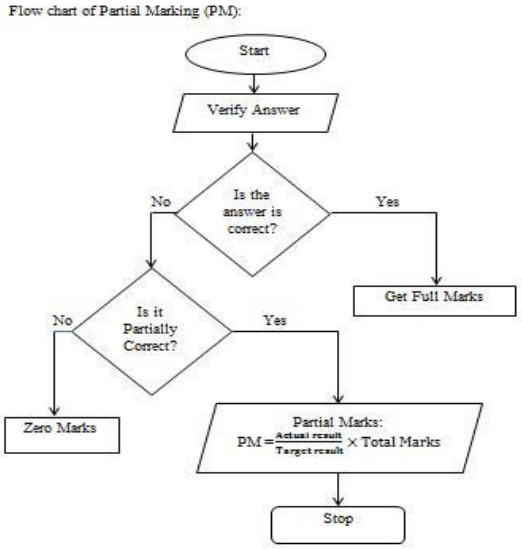

Fig. 5. Flow chart of partial marking system.

XII. RESULT AND DISCUSSION

It is mainly developed for blended learning evaluation progress of increasing online interaction. Since it is the part of universities exam system, a student can appear in the exam from distance. This automated exam controlling system is fully online based which is fully controlled by institution head. Teacher of that organization also be controller of the site that is assigned by head of the institution head. There is the relevant courses of the syllabus will be assigned to the teachers "available course".

A teacher will set the question of three types for java programming Simple, Medium and Hard.
Marks of the provided questions will be added by a teacher. Mid and Final exam options are also available, registered students of the universities can appear to the exam from online at distance at a fixed exam time & date.

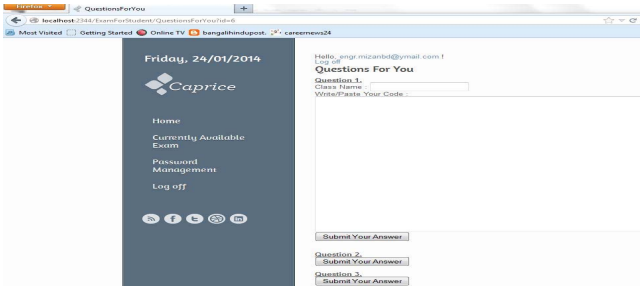

Fig. 6. Online exam system for question.

Students get the questions and answer that question. For that an editor will be found, where you can write the program of that questions requirement and check the target output with real output. After answering the three types of question within the time exam will over. Teachers no required for checking the answer for marking, it will be automated and partial marking also available. So teacher easily can see the over result with questions.

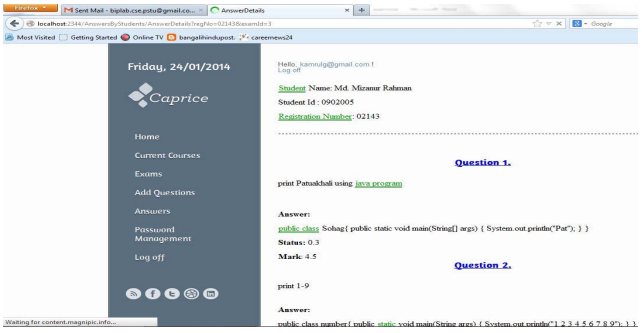

Fig. 7. Total result of exam.

XIII. CONCLUSION

Traditional learning should be avoided to better understanding in engineering education. To develop in engineering education need the blended learning approach. Students and teachers can collaboratively analyze the problem definition. Technology enhances learning capabilities of learners by our proposed work. Blended learning approach helps to understand engineering subject at easier fashion. Increase the knowledge of education through social interaction. We took only 100 students as our sample and our efficiency of blended learning approach is 78%. Our approach can be easily configured to any institutions because it can be applied with existing infrastructure of university class room. Because most of the universities already have multimedia projectors, internet, internal server, e-library and sound system based class room. This learning approach can be evaluated by the automated exam controlling system. As a result a student able to appear in the exam from distance places in the world. On the other hand, due to the automated marking system, there is no chance to misguide the answering notes. In our typical teaching system, teachers are teaching their students and students are learning, but in the most cases it's boring for the programming classes. That's why students do fear with their programming subjects. But if teachers provide their next lecture with an example that is implemented in the video tutorial on the website, students can easily collect those and see the video and follow the tutorials. Therefore, the students and teachers can discuss with the topic and can find the problems and solve that instantly. So the students can extend their performance in the class. Our aim is to work with more students from many other universities of Bangladesh and we will try to get the more accurate output. Again we will try to find the best decision so that we can increase the performance of our classes.
In future we want to develop the all type of unstructured answer of the question converts to structure for automated examine answer script and partial marking.

REFERENCES

[1] K. Scott, & R. Benlamri, (2010). Context - Aware Services for Smart Learning Spaces. IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES, 3(3): 214-227.

[2] Giuliana Dettori & Donatella Persico. (2008). Detecting Self-Regulated Learning in Online Communities by Means of Interaction Analysis. IEEE TRANSACTIONS ON LEARNING TECHNOLOGIES, 1(1): 11-19.

[3] Lubica Stuchlikova & Jana Benkovska. (2011). eLearn central- the journey to e-learning. 14th International Conference on Interactive Collaborative Learning (ICL2011).

[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] ShuanglanLuo, Guangxi, Guilin & Xueqin Huang, (2012). survey research on the online learning adaptation of the college students.

[6] Wikimedia Foundation. Date (25 January 2014). Blended Learning. [Online].Publisher,Available:URL. http://en.wikipedia.org/wiki/Blended_learning [23/01/2013].

[7] Chin-Yi Yang, Ching-Tao Chang & Li-Ren Chien, (2010) A Teacher Control Model of a Blended Learning Environment based on a Typical Classroom in Secondary School. 2nd International Conference on Computer Engineering and Technology, 6: 720-724

[8] Osguthorpe, T. R., & Graham, R. C. (2003). Blended learning environments. *Quarterly Review of Distance Education, 4*(3), 227–233.

[9] Adem Uzun & Aysan Senturk (2010) Blending Makes the Difference: Comparison of Blended and Traditional Instruction on Students' Performance and Attitudes in Computer Literacy. CONTEMPORARY EDUCATIONAL TECHNOLOGY, 1(3), 196-207

[10] Delialioglu, O & Yildirim, Z. 2008). Design and development of a technology enhanced hybrid instruction based on MOLTA model: Its effectiveness in comparison to traditional instruction. *Computers and Education*, *51*, 474-483.

[11] B.C.Debnath. Date (23/12/2013). Online survey for quality assurance of blendedlearning.[Online].Publisher.Available:URL.https://docs.google.com/forms/d/1y4SPNEtavZQZeI9ZPFcH4brzXvtofky8We_JHhjO2A/viewform/ [23/01/2013].

[12] Natasa Hoic-Bozic, Vedran Mornar, & Ivica Boticki, (2009). A Blended Learning Approach to Course Design and Implementation. IEEE TRANSACTIONS ON EDUCATION, 52(1): 19-30.