# Interactive Technologies for Improving Quality of Education to Build Collaborative Learning Environment in Academic Institutes

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*Abstract*— Today with advancement in Information Communication Technology (ICT) the way the education is being delivered is seeing a paradigm shift from boring classroom lectures to interactive applications such as 2-D and 3-D learning content, animations, live videos, response systems, interactive panels, education games, virtual laboratories and collaborative research (data gathering and analysis) etc. Engineering is emerging with more innovative solutions in the field of education and bringing out their innovative products to improve education delivery. The academic institutes which were once hesitant to use such technology are now looking forward to such innovations. They are adopting the new ways as they are realizing the vast benefits of using such methods and technology. The benefits are better comprehensibility, improved learning efficiency of students, and access to vast knowledge resources, geographical reach, quick feedback, accountability and quality research. This paper focuses on how engineering can leverage the latest technology and build a collaborative learning environment which can then be integrated with the national e-learning grid.

***Key words:*** Engineering, Education, E-learning Grid, Collaborative Learning Environment, ICT, New Ways in Education, Learning Content

## I. INTRODUCTION

Over the last decade the Information Communication Technology underwent drastic changes from wired to wireless, from display screens to touch panels, from 2D to 3D technologies and High speed networks. These changes have led to development of various new applications which earlier where thought to be not feasible becoming reality. Academicians have started to look towards the new applications being developed and how they can be leveraged to make the studies more interesting. Lots of effort is being spent on developing the interactive learning applications and content for improving the quality of education.

In developed world like United Kingdom they started the initiative to modernize the education system and leverage the ICT in education with that in mind they started the national e-learning grid initiative in 1998 and targeted to connect all its schools to the national e-learning grid by 2002. They invested huge sums of money to upgrade the infrastructure of schools and various academic institutes with the objective to improve the quality of education and standardize it across the various institutes. They have been able to achieve its objectives. While in the developing world like India the market is still in the nascent stage and no clear policy or steps are taken by the government towards developing such infrastructure whereas schools are trying to adapt to what is available in the market without looking at how the technology is changing and in what direction they should go. They are just trying to differentiate themselves from their peers due to competitive market space and also to maintain their leadership positions.

Currently schools and academic institutions in India are going in for upgrading the infrastructure to leverage the advancement in ICT technology in education. They are investing in hardware equipment like projectors, sound system, smart boards and computers in the classrooms sometimes connected through LAN and sometimes stand-alone. They are purchasing interactive applications, 2-D, 3-D learning content, animations, live videos and educational games. They are collecting the CD's, DVD's and also taking content from the vendors. Once these things are taken then they struggle to use as their teachers do not feel comfortable using such equipment's and content while teaching and entire investment goes wasted as it is not used properly.

The schools and academic institutes need to have a strategy in place with long term vision of how these things will be used and what is going to be the future of ICT usage in education. How ICT will bring the stakeholders (management, teachers, students and parents together). This paper focuses on providing the roadmap to academic institutes to understand the developments in ICT technology, its challenges and how they should go about adopting it.

## II. TWO MAIN CONCERNS OF EDUCATION

This study employed both qualitative and quantitative methods [1].

### *A. Qualitative Component*

Case studies of six engineering schools based on rich qualitative data identify unique practices used for recruiting women engineering students. Qualitative data were gathered as part of the NSF-funded, and Engineer of 2020 inspired study entitled Prototyping the Engineer of 2020: A 360-degree Study of Effective Education (DUE 0618712). To select case study sites in a purposeful manner, the research team used quantitative data from the nationally representative Engineering Change study [2],

which assessed the impact of ABET's outcomes-based EC2000 accreditation criteria. With guidance from a National Advisory Board comprised of engineering education leaders, the team identified the following institutions that exhibited superior performance on focal learning outcomes (i.e., design and problem solving skills, interdisciplinary competence, and contextual competence) and/or recruiting and graduating women and underrepresented students: Arizona State University (ASU), Howard University (Howard), Massachusetts Institute of Technology (MIT), the University of Michigan (U-M), and Virginia Tech (VT). Four of the six institutions studied outperformed their peers on measures of women students' enrollment and graduate rates. These institutions are diverse in size, institution type (public or private, research focus), geographical region, and student body characteristics.

*B. Quantitative Component*

Quantitative data were drawn from a companion study funded by the National Science Foundation, entitled Prototype to Production: Processes and Conditions for Preparing the Engineer of 2020 (EEC-0550608). The study collected data from engineering undergraduates, alumni, faculty members, program chairs, and associate deans in a nationally representative sample of 31 colleges and universities Education and engineering researchers developed the survey-based instruments for each of these populations through a two-year process. Literature reviews resulted in a survey bank of over 1,000 items, and interviews, focus groups, and pilot testing with administrators, faculty, students, and alumni on multiple campuses ensured that survey items would be interpreted by respondents as anticipated by the research team. Survey items were adjusted following these tests to enhance construct validity.

## III. VARIOUS STEPS TO ESTABLISH A COLLABORATIVE LEARNING ENVIRONMENT

The various stages in which the academic institutes should plan to establish a collaborative learning environment using the ICT technology keeping futuristic technology in mind is as stated below:

*A. Step I: Understanding The Education Landscape and Infrastructure Using ICT Based Learning Environment.*

The learning environment refers to learning models that combine traditional classroom practice with e-learning solutions. The environment should also support the interaction between the various stakeholders involved in the academic institutes to run it smoothly. It should also facilitate discussions, collection of data, chatting and exchange of ideas within the academic institute as well as with other academic institutes or research initiatives. The most important aspect of learning environment is the class room which needs to be fully equipped. The components of learning environment are shown in the picture below:

*1) Digital Content:*

Digital content comprises of 2-D, 3D animations, Video recordings (lectures, experiments, observations, natural habitats, places etc.), games etc.

*2) Smart Classrooms Setup:*

Classroom having Display device, computer, a sound system, Internet, interactive board, smart desks within build touch panel, web cam, response system etc. is known as smart classroom.

*3) Internal and External Network:*

It means the academic institute should have LAN, intranet based internal applications, internet and internet based applications for exposing and interacting with external networks like national e learning grid etc.

*4) Software Applications:*

Software applications means like ERP software to involve parents, management, teachers and students into one system where they can see their academic performances and other administrative tasks. Web based applications like Knowledge repository, online questions/quizzes, interactive games, applications to run smart desks etc. Laboratories are with data capturing and sharing equipment. Now a days the instruments are coming which can record the observation being done in the experiments and hence can be shared with others doing similar kind of research as a result collaboration can happen in such activities so equipment needs to be built in the academic institutes to leverage the full potential of ICT in the education.

*5) Video Recording and Online Lecture Facility:*

In this facility a video conferencing facility is required in which a faculty can interact with students sitting in at different location and vice versa. This will help in conducting remote classes.

*6) National e- Learning Grid:*

The basic idea of national e learning grid is that it will comprise of a mosaic of interconnecting networks and education services based on the Internet, TV and radio networks which will support teaching, learning, training and administration in schools, colleges, universities, libraries, the workplace and homes. The national grid will have a centralized repository which will contain the entire knowledge base of the country and will be used to provide the various education and learning programs.

The examples of professional groups includes teachers, teacher trainers and educational researchers, advisory staff, education staff, librarians, curators /educators in museums and galleries, faculty staff in higher education, trainers involved in vocational and workplace education, specialists in career guidance, educational consultants and educational administrators. All these can contribute to the creation of good repository. This centralized repository will also be utilized to offer the education programs through TV and radio networks apart from the academic institutes thus enabling its reach to all. The various stake holders like schools, colleges and universities, experts from various fields, scientists etc. will be allowed to upload the content and then the review team will review and approve the content which will then be integrated into the education and various vocational and non-vocational programs thus maintaining standard and quality will become easy across the nation as same will be accessed by the students, teachers, researchers etc. while learning.

The national grid will provide the education services which will be linked up throughout the country via internet, TV, mobile and Radio networks as shown in the figure below: The various academic institutes, corporate, schools, universities and end users will then connect to national grid to receive these services via internet and other communication means.

Now after understanding the component of ICT in the education the next step is how to go about adopting it. The next step is to establish the learning environment infrastructure in the academic institutes.

*B. Step II: Establishing The Infrastructure*

To establish such learning environment one needs to build the infrastructure in a phased manner:

- Phase – I: The focus is on involving students and teachers in using the digital content in the classrooms for learning purpose. It is the first step in adopting the ICT in education. The basic class room set-up which includes a Display device (LCD or projector etc.), a sound system, and a computer system to run CD's, DVDs, learning content and stand-alone applications.
- Phase-II: Taking the infrastructure beyond the classroom to the academic institute and leveraging what is available in the internet. This enhanced set-up which includes connectivity to central repository, High speed internet connection using a leased line (LAN), video conferencing equipment like web cam, mic etc. and a centralized server based applications which can be accessed easily thorough internet. Setting up of digital labs also known as virtual labs to conduct the experiments and capture and share the data. The purpose of this phase is also to create in-house content and build institutes its own knowledge repository.
- Phase – III: Interactive devices or smart desks to be used by the students in the class which includes problem solving applications, display device and input capturing device. This set-up helps in quickly evaluating the tasks assigned to the students, also to collaborate among various students on different topics and provides access to the central repository.
- Phase – IV: A web based knowledge repository and collaboration space where ideas can be exchanged, discussed and shared among various communities. This software should be capable of hooking up with national e-learning grid and ERP application to involve all the stake holders.

*C. Step III: Focus on training the teachers and adopting new teaching methods leveraging ICT*

After setting up the infrastructure of such learning environment the biggest challenges is its adoption by the teachers and integration of content into the curriculum. The first challenge of adoption by the teachers has two aspects one is lack of familiarity with the equipment and second is how we can use the content while teaching as they are not use to it.

Firstly, they should be trained on how they can use the equipment and make them comfortable before moving on to the next step of how they should adapt to using the content in their teaching. Most academic institutes focus on how the content to be used rather than how the equipment is used and hence teachers do not feel comfortable in using it.

Once the teachers are comfortable in using the equipment then only the next step of how it gets integrated in to the curriculum should be taken. For this academic institutes need to modify the curriculum and lecture plan to include the usage 2D, 3D content and various interactive applications. Once such plan is developed it should be vetted by the experts and training should be provided to the teachers accordingly. The benefits of using such technology should be shared with the faculty so that they can understand it and adopt it. After teachers the focus is on the students to see to it how they are taking it and enjoying the new methods of learning. A drastic improvement is seen in terms of their interest and focus on studies.

*D. Step IV: Adding Interactive Applications and Smart Desk for Students*

Now the next step is to bring the technology to the doorsteps of the students and involve them more in the learning process. Having smart desks for the students will help teachers more in personalized attention as it becomes very easy to identify the need to each and individual student. In smart desks the best part is teacher can monitor from his electronic slate what each student is doing on its desk. Say e.g. a math's question is given for solving to the students and they are asked to do it. The teacher can see what each student is doing from the main panel without going to the desk of each student and can evaluate it faster and help the student in solving it. She can also project it in the class which she feels is the best solution done by the student hence increasing the competitiveness and instilling confidence in the student.

She can also help the students who failed to solve to exactly where their mistake was and how it can be rectified hence provide multiple ways of solving the questions. This smart desk also has various learning applications and games which make learning more fun for the students and hence they enjoy more and grasp more. The quizzes can be pushed through and immediate results can be provided hence evaluation becomes much easier. The virtual labs are based upon the concept of I listen I forget, I see I retain some I do I remember for life. It provides opportunity to do the experiments and see their results hence making it much easier to remember.

*E. Step V: Integrate with Learning Grid or Education network.*

In this step the academic institute will link up with the learning grid and contribute in it by providing the content and researches being done. They will also use the grid to download useful information and adopt new good quality content in its academic curriculum. It will also provide the opportunity to do collaborative research and development. This collaboration is feasible only if institutes are ready and national level grid is built without which the collaboration will be limited to few academic institutes which will come together with each other.

## IV. ENGINEERING METHODS THAT IMPROVE EDUCATION

### *A. Multimedia Enables Alternative Assessment:*

The use of interactive multimedia capable computer systems enables more effective ways to achieve the desired goals, even in resource-limited settings. Appropriate use of multimedia extends the involvement of the student (bringing additional senses into play and employing both "left-" and "right brain" faculties), facilitates confidence measuring protocols, and provides practicable performance assessment (evaluating students' ability to solve problems that include the performance of particular tasks or procedures [3]). These modes make it easier for students to use the system, enhance the presentation of problem context, and support the simulated environments used for performance assessment. Our investigation of the feasibility of developing such alternative assessment tools for engineering education [4, 5] combines essentials of assessment and performance testing[6, 7, 3, 8, 9-12] with student modeling[l3-15] and principles of interface design[16-21]. In the following sections we describe the confidence measuring and performance testing concepts and their embodiment in prototype assessment systems.

### *B. Confidence Measuring*

The goal of confidence measuring assessment is to more accurately measure students' true knowledge states. Typical multiple-choice respond with what amounts to a probability distribution restricted to 0 and 1 value as in the example shown here:

In "No Silver Bullet," Brooks cites which of the following as the most profound long-run trend in software engineering?

- [1] A. The spiral model
- [0] B. The mass market
- [1] C. Automatic programming

By restricting responses to 0 or 1, we lose the ability to discriminate between states of knowledge such as"I strongly believe B to be correct," "I believe C to be incorrect but can't distinguish between A and B," and"From what I know, each alternative seems equally likely to be correct."

## V. AN ENGINEERING TECHNOLOGY PROGRAMME DEMONSTRATION CRITERIA

An engineering technology program must demonstrate that graduates have following criteria:

1) An appropriate mastery of the knowledge, techniques, skills and modern tools of their discipline
2) An ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering and technology
3) An ability to conduct, analyze and interpret experiments and apply experimental results to improve processes
4) An ability to creativity to design systems, components and processes appropriate to programmed objectives
5) An ability to function effectively on teams
6) An ability to identify, analyze and solve technical problems
7) An ability to communicate effectively
8) A recognition of the need for, and an ability to engage in lifelong learning
9) An ability to understand professional, ethical and social responsibilities
10) A respect for diversity and a knowledge of contemporary professional, societal and global issues, and
11) A commitment to quality, timeliness, and continuous improvement.

## VI. CONCLUSION

Full understanding of ICT, its components, and future direction will help academic institutes to plan better and adopt it. A well thought phased approach has better chances of success and long-term usage of ICT in education the academic institutes can follow the step by step approach stated here to adopt the technology and realize its benefits with ease. In this way engineering technologies are used to get better qualitative education.

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