Investigating the Effectiveness of Non-interactive video-based Lectures in eLearning

Case Study at Master of Science in Information Technology (MSIT) Program

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Abstract—**The Master of Science in Information Technology (MSIT) program follows a unique "learning by doing" methodology, woven around a project centric curriculum. Project assignments carry real life flavor which are typically task-based, requiring application of specific knowledge and skills that are delivered to the learners, "just-in-time," through the learning management system.**

The knowledge component of the course is often delivered to the learners as video-based lectures and presentations with voice-overlay. These become learning support materials to the learners in accomplishment of their tasks.

This paper investigates the effectiveness of video-based lectures and voice-based presentations in terms of:

- **Learning content**
- **Retention of learning**
- **Ease of use**
- **Satisfaction**
- **Video quality**
- **Audio quality**

The paper reports findings of a survey administered to the students of academic batch 2010-11, at the Hyderabad campuses in India. The paper also proposes improvement and enhancements to the video-based lectures to make learning more interesting, fun, and effective in task accomplishments.

Keywords- Video lectures, eLearrning, project-centric, learning by doing, just-in-time, multimedia, presentations

I. INTRODUCTION

Multimedia based eLearning provides flexibility in program delivery and enhances richness in content by capturing subject matter expertise that may not be locally available. More importantly, video e-lectures provide "personalized and self-regulated" learning medium [1]. Integrating the lecture with audio and video further enriches the learning experience, where students can see and listen to the facilitator, much like a real-life class room.

The efficacy of on-line teaching methods has been investigated by several educators. Bartsch and Cobern [2] noted that students preferred power point presentations to overhead transparencies of yesteryears. The inclusion of e-lectures in university education is increasing. E-lectures provide flexibility, accessible on demand, and most importantly, are reusable. Demetriadis and Pombortsis [3] contend that e-lectures have a pedagogically constrained perspective, more in the role of knowledge acquisition, than construction. Interactivity supported e-lectures have found to be more effective.

Several studies and surveys have been reported in literature that investigated the impact of e-learning or e-lectures on the learning outcome and their pedagogic constructs. These include, software courses at Tamk University, Finlad, and Open University, United Kingdom [4]; 100% on-line courses at Texas University [5]; Business administration and education students at Johannes Kepler University [6], a summary of findings from these papers are presented in Table I.

TABLE I. SUMMARY OF FINDINGS FROM REPORTED STUDIES

#	Findings
1	Students with prior experience to e-learning adapt better to e-lectures. For new comers, structured face to face intervention prior to commencement of e-lectures help.
2	For success of e-lectures, students should be encouraged to play an active role, which may mean, close mentoring.
3	Time management and meeting course schedules becomes student's responsibility, which again emphasizes on close mentoring.
4	Because of asynchronous communication and time delay for responses in e-lectures, continuous feedback by the facilitator assumes importance.
5	Learners' strategy in use of e-lectures has significant impact on achieving learning outcomes. Students who repeat the e-lecture several times for reinforcing knowledge did well on knowledge based tests.
6	E-lectures accompanied with transcript of presentation were more effective.

The key-determinants to success of e-learning can be succinctly stated as follows:

- Ensure appropriateness and depth of content
- Build immersive story-line context in presentation
- Ensure positive engagement with learner
- Make learning content easy to understand
- Provide support and continuous mentoring
- Facilitate peer support
- Ensure systems availability, bandwidth and uptime of computing environment and network
- Provide positive motivation to learner

II. PROBLEM STATEMENT

The purpose of this paper is to analyze the usability of e-lectures and their effective contribution towards the

accomplishment of task-based project assignments delivered by learners during the MSIT program.

In the context of this paper, the author prefers to use the definition of usability as specified by ISO 9241-11 [7]: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use."

Therefore, this paper would survey, analyze and report effectiveness of e-lectures with regard to:

- System Usability: Meeting video-based e-lecture objectives resulting from satisfactory interaction with system and learning environment.
- User Experience (satisfaction): Meeting learning outcomes derived from the usage of e-lectures.

III. BACKGROUND TO MSIT CASE STUDY

The Master of Science in Information Technology (MSIT) program adopts a project centered curriculum using "learning by doing" methodology. Through carefully selected project work, the curriculum simulates the corporate environment that promotes creative thinking and practical application of the concepts learned.

A principal mentor assumes the role of project manager and is responsible for the conduct of the course. A typical course offering comprises:

- Course preamble
- Required skill-matrix for completing the course
- Portfolio of tasks with well-defined deliverables and deadlines.

Fig 1 captures the typical distribution of pedagogical components during a MSIT course.
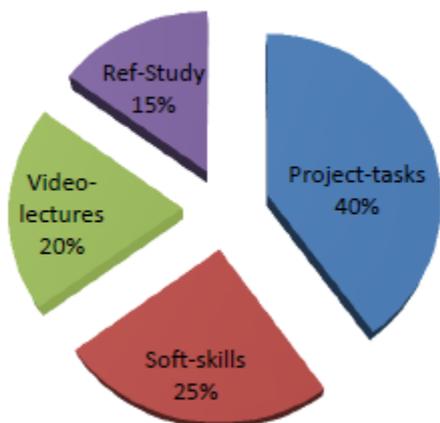

Figure 1. Distribution of Pedagogical Components at MSIT

Each course is offered in the form of a project which is subdivided into manageable tasks. Each task to be done by the student is supported by e-resources which include e-lectures, videos, and PowerPoint® presentations with voice-over slides and are delivered just-in-time for completion of an ensuing task. The digital content is accompanied with active personalized mentoring.

The e-lectures provided are of three different types:

- Lecture supported with both voice and video of the actual presenter;

- E-modules in soft skills with the voice of presenter
- Presentations carrying voice over of the actual or different presenter

Since the e-lectures are delivered using the LMS, they are available to the learners on the course website along with the task description. The course website also offers references that can be used by the learners to surf the net and obtain supplemental content to enrich their learning.

Students assimilate concepts through "Learning by Example," appreciating practical nuances as they work through their projects. On-line forums supported by LMS facilitate collaborative learning and interactive mentoring. A mastery model of evaluation is practiced in the program which sets high standards of achievement for the learner. When the subject matter experts are at a distance, the course is offered in a remote mentoring mode and they guide the students from a distance in a synchronous mode using a VTC (Video telephonic conference).

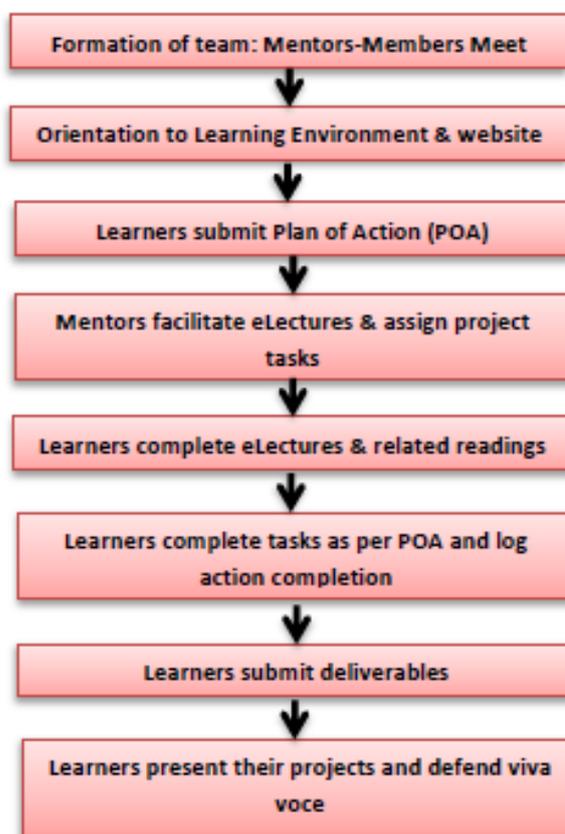A typical academic work flow of a MSIT course is shown in Fig 2.

Figure 2. Program-Activity Flow Chart

A major course differentiator of the MSIT program is soft-skills training. The soft-skills practice in the program is a blended learning model where 40% of soft-skills are activity based. Fig 3 shows the pedagogic distribution of soft-skills learning.

E-modules offer case studies, simulations, role plays, pre-assessments and post assessments. The e-modules are supplemented with finely integrated class based activities reinforcing the e-content and help internalizing the concept.
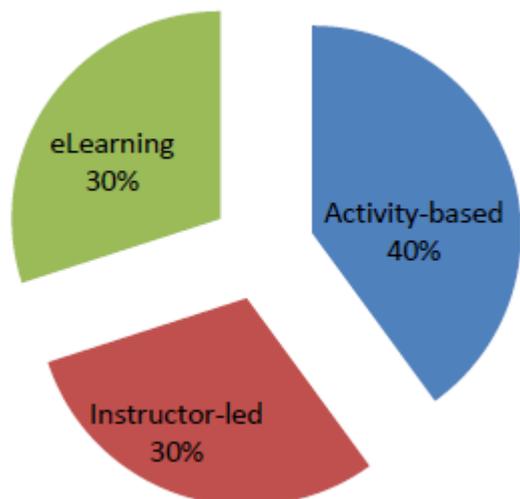
Figure 3. Blended Soft-Skills Training Approach at MSIT

IV. SURVEY BASED STUDY AND ANALYSIS: MSIT

The survey based study presented in this paper was designed to gauge the effectiveness on e-lectures on the learning outcomes of a MSIT course.

A structured questionnaire was administered on-line to the students of MSIT program enrolled at two local campuses. Convenience sampling methodology was used. The survey covered 70% of the population.

The questions in the survey covered four dimensions of e-lectures as component of e-learning, namely:

- Depth and quality of learning content
- Quality of video presentation
- Aid to retention of concepts
- Ease of use and system support

The questionnaire contained demographic inquiries; 18 questions related to the four dimensions mentioned above, structured on a five-point Likert scale: (1: highly dissatisfied to 5: highly satisfied); 9 questions on general attributes of e-lectures; and finally, 5 qualitative questions which involved, top of the mind recall, to the best and worst attribute experienced by the learners.

The eighteen questions on the four dimensions of video lectures were asked for 5 different e-lecture kinds used at MSIT, which are as follows:

- Cat-A E-lectures prepared by mentors at Carnegie Melon University (CMU), USA, and delivered as a video
- Cat-B E-lectures prepared by mentors at MSIT and delivered as a video
- Cat-C E-lectures prepared by other University professors who are subject matter experts in the concerned area
- Cat-D Presentations with voice-over by ex-MSIT students
- Cat-E Soft Skills e-modules

V. ANALYSIS OF QUALITATIVE QUESTIONS IN SURVEY

The survey analysis is based on 100 respondents. Interestingly, 31% of participants polled had previous experience with e-learning of some kind. This orientation

with e-learning has a positive impact on acceptance of e-lectures as a mode of learning intervention [4].

The basic demographic details comprising gender, language of study in school, and academic performance consistently since school leaving examinations. Table II summarizes these attributes as a percentage of sample population polled.

TABLE II. BASIC DEMOGRAPHIC ATTRIBUTES

#	Demographic Attribute	Percentage
1	Medium of study at school	
	English	93
	Hindi	3
	Vernacular Indian	4
2	Gender	
	Male	69
	Female	31
3	Academic performance since school	
	High First class	22
	First class	68
	High second class	8
	Others	2

The top-of-the-mind response on using the word e-lecture to MSIT learners evoked different one-word answers. These are summarized in the word cloud shown in Fig 4, where the larger the word size, more prominently it has been repeated as responses in the survey.

Figure 4. Top of the mind responses on MSIT Video Lectures.

From the qualitative responses, the top 5 positive and negative attributes as perceived by the MSIT learners have been identified and summarized in Table III.

TABLE III. TOP 5 POSITVE AND NEGATIVE ATTRIBUTES

Top 5: Positive Attributes of e-lectures at MSIT
1. Provides Flexibility of revisiting lectures
2. Creates opportunity to learn from experts
3. Makes concepts easy-to-understand
4. Provides easy accessibility to resources
5. Facilitates self- learning
Top 5: Negative Attributes of e-lectures at MSIT
1. Lengthy e-lectures become boring and ineffective
2. Lack of interactivity negatively impacts learning
3. E-lectures of voice-over presentation kind not effective
4. Slow-network access, system problems affect learning process
5. Some e-lectures inadequate for connected task to be performed

Almost 60% of polled participants indicated that they enjoyed the e-lecture experience in MSIT program. About 31% of participants did indicate that they experienced uneasiness and headache while continuously watching e-lectures. In fact, in a study reported by Suman Singh and Jyoti Wadhwa [8], a vast majority of users indicated that they suffered from shoulder pain, headache, eyestrain, back pain and felt discomfort during long exposure to computer.

Summary of responses to other qualitative questions asked in the survey have been elucidated in Table IV.

TABLE IV. RESPONSES TO QUALITATIVE SURVEY QUESTIONS

Qualitative Questions in the Survey	Yes (%)	No (%)	Sometimes (%)
Would you prefer face-to-face instruction over e-lecture?	28.3	5.1	66.7
Would you want to have your actual faculty as the presenter in e-lecture?	32.3	41.4	26.3
Did you find a foreign voice in the e-lecture difficulty to follow?	12.2	68.4	19.4
Did you find the level of communication difficult to follow?	6.1	85.7	8.2
Did you find lack of interactivity hindering your understanding?	28.9	38.1	33.0
Did you re-visit the e-lecture to gain more understanding?	61.6	10.1	28.3
Did you re-visit the e-lecture to seek information when required?	61.6	13.1	25.3
Did you find uneasiness in experiencing e-lectures in terms of headache, claustrophobic, lack of activity?	31.3	38.4	30.3
Did you have to refer to other resources on topics covered by e-lectures?	54.5	11.1	34.3

The qualitative responses also highlighted three prominent aspects of video lectures viz.:

- Length of video, or e-lectures, made it difficult for students to concentrate, and at times bordering to boredom
- Absence of interactivity in e-lectures
- Lack of opportunity for immediate discussion or feedback from faculty

A. Length of video

Length of a video lecture has always been a critical factor for learning effectiveness [9]. On an average, a typical video or e-lecture at MSIT runs for over 30 minutes.

A typical one week sample of video lectures used in the data base and web programming course indicates that the average length of a video for was 39 and 25 minutes respectively.

Proponents of active learning suggest that a lecture session must be limited to 15 - 20 minutes to be effective

[10]. The authors suggest that video lectures, where deployed, should be limited to less than 20 minutes at a stretch, so as to keep the participants interest alive.

Strategies such as movement of mouse within the lecture, animations and change of tone and pace of voice can be used during development of video lectures.

B. Interactivity

Passive e-lectures can be tedium. The survey showed a marked preference to video-lectures with the presenter in picture, than PowerPoint® voice-over slides. Embedding interactivity in e-learning has been a point of repeated discussion in several research papers [11]. Strategies for development of video-based courseware include animated play-pause buttons that permit practice work on an ancillary window or paper-based assignment; interview based presentations than the presenter lecturing in solo mode; just-in-time reference links; interactive quizzes embed as part of presentation, and at the higher-end, using tools of experiential immersion to provide the participant realism of activity. The authors suggest that passive voice-over presentations be replaced with active video lectures to be more effective in achieving learning outcomes.

C. Opportunity for Discussion or Feedback

Participants in the survey also indicated that lack of feedback or opportunity to clarify concepts hampered learning effectiveness. Use of blogs or wiki will further social constructivism [12] and improve learnability. In the MSIT learning environment, this can be easily overcome, since the programs are offered from regular academic campuses. Bi-weekly face-to-face discussion forums with facilitator(s), or subject matter experts, along with the peer group can enhance the learning process and knowledge assimilation and construction.

VI. ANALYSIS OF QUESTIONS RELATED TO THE FOUR DIMENSIONS OF VIDEO LECTURES

As mentioned under the case-study methodology, the effectiveness of video lectures on each of the four dimensions were analyzed for all five different e-lecture offerings, i.e. Cat-A to Cat-E.

For each of the four dimensions, a Cumulative Response Point Average (CRPA) was computed, using numeric values for the 5-point Likert scale (1: highly dissatisfied to 5: highly satisfied). The CRPA therefore represents the weighted average of responses to the questions pertaining to each of the dimensions, and is calculated as:

$$CRPA = \sum_{i=1}^{5} iN_i \ / \sum_{i=1}^{5} N_i$$

Where:
  N_1 = Numbers polled for option 1, highly dissatisfied
  N_2 = Numbers polled for option 2, dissatisfied
  N_3 = Numbers polled for option 3, neutral
  N_4 = Numbers polled for option 4, satisfied
  N_5 = Numbers polled for option 5, highly satisfied
  and, i is the point-score associated with Likert scale option

Fig 5 to Fig 8 shows CRPA for each of the dimensions as a comparative bar chart for Cat-A to Cat-E video lectures.
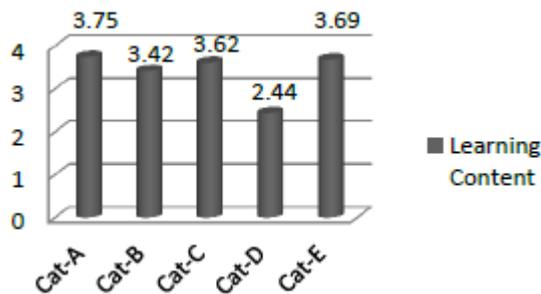

Figure 5.   CRPA on Learning Content.

The CRPA score of 2.44 for Cat-D type e-lectures, which are PowerPoint® presentations created by ex-students of MSIT is the lowest. It must be appreciated that such presentations tend to be least interactive, where the participant only hears an audio with power point slides to see. It is evident that for effective video lectures, the presenter should be seen as talking to the participants during video delivery.

The participants preferred video lectures prepared by faculty of CMU, which seemingly are more professionally created.
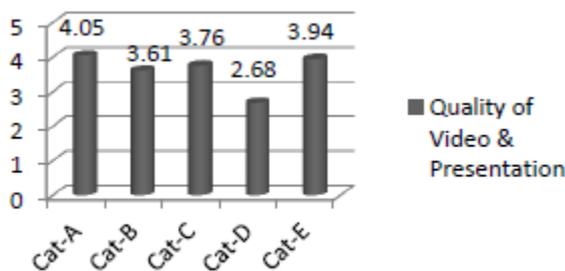

Figure 6.   CRPA on Quality of Video and Presentaion.

Cat-A scores the highest in quality of video and presentation, whereas Cat-D continues to be the lowest in this dimension too. This reiterates the view that the video created by faculty at CMU were of a much superior quality than to other forms of video lectures used in MSIT.
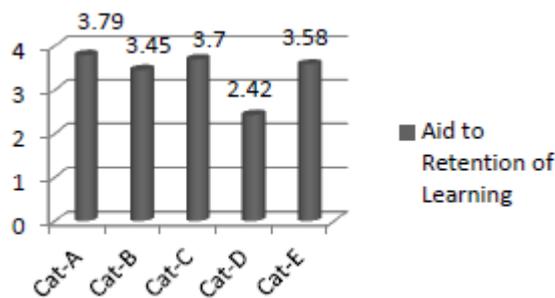

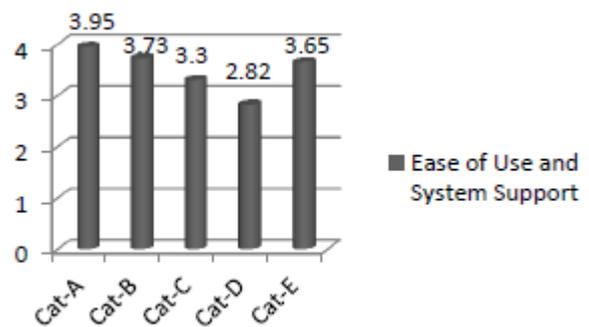Figure 7.   CRPA on Aid to Retention of learning.

Figure 8.   CRPA on Ease of Use and System Support.

It may be noted that CRPA scores of less than 4 seem to suggest that there is definite scope for improvement in all the four dimensions: learning content, quality of presentation aid to retention of learning, and ease of use. This corroborates very well with the top of the mind responses on MSIT video lectures depicted in Fig 4.

Stray qualitative observations in the survey also mentioned that the video lectures must have more examples and illustrations embed into them, which is one way to ensure increase in CRPA values and thus, effectiveness of e-lectures.

Table V captures mode-values of responses to each of the 18 questions posed to study the effectiveness of video lectures against Cat-A to Cat-E offerings. These 18 questions have been enumerated in Table VI.

TABLE V.   MODE-VALUES OF SUVERY RESPONSES USING 5-POINT LIKERT SCALE

Question Number	Cat-A	Cat-B	Cat-C	Cat-D	Cat-E
1	4	4	5	1	5
2	5	4	3	2	5
3	4	3	3	2	5
4	4	4	3	1	4
5	5	5	3	2	4
6	5	4	3	2	5
7	4	4	3	1	5
8	4	4	3	1	4
9	4	3	3	1	4
10	4	4	3	2	4
11	4	4	4	1	3
12	3	3	4	2	4
13	3	3	4	1	4 and 3
14	4	4	3	2	4
15	4	3	3	1	4
16	5	4	3	2	4
17	5	4	5	5	4
18	4	4	3	2	4
1: Highly dissatisfied 2: Dissatisfied 3: Neutral 4: Satisfied 5: Highly Satisfied					

Cat-D, PowerPoint® slides with voice over prepared by ex-MSIT students showed consistent dissatisfaction for all questions, except question number 17. These e-lecture contents could be considered to be redone with video lectures or flash-based movies.

Cat-C offerings, viz. e-lectures delivered by professors of other universities who are not part of MSIT did not evince much positive response. In fact 13 responses out of 18 were indicating neutral acceptance. The content of these e-lectures and their relevance to the connected task-based assignments needs to be scrutinized.

The maximum number of "highly satisfied" response came from Cat-A offerings, which are video lectures prepared by CMU faculty for MSIT program. Cat-B offerings, that is, e-lectures prepared by local MSIT faculty largely received "satisfactory" response. Soft skills e-modules (Cat-E) have also been rated as largely satisfactory.

TABLE VI.   18 QUESTIONS ON EFFECTIVENESS OF VIDEO LECTURES ELICITING RESPONSES USING 5-POINT LIKERT SCALE

Quality of Video Presentation	
1	Did you find the visual layout and appeal satisfying?
2	Did the audio and video synchronize well?
3	How did you find the body language of the narrator?
4	How did you find the voice of the narrator?
5	Was the size of text on the screen easy to read?
6	Was the speed of e-lecture comfortable?
7	Overall, did you find the e-lecture experience pleasing?
Depth and Quality of Learning Content	
8	Did the content of e-lecture help you in task completion?
9	Did the content flow logically and understandable?
10	Was the content informative and relevant?
11	Were there examples to aid understanding the subject?
12	Was there adequate animation to explain concepts?
13	Did you feel motivated to learn from e-lecture?
Aid to Retention of Learning	
14	Did e-lectures aid retaining concepts when needed?
15	Did e-lectures enhance your knowledge/ skills for future?
Ease of Use and System Support	
16	Did you find the e-lecture easily accessible?
17	Did your systems support e-lecture files seamlessly?
18	Overall, did you find e-lecture experience purposeful?

VII.   CONCLUSIONS

Video lectures, along with document references, delivered as an e-learning based methodology forms 35% of the MSIT curriculum. The content and quality of video lectures used in the program has significant impact on learning outcomes.

Inferring from the survey responses and analysis, the authors recommend the following:

- Length of video lectures may be limited to a maximum of 20 minutes.
- As far as practicable, video lectures must be narrated and presented by the faculty or concerned mentor of MSIT.
- Best practices of Cat-A offerings of video lectures must be proliferated across MSIT.
- Existing video lectures may be revised with relevant examples and illustrations that have a direct bearing in accomplishing task based assignments.

- Interactivity in video lectures must be given due consideration. In fact, interactivity forms the bedrock of e-learning courseware design [11]. The fundamental techniques used in e-learning based lectures include explanation of text-based concepts with animated diagrams and graphics; supplemented with connected hyperlinks for more examples, illustrations, or explanatory videos. This would encourage the participant to use the MSIT video lectures as a base platform, and build knowledge and skills extending from it while practicing them on the assigned tasks, in a "learning by doing" paradigm.
- Providing transcripts of the video lectures as a multi-modal strategy [6] can enhance the learning experience and retention of knowledge.
- Immediately upon completion of a set of e-lecture(s) schedules, the authors suggest that a discussion forum must follow. Such forums may be organized at least weekly, which can be either face-to-face, or through video conferencing. Such discussions shall promote assimilating and constructing knowledge in a social setting, where peer groups can share their knowledge and experiences, and suitably moderated by the mentor or faculty. Discussion groups can also be set as wiki or blogs, in which case, these must be active and updated every day. These discussion forums could become a vibrant platform for feedback, and reflection on learning.

The success of MSIT's unique project-centered curriculum driven through "learning by doing" pedagogy has been demonstrated and amply validated for over a decade. The merit of this approach has been proved by performance of the students in task based assignments, end-of-the-course presentations and viva voce, and near 100% placement record for several years in a row.

Through this paper, the authors have set to further improve the learning process at MSIT, absorbing the best practices of e-learning, experienced and reported in literature.

"The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn."

~Alvin Toffler~

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