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ICT andActive Teaching-Learning-Assessment Process in the Engineering Education

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Abstract: The tremendous developments in the technology in recent years have brought revolutionary changes in the education sector. The millennial learners are increasingly comfortable with technology. The change in traits and needs of the learners has been forcing education system to adapt to these learners. Information and communication Technology (ICT) plays vital role in the teaching learning activities in the engineering education such as resource creation, delivery of contents, assessment, monitoring, administration etc. In this paper such ICT tools are discussed and their analysis is done on the basis of feedbacks obtained from a group of learners. The specific activity of flipped classroom is focused with its impact on students' participation, learning and satisfaction. The innovative numerical based assignment and its assessment using MATLAB tool are also elaborated.

Keywords: ICT, Resource Creation, Delivery, Assessment

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1. Introduction:

The technology has created major impact on our day to day life. These technologies are now part of engineering education. Information and communication (ICT) tools have the potential to fundamentally revamp engineering education. ICTs are a series of instruments that transform the way human collectively produce and consume information on a global scale [1]. The ICTs have already changed the way the knowledge is disseminated.

The millennials who were born between 1980 and 2000 spend around 6-7 hours each day in technology enabled media. These learners like to be in control, they are inclusive, group oriented and social. To effectively engage these learners, engineering institutes must be outfitted with ICT resources and curriculum must be designed to promote active and cooperative learning styles [2][7]. The technology has also enabled a way to manage the student driven learning process through learning management systems [3].

Online modalities also require a learning discipline that young students may not haveacquired. Using the course management tools, we know preciselywhen and for how long students spend with online assignments. Faculty need to help studentsdevelop the ability to use technology tools effectively [4].

2. Methodology

The different technology tools are tested in the Electronics and Telecommunication engineering programme and the efficacy is discussed in the subsequent sections. The different tools used are with respect to resource creation and its access, course delivery and assessment, overall monitoring/learning management. Course website, Moodle, Edmodo, Matlab/scilab, Screencasting softwares, flipped classroom, You-tube, Whatsapp, these are some of the tools which are discussed here.

3. The technology tools impacting on engineering education.

The different tools which are used for resource creation and their access-

- Many Screencasting softwares are available to record the presentation along with voice. Some of the freely available tools are Active-Presenter Free Edition, Capture Fox, Microsoft Expression Encoder, Screencast-o-matic, allcapture, hypercam [5] etc.

- These resources can be made available to learners through different channels such as Course website, Moodle, You tube, spokentutorial.org.

3.1 Flipping the classroom with Technology-an Active learning strategy:

In the course of Digital Communication for class of third year B.Tech, flipped classroom technique is implemented as an active learning strategy. In this activity the resources are provided to students.In essence, "flipping the classroom" means that students gain first exposure to new material outside of class, usually via reading or listening lecture videos, and then use class time to do the harder work of assimilating that knowledge, perhaps through problem-solving, discussion, or debates.In terms of Bloom's revised taxonomy (2001), this means that students are doing the lower levels of cognitive work (gaining knowledge and comprehension) outside of class, and focusing on the higher forms of cognitive work (application, analysis, synthesis, and/or evaluation) in class, where they have the support of their peers and instructor. This model contrasts from the traditional model in which "first exposure" occurs via lecture in class, with students assimilating knowledge through homework; [6]. The comparison

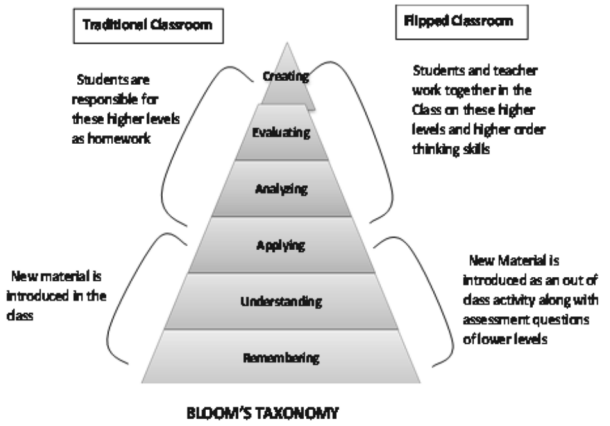


Fig.1 Comparison of traditional and flipped class

of flipped classroom with traditional classroom is as shown in fig.1

To implement this activity, the screen casting of PowerPoint presentation along with the voice is done with the help of a freeware screen casting software Screencast-O-Matic. The recorded videos are then made available to students through you tube, Moodle, and course website. The pace of presentation was such that it matches with pace of students of all cognitive levels. The detailed instructions were provided along with videos and other supplementary resources. This forms the out of class activity (pre-class activity).

The learning objectives were defined for this flipped class activity and the assessment questions were also formed aligning these objectives. For every video resource, the assessment questions were provided. The assessment questions were at lower cognitive levels such as recall, understand and apply. To understand the level of students the evaluation of assessment questions was done before In class activity.

In the In-class activity, effective learning is expected. To achieve this goal students were engaged in higher order thinking skills. Two different active learning activities were conducted in this segment to stimulate the higher order thinking. Strategies such as Think Pair Share and Peer Instruction were employed.

The technology component involved in this part of activity was to use online assessment tools such as Edmodo, Clicker etc. In case of Edmodo, students joined the group created by instructor and with the help of facility of polling, quiz and comments, the feedback of students was received.

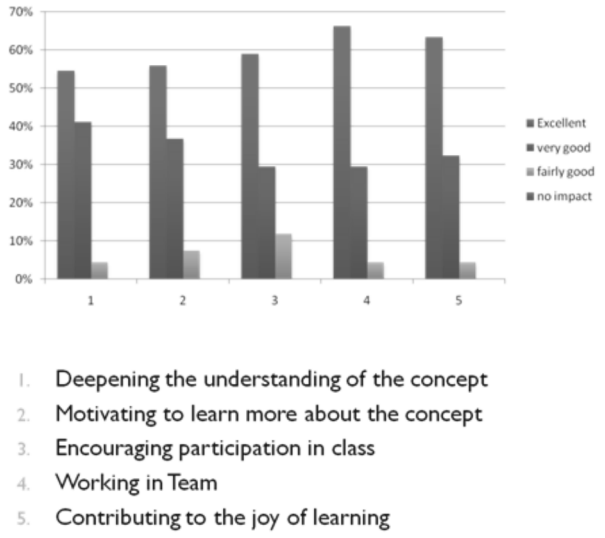


Fig.2 Students' feedback to flipped classroom

The student feedback is shown in fig.2.

Some of the comments of students on this approach are

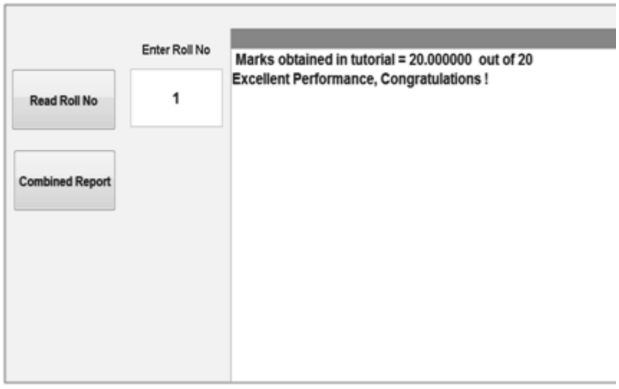
- "In normal classroom, there are many disturbances, it may lose one's concentration, but in this activity the resources such as videos are provided which can be learnt by students at any time & as many times. It helps in understanding concepts very well."
- "The task is given to study ourselves by videos provided by teacher, so it is student's responsibility to study. giving such responsible work can develop self learning ability."
- "I find difficult to maintain curiosity while learning on my own"

Overall it was successful activity with the help of use of technology.

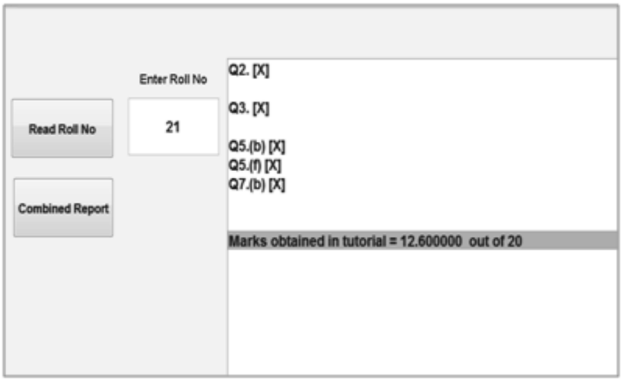
3.2 Innovative practices of conducting tutorials and assignments

In Engineering courses, tutorials and assignments are given to students for developing their problem solving ability which leads to better learning. Traditionally the problems given to all students in the class under tutorials and assignments are same. Here the possibility of getting the answers copied from one student to another is very high, which may not serve instructor's purpose. In this paper, an innovative method is proposed in which unique questions are given to individual student for each tutorial/assignment. The manual assessment of all such questions would be cumbersome and time consuming. Hence a software program has been developed for quick and correct assessment of such tutorials and assignments.

The proposed method is applicable to tutorials and assignments having only numerical type questions. One sample question for tutorial in the course-Electromagnetic Engineering at Second Year B.Tech Program can be set as " Find electric field intensity at point(RN+3, 0.6 RN, -3RN)m due to 10 μC charge located at origin?". Here RN represents last two digits of a roll number of student. In case if last two digits are same for multiple students, then instructor of the course has to give unique two digit code to those students. Giving questions in such form prevents students copying the answers from peers. It may be possible that slow learners may take help from good learners to understand steps in solving particular question, eventually it helps in collaborative learning.



a)



b)

Fig.3 GUI output for different roll numbers

The assessment of these tutorials/assignments can be done using any software tool. The proposed method uses MATLAB tool for the process. Instructor provides a soft copy of template consisting question numbers with spaces to fill the answers. Students are asked to fill the answers obtained by them in the template file which is renamed to get the unique file name. e.g. if RN =05 and tutorial no. is 2 then file name can be 'tutno_02_rollno_05' . The purpose of giving unique file name is to identify submission of individual student for each tutorial. The student uploads this file to the department file server before due date and instructor collects all such files from server. Before grading the tutorials instructor obtains the solutions on paper in terms of variable RN. Then this solution is implemented in MATLAB program. MATLAB program compares the answers of students with instructor's answers, if difference is less than or equal to 3 % then answer is considered as correct. The snapshots of the MATLAB GUI for checking tutorial/assignment and giving result in terms of marks and the feedback about incorrect answers is shown in fig. 3

```
Q1. Qenc = 150.4   [C]

Q2. The flux passing through surface = 11.08   [C]

Q.3 Work done W = -1.1   [J]

Q4.(a) Differential Work done along arho dW = -11.0368e-009   [J]
Q4.(b) Differential Work done along aphi dW = 14.9968e-009   [J]
Q4.(c) Differential Work done along E dW = -35.6547e-009   [J]
Q4.(d) Differential Work done along G dW = -32.3916e-009   [J]

Q5.(a)Volume integral RHS =  2000   [C]
Q5.(b)Integration over constant rho equal to RN surface = 200     [C]
Q5.(c)Integration over constant z equal to 0 surface = 10       [C]
Q5.(d)Integration over constant z equal to 0.5RN surface = 10   [C]
Q5.(e)Integration over constant phi equal to 0 rad surface = 10   [C]
Q5.(f)Integration over constant phi equal to pi/4 rad surface = 10   [C]
Q5.(g) Closed surface Integration LHS = 160   [C]

Q6.Potential at point P  = 38.763   [Volts]

Q7.(a) Potential at a point V = 250.94   [Volts]
Q7.(b) Potential at a point V = 100.487   [Volts]
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Fig.4 Tutorial submission template

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 Marks obtained in tutorial = 20.000000  out of 20
Excellent Performance, Congratulations !


 The solution of Tutorial no.1 for your enrollment no. is as follows

Q1.Qenc = 5.14e-005   [C/m2]

Q2.The flux passing through surface = 0.00483   [C]

Q3. Work done W = 0.0087   [J]

Q4.(a) Differential Work done along arho dW = -4.02e-009   [J]
Q4.(b) Differential Work done along aphi dW = 2.02e-009   [J]
Q4.(c) Differential Work done along E dW = -4.9235e-009   [J]
Q4.(d) Differential Work done along G dW = -2.1142e-009   [J]

Q5.(a)Volume integral RHS = 0.27498[C]
Q5.(b)Integration over constant rho surface = 0.0098175[C]
Q5.(c)Integration over constant z equal to 0 surface = 0.94281[C]
Q5.(d)Integration over constant z equal to 0.5RN surface = -0.94281[C]
Q5.(e)Integration over constant phi equal to 0 rad surface =    0[C]
Q5.(f)Integration over constant phi equal to pi/4 rad surface = 0.26517[C]
Q5.(g)Closed surface integral LHS = 0.27498 [C]
```

Fig. 5 Response to tutorial submitted by student

In fig 3a the result of roll number 1 is shown, who has given correct answers whereas in fig. 3b, for roll number 21, the answers of some questions were wrong and they are shown in the GUI along with marks.

The tutorial submission templates are provided to students, one of such template is shown in fig.4.

After assessment of tutorials in MATLAB program, separate assessment report is automatically generated for each tutorial and student. The assessment report contains the detailed evaluation, incorrect responses given by student and expected answers for all questions. These student wise reports are kept on server for students' information.The response to the tutorial submitted by student with roll number 1, who got 20 marks out of 20 is shown in fig. 5. In this response, the actual answers given by student are shown along with his marks for this tutorial.

Students may use these reports for their further improvement in the course. The marks obtained by each student are written in Excel sheet automatically for each tutorial by the MATLAB. Final grading is done according to these marks in the Excel sheet itself at the end of semester.

4. Findings

The idea of flipped classroom with Think-Pair-Share, peer instruction showed that students who worked in this model had significant learning gains compared to traditional instructions. Flipping the classrooms with small group discussions has also produced significant learning gains. There are gains not only in terms of student learning, that students learn better and they are able to perform better in the exams,but also there are gains in terms of students'interest to learn and increase in attendance due to joy of learning.

The innovative practice of tutorials and assignments has created major impact on students' behaviour and their learning. Students had to pay attention in the class and workout the problems individually which made them responsible and attentive in the class and in tutorials. One more advantage is that students cannot copy from their peers. The use of technology has made the efforts simple and effective. These claims are supported by evidences in terms of results.

5. Conclusions

The use of ICT in education has improved the delivery methods which are complementary to the needs of the millennial learners. The methods which are used in this paper have significantly improved the attentiveness of students and brought transparency in the assessment. The method of flipped classroom helped students to go with their pace of learning. Innovative practice of evaluation of tutorial/ assignment is advised to every faculty member in engineering education to avoid merely copying of tutorials/assignments from peers and improving the problem solving capability of students.

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