Effective use of information and communication technology in enhancing teaching-learning outcomes: Some thoughts

Dr.SrinivasaPai P.[1], Dr.Niranjan N. Chiplinkar[2],
Dr.Shrinivasa Rao B. R.[3], Dr. K. Subrahmanya Bhat[4]
[1]Professor, Dept. of Mechanical Engineering,[2]Principal, NMAM Institute of Technology, Nitte
[3]Vice Principal & COE,[4]*HOD,* Dept. of Mechanical Engineering
NMAM Institute of Technology, Nitte - 574110, Karnataka State, India.
[1]srinivasapai@nitte.edu.in
[2]principal_nmamit@nitte.edu.in

Abstract: Teaching–learning process is the important component of any education system. In the context of outcome based education (OBE), its outcomes have assumed significance. There has been a paradigm shift from a teacher-centered education system to a learner-centered system, where students play a major role. The explosion in information and communication technology has impacted education in a big way. There has been a sustained interest and use of information and communication technology (ICT) in higher education. This paper tries to provide some perspective on use of ICT for enhancing the teaching-learning outcomes. Video is one technology which is being widely used both in normal mode and distance mode for delivery of education. Some thoughts on use of video has been discussed based on the literature and a plan of action for implementing video in teaching one course in the author's institution has been presented. A survey instrument regarding use of ICT by teachers has been administered and the results of the same have been presented to establish the need for use of ICT in teaching-learning process.

Dr.SrinivasaPai P.
Professor, Dept. of Mechanical Engineering,
NMAM Institute of Technology, Nitte - 574110,
Karnataka State, India.
srinivasapai@nitte.edu.in

Keywords: Outcome based education, Information and communication technology, Video

1. Introduction

Higher education has seen lot of changes and developments over the years. These are in terms of curriculum development, focus on the student or learner, use of information and communication technology, different pedagogy, teaching-learning modes, evaluation schemes etc. Ever since we have moved to 'outcome based education' (OBE), these changes have been significant. OBE is an approach to education in which decisions about the curriculum are driven by the exit learning outcomes that the students should display at the end of the course [1].

One of the major factors which have a significant role in implementing OBE is the use of ICT in education delivery. In fact ICT has revolutionized the way things are happening in the world. Availability of internet has transformed the way we live. It has affected every aspect of human life be it education, governance, services, entertainment etc. The application and use of ICT has tremendous potential for improvement in sectors like education, health care and other government departments [2-3]. In education, ICT is being used in main stream leading to regular award of degrees and diplomas, but also in the distance mode, where ICT helps to break the barrier of time and distance. There has been a paradigm shift in the teaching-learning process, where the focus in more on the students rather than on the teachers. Students have freedom to learn courses at their own

pace with less dependence on regular class room teaching.

Teaching is a challenging task these days, with students who are 'digitally smart', who are no longer mute spectators and complacent listeners, but dynamic and dominating in the class room. Teachers can no longer treat their students as passive and disengaged individuals. Thus addressing the needs of these students is not only a challenge, but also engaging. There is a need to use ICT judiciously and in the most effective manner, so that teachers are able to meet the needs of the students [3]. Thus there is a need to critically evaluate the different technologies available and make use of them in the best possible way. The traditional 'chalk and talk', is still the preferred mode of teaching, but it needs to be blended with ICT so that the curricular requirements are met. In the present context, students need to be allowed to decide on 'what', 'when', 'where' and 'how', he or she is learning. Blended learning or hybrid learning can combine face-to-face learning with virtual learning.

ICT can provide lot of flexibility to a teacher to carrying on with his or her teaching process. It can complement and supplement sometimes the regular teaching process. It not only regulates and controls the teaching process of a teacher; it also provides lot of flexibility and controls the learning process of the students [4].

In this context, this paper tries to understand the role of ICT in teaching-learning process. A literature perspective has been presented to know its effect in enhancing the learning outcomes. Video is one technology which is widely used both in normal and distance or virtual mode of education. A pilot study regarding the use of video as a mode for capturing lectures of faculty in one course in the author's institution is discussed and these videos are made available to students through 'moodle'. A preliminary feedback taken from the students gave some interesting results. A survey questionnaire has been used to elicit the response of faculty of two departments to know their awareness, preparedness and experience regarding use of ICT in the author's institution. The results of this survey are analysed and presented.

2. Use of TCT in Education: A Literature Perspective

Use of ICT to support teaching-learning process is called 'technology enhanced learning' (TEL). It is defined as any on-line facility or system that directly supports learning and teaching. The Higher Education Funding Council for England (HEFCE) in their revised e-learning strategy (2009) defines TEL as 'enhancing learning and teaching through the use of technology'. According to them, the three levels of potential benefits that TEL can bring are efficiency – existing processes can be carried out in a more cost-effective, time-effective, sustainable and scalable manner, enhancement – improving existing processes, outcomes and transformation radically and positive change in existing processes or introducing new processes [5]. Warren Wilson (2003) suggests using technology in higher education, not merely as a tool for delivery, like a sophisticated interactive video system, but as a means to improve learning. It is a tool if used wisely, can produce improved learning experiences. Technology has the potential to transform and expand the educational experience by enhancing real-world, lifelong learning and problem-solving skills [6].

Use of ICT in education promotes 'active and independent' learning. According to Cengage learning [7] some of the ICT tools, devices and infrastructure are mentioned in table 1.

Of these various technologies, the focus of this paper is on content delivery methods namely use of videos to deliver educational content to the students.

Jaflab Al-Ammary (2013) discussed the current situation regarding use of educational technology at the University of Bahrain, regarding the use of technology in teaching-learning process, obstacles facing its adoption, its effects on student achievement and teaching effectiveness. The results of the study reveal that there has been an enhancement of teaching-learning process, motivated students to get involved in learning and teachers are able to communicate well with the students. However there are some impediments that need to be overcome for effective implementation of technology [8]. Syed Noor-Al-Amin has presented a literature review regarding use of ICTs in education. Some important observations made were: ICT has a positive impact on teaching, learning and research, it can affect the delivery of education and enable wider access to the same, it will increase flexibility and will break the barriers of time and geography, influence the way students are taught and how they learn [9].

Table 1.ICT Tools, Devices and Infrastructure

Classification of ICT tool, device, infrastructure	ICT tools used
Web based tools and Applications for managing learning and teaching	Learning management systems, Student management systems, Digital student report card systems, Plagiarism detection systems, Online Collaborative workspaces, Virtual classroom software systems and e-Portfolios
Learning and Teaching tools	Interactive whiteboards, Digital communication,
Mobile delivery devices	Storage devices, Personal Digital Entertainment devices and MP3 players, Personal digital assistants, Mobile phones, Laptops, Tablet PCs, Gaming devices, Assistive and Adaptive technologies
Content delivery methods	Podcasts, Vodcasts, Blogs, Wikis, VoIP, Digital TV,
Other devices, concepts and technologies	Moblogs and photologs, Digital cameras, Scanners, Swarming, Peer-to-peer networking and technologies

3. Video

Use of video has undergone a rapid increase due to several reasons, some of the important include – technology improvement, availability of infrastructure, increasing usage of internet, availability, viewability and downloadability, free exchange of information with lesser issues of copyright etc. Newer companies, enterprises and initiatives are making video popular, eg., YouTube, Wikipedia etc. Internet users watched 12.7 billion online videos in November 2008 and about 136 million people watched professional video content online in January 2009. Every minute approximately 13 hours of video are uploaded onto YouTube. There has been a shift from 'media literacy' to 'media fluency'. There has been an increase in mobility of access to resources. People access videos more through mobile devices than through laptops and computers. This has been possible due to portability of media assets, which has led to an exponential increase in the access to resources and also their distribution channels. This has been possible due to reduced cost of infrastructure and storage of data and information. It is said that the bulk of internet traffic worldwide is comprised of audiovisual films, which are being shown on the internet through different protocols [10].

Videos are widely being used in education. It is a powerful communication medium, which can be used in combination with other learning resources and instructional strategies. It facilitates effective teaching-learning process and provides flexibility to a teacher to teach difficult concepts and at the same time provides students lot of freedom to learn them at their own pace and leisure. They are widely used not only for regular, normal and class room mode of teaching, but also in on-line education in the distance mode. This has been possible because of availability of resources for free on various subjects. NPTEL, one of the largest initiatives by the central government in providing engineering education through lectures and resources provided by faculty from IITs, makes use of video widely. Other examples which make use of video for offering courses include Khan Academy, open courseware initiatives like MOOCs, which includes edX are changing the face of higher education.

SruthyAnand et al. (2010) explore the effectiveness of various video-based learning methods. They evaluate three scenarios with regard to flipped class room – delivering the lecture live and providing the entire recorded video of the class to the students, delivering the lecture live and providing short videos of the main concepts discussed in that class and recording lecture videos and making them available prior to the class. The results show that recorded videos are useful for students. Among the scenarios, the second one of delivery of live lecture, followed by a short video summary is the most effective [11]. Edno Bravo et al. explored the results of the use of videos as an educational tool, which helps in increasing student's motivation in any discipline. It is based on use of streaming videos created as a support material for learning and used by 12 lecturers with 487 students in different degrees of engineering at School of Industrial and Aeronautical Engg. of Terrassa, Spain. It emphasizes the skills developed in each application and the results of the impact of the use of videos on student motivation [12].

Matthew Liberatore (2012) used YouTube videos to teach introductory Thermodynamics to a class which contained a mix of students including juniors and seniors with majors in different specialization. This study was undertaken at Colorado School of Mines. The student led video selection and problem writing encouraged the students to use concepts from class to situations, where some or all of the data was missing. The feedback from the students was positive, it helped them to understand the concepts and apply them to open-ended real world situations [13]. In another study (2013), the use of YouTube videos was made to create a new learner-centered pedagogy that

created home-work style problems inspired from these videos. A survey made at the end of the study, revealed that 88 % of the students felt that they learnt effectively from student-written YouTube problems [14].

INT (2009) in a study in collaboration with New York University interviewed 57 faculty and librarians from 20 institutions across 18 academic departments, regarding the use of video in higher education. Some of the major observations they made included – there was demand for on-line repositories of video by faculty, faculty wanted to play a role in determining and customizing the contents in their libraries, they wanted facilities to be created to enable creating and uploading of videos and faculty and librarians wanted to collaborate in creating faculty-friendly video resources in a variety of subject areas [10]. Mike Hoxley& Richard Rowsell (2006) report their experience of using the materials produced by the Video project at the University of The West of England in teaching level 1 domestic-scale construction technology at Anglia Ruskin University. This discusses the role of videos in lectures. Data collected by the questionnaire from more than 200 students, establishes the use of focused quiz as an 'orienting activity' to encourage 'active learning'. They suggest the need to encourage active rather than 'passive' viewing [15]. Thus use of video has been very useful in improving the learning outcomes of students.

A. Use of Video at the Author's Institution

To understand the use of video as a ICT tool for improving the teaching-learning process. A pilot study has been initiated, wherein a course on 'Basic Thermodynamics' offered in third semester has been selected from mechanical engineering department. This is a core course in the department and the feedback from the students, who have already taken up this course is that this is a difficult course. The examination performance of students in this course is not very encouraging based on the results. The methodology adopted is one of the faculty teaching this course delivers this lecture live in the class, which is recorded and the entire recorded video of the class is made available in the college intranet ('Moodle') for the benefit of the students. The video recorded included not only the audio of the lectures, but also the chalk and board work of the faculty, covering different topics. The lectures of a given week (three in number) are recorded and at the end of the week, it is uploaded

in the moodle, which is accessible anywhere in the college and also in the hostels.

From the literature, though the effective method is live lecture, followed by use of short videos of lecture, for implementation, the mode of using entire recorded videos of lecture has been considered. The reason being, this is a first such effort in the author's institution and there is a lack of awareness among the students regarding the use of videos as a technique in teaching-learning process. Another reason being, this course is considered to be a difficult course and there are only three hours per week allotted to this course. The students do not get much time to interact with the faculty inside the class and the faculty are under pressure to complete the syllabus and hence do not get much time to interact with the students. Thus the authors feel that this mode of using videos would help the students to better understand some difficult topics and improve their knowledge and would also help them to perform well in the exams.

To create awareness about this newly created facility, efforts were made at different levels. A circular duly signed by the Head of the Institution was circulated and put on the notice board for student information. The head of the department, addressed the third semester students in each of their class, where he made a mention of this facility and motivated the students to make use of this facility. The individual faculty who handle this course also informed the students about this facility and motivated them to use the same, to clarify their doubts about different topics.

In order to understand the effectiveness of this newly introduced ICT tool for education delivery in the department, feedback has been collected from the students after the completion of the first mid semester examinations. The feedback obtained from the students is quite surprising and interesting. To the authors' surprise, majority of the students had not watched the videos and expressed their ignorance about it. This could be due to ineffective publicity about this facility to the students and the students not understanding the utility of this tool and its help in making them understand the course. Some other feedback obtained included – a few of the students were aware of this facility, but had accessibility problems, the students had not registered their laptops for accessing the college intranet and some students staying in hostels had problems in accessing it.

Thus this preliminary feedback has been an eye opener for the authors. Hence forth measures will be taken to create more awareness in the students about this facility, make them understand the utility of the same and how it helps their teaching-learning process and trying to solve all other problems like registering the personal laptops with system administrator in the college and accessibility in the college and hostels. Accordingly some of the measures have already been implemented, by the time this paper is being prepared and feedback will be taken again after the second mid semester examinations. Based on the final feedback, efforts will be made to implement the most effective mode of use of video in the other difficult courses, in the coming semester.

4. Results of Survey

Further to obtain a perspective from faculty regarding the need and use of ICT in teaching-learning process, a survey has been carried out at the authors' institution in two departments namely Mechanical and Computer Science & Engineering. The survey is based on questionnaire. Based on the questionnaire prepared by Clemence Michael Kadzera (2006), as part of his PhD dissertation work regarding use of Instructional Technologies in Teacher Training colleges in Malawi, a questionnaire has been prepared to obtain information regarding use of ICT in teaching-learning process [16]. The questionnaire has been included in the appendix. Out of the 100 questionnaire administered only 57 faculty have responded, with a response rate of 57 %.

The findings have been analyzed under – personal details and use of ICT. The personal details include – gender, age, qualification and the courses handled by the faculty during the current semester. The details are as follows, out of the total 57 responded, 9 are female faculty and the rest are male, as the mechanical department has predominantly male faculty members, when compared to computer science and engineering. Also out of the total, 8 were PhD degree holders and the remaining were M. Tech. The faculty were in a wide age range as follows - < 30 years – 16 in number, between 30 and 40 – 26 in number, between 40 and 50 – 9 in number and the remaining were more than 50 years old. It is evident that most of the teachers surveyed were between 30 and 40 years, who are in the beginning of their teaching career and who are enthusiastic about use of ICT in the teaching-learning process.
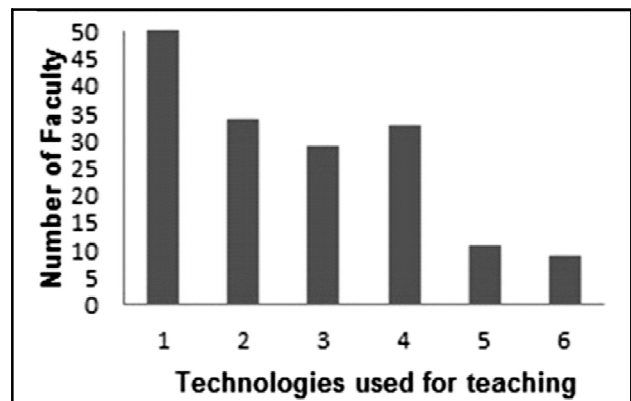

Fig. 1 Faculty using ICT technologies in teaching

In the second part of the survey questionnaire, questions regarding use of different technologies other than chalk and board, reasons for using these technologies, reasons for not using these technologies, competence level in using these technologies, attitude towards use of these technologies and the factors influencing the use of these technologies have been asked. Some of the important results have been presented here. Fig. 1 shows the faculty experience of using ICT technologies in teaching (1- LCD projector with PPT presentation, 2 – Use of videos from different sources including YouTube, 3 – NPTEL and other E-resources, 4 – Digital textbooks and resources from the internet, 5 – Digital library in the college and 6 – Use of social networking media).
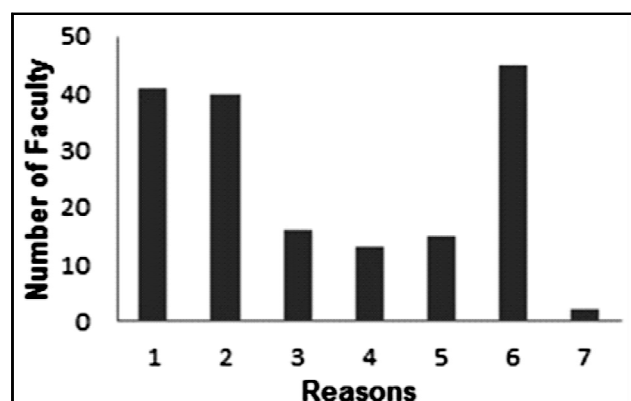

Fig. 2 Reasons for using ICT Technologies

Fig. 2 shows the reasons why faculty use ICT technologies in the teaching-learning process (1 – availability of infrastructure, 2 – awareness, 3 – availability of necessary training, 4 – adequate Wifi connectivity, 5 – proper accessibility, 6 – motivation to improve the teaching-learning process and 7 – pressure of peers, HOD and management). Fig. 3

gives details about the competence of the faculty in using the ICT technologies listed in Fig.1. The levels of competence has been evaluated as (1 –no competence, 2 – little competence, 3 – average competence, 4 – Above average competence, 5 – Highly competent). The graph has been drawn considering the competence levels 3 and above, while calculating the statistics, to make the analysis simpler.
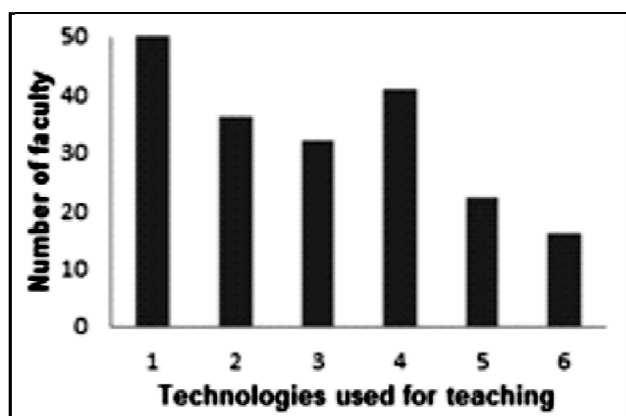

Fig. 3 Competence of the faculty in using these technologies

A. Discussion

1) The faculty who participated in the survey are aware of the existence and use of ICT technologies in the teaching-learning process, though all may not be aware of its effectiveness, which may warrant a more detailed study.

2) More than 50 % of the faculty surveyed used the first four ICT technologies in different proportions namely PPT presentation, use of videos, NPTEL and other E-resources and digital textbooks and other internet sources. Out of these four, 53 faculty used PPT presentation, 34 used videos from different sources, 33 used digital textbooks and other internet sources and 29 faculty used NPTEL and other E-resources. There is a need to encourage more faculty to use these technologies in a more efficient manner.

3) The use of digital library, which is available in the institution's library and social media is less, which can be improved in the days to come to improve the teaching-learning process.

4) The results regarding reasons for using these ICT technologies and also reasons for not using them (results not included in his paper) are interesting.

More than 75 % of the faculty use these technologies for various reasons, predominant among them are availability of infrastructure, awareness and motivation to improve the teaching-learning process. Among these the motivation reason, was the overwhelming reason for the use of these technologies, which is a positive development regarding better adaptation of these technologies. Among the reasons for not using these technologies, predominant reasons were lack of training and resources. There is a need for the management of the institution to make better efforts to improve the availability of resources and also provide necessary training through seminars and workshops.

5) With regard to the competence of the faculty in the use of these ICT technologies, more than 75 % of the faculty surveyed were competent in using LCD projectors for PPT presentation and digital text books and other resources from the internet. More than 50 % were conversant with use of videos and NPTEL and other E-resources and less than 50 % were conversant with other technologies namely digital library and social media. Also it is to be noted, these statistics reflect different levels of competence, but only levels 3 and above have been considered for plotting these results.

5. Conclusions and some suggestions

This paper presents some thoughts on use of ICT in teaching-learning process, to enhance the teaching-learning outcomes. There has been a sea change in the use of ICT in education, particularly in technical education. This paper presents some preliminary results of use of recorded video as a means to improve understanding of a difficult core course in a department in the author's institution. Also the results of a preliminary survey carried out regarding the use of ICT in teaching-learning process in the author's institution in two departments are presented. The results of the survey are encouraging. Thus this paper presents perspective of students and faculty in effective use of ICT in teaching-learning process by improving the learning outcomes.

Based on the studies, the following suggestions are offered –

1) Students need to be motivated and made to understand the use of recorded videos in understanding and learning difficult courses. Faculty also need to understand its effectiveness and should

motivate the students in the class regularly to use these and improve their understanding of the course and their performance in the exams.

2) The management of the institution can provide necessary infrastructural support to implement the use of videos to improve the learning outcomes and see its influence on students.

3) It has to improve network connectivity, provide laptops to faculty and provide LCD projectors in all class rooms, procure E-books and E-resources for use by the faculty.

4) The faculty needs to be trained regularly through workshop and seminars, in order to make them understand the effectiveness of ICT tools in the teaching-learning process.

5) The management can devise plans to incentivize the efforts of the faculty in effective use of ICT in teaching-learning process.

References

[1] Margery H.Davis, "Outcome-based Education", JVME 30(3) © 2003 AAVMC, pp 227-232.

[2] Sujatha, Rajshri Jobanaputra and R.V.Joshi (2011)doi:I 10.1109/T4E.2011.65, pp 303-304.

[3] Mansotra V., Vinod Sharma & Sambyal G.S. (2009) doi: 10.1109/ICCSIT.2009.5234382.

[4] Mario Edelmiro Antunez, Maria Kolb Koslosky &Veronica Marina Longobardi (2014) doi: 10.1109/IMCTL.2014.7011100.

[5] Adrian Kirkwood & Linda Price (2014) doi: 10.1080/17439884.2013.770404.

[6] Warren Wilson, "Faculty perceptions and Uses of Instructional technology", EDUCAUSE QUARTERLY, Number 2, 2003, pp 60-62.

[7] "More definitions of ICT tools and devices for your teaching", CENGAGE Learning Australia, 2010.

[8] Jaflah Al-Amary (2013) doi:10.1016/j.sbspro. 2012.09.501.

[9] Syed Noor-ul-Amin, "An Effective use of ICT for Education and Learning by drawing on Worlwide Knowledge, Research and Experience",www.nyu.edu/classes/keefer/waoe/amins.pdf, pp 1-13.

[10] "Video Use and Higher Education: Options for the Future", INT, New York University, June 2009, pp 1-14.

[11] Sruthy Anand, Shiffon Chatterjee & Kamal Bijlani (2014) doi: 10.1109/T4E.2014.43.

[12] Edna Bravo et al.(2011)doi:10.1109/EDUCON.2011.5773205.

[13] Matthew W. Liberatore, Charles R. Vestal & Andrew M. Herring, "YouTube Fridays: Student led development of engineering estimate problems", Advances in Engineering Education, ASME, Winter 2012, pp 1-16.

[14] Matthew W. Liberatore et al., "Student created homework problems BASED ON YOUTUBE VIDEOS", Chemical Engineering Education, Copyright ChE Division of ASEE 2013, pp 122-132.

[15] Mike Hoxley & Richard Rowsell (2006) doi: 10.1080/17452007.2006.9684609.

[16] Clemence Michael Kadzera , "Use of Instructional Technologies in Teacher Training Colleges in Malawi", Ph. D Dissertation, Virginia Polytechnic Institute and State University, 2006.

APPENDIX
SURVEY QUESTIONNAIRE REGARDING USE OF ICT IN TEACHING-LEARNING PROCESS AT NMAMIT, NITTE

Section 1 : Personal Details

1. Gender (M/F);
2. Age:
3. Highest qualification:
4. What are the subjects you teach this semester? :

Section 2: Use of Information and Communication Technology

1. Other than chalk and board, what are the technologies you make use of in your teaching (please tick the choices you use
   a) LCD projector with PPT presentation
   b) Use of Videos from different sources(including YouTube)
   c) NPTEL and other E-resources
   d) Digital textbooks and resources from the Internet
   e) Digital library in the college
   f) Use of social networking media

2. Reasons for using these technologies (please tick)
   a) Availability of infrastructure
   b) Awareness
   c) Availability of necessary training
   d) Adequate Wifi connectivity
   e) Proper accessibility
   f) Motivation to improve the teaching-learning process
   g) Pressure of peers, HOD and management

3. Reasons for not using these technologies (please tick)
   a) Lack of infrastructure
   b) Lack of awareness
   c) Lack of training
   d) Lack of resources
   e) Not interested
4. Your competence level in using the technologies selected in Question 1
   (1 –no competence, 2 – little competence, 3 – average competence, 4 – Above average competence, 5 – Highly competent)

Technologies	1	2	3	4	5
LCD projector with PPT presentation					
Use of videos from different sources					
NPTEL and other E-resources					
Digital textbooks and resources from the Internet					
Digital library in the college					
Use of social networking media					

5. What is your attitude towards use of these technologies?

(1   strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, 5 – strongly agree)
a)   Use of chalk and board is sufficient
b)   Using E-resources is difficult
c)   Use of computers / lap top is difficult
d)   Requires lot of time to collect resources and putting them in a proper way
e)   Use of video / YouTube is difficult to use

JEET

f) Difficult to read and understand the resources on computers
g) Use of technologies in classrooms is a distraction
1. What is your attitude towards use of these technologies?
–
(1　strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, 5 – strongly agree)
a) Use of chalk and board is sufficient
b) Using E-resources is difficult
    c) Use of computers / lap top is difficult
    d) Requires lot of time to collect resources and putting them in a proper way
    e) Use of video / YouTube is difficult to use
    f) Difficult to read and understand the resources on computers
    g) Use of technologies in classrooms is a distraction

2. What are the factors that influence the use of technologies?
    (1 – not at all important, 2 – somewhat important, 3 – neutral, 4 – important, 5 – very important)

Factors	1	2	3	4	5
Awareness					
Availability of infrastructure					
Training					
Administrative and peer support					
Workshops and seminars					
Personal interest in technology					
Personal interest in improving my teaching					
Personal interest in enhancing my teaching					

THANK YOU FOR YOUR TIME AND PARTICIPATION IN THE SURVEY