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# Flipped Classroom Using ICT Tools to Improve Outcome for the Course 'Soft Computing' - A Case Study

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**Abstract:** Flipped Classroom (FC) or Inverted Classroom is now an important area of focus in educational studies which is supposed to promote critical thinking inside classroom providing time for learner-centered activities such as active and problem-based learning. There is a lack of skills and awareness in implementing FC in Engineering Education. This paper illustrates an effort in implementing FC based teaching - learning process and assessment methodologies using Information and Communications Technology (ICT) tools to achieve the course outcomes for an elective course 'Soft Computing'. The outcomes are obtained for two different set of students, where one set undergoes FC with ICT tools, second set undergoes traditional classroom. The student outcomes are discussed in terms of their exam and assignment marks and their satisfactory index towards the course. It is obvious from the case study that satisfactory index is high for the students who were taught based on FC where there is proper planning which is implemented using ICT tools.

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**Key Words:** Soft computing, active teaching and learning strategies, ICT tools, Flipped Classroom.

## 1. Introduction

In India, more concerns such as lack of capability of graduates to cater industry need, unaccredited programmes, poor implementation of outcome-based education (OBE) etc in accredited programmes in higher education are reported severely. Among these, opinion concerning the implementation of OBE paradigm is recently seriously argued among the higher education institution.

The National Board of Accreditation (NBA), India was initially established by AICTE (All India Council of Technical Education) for periodic evaluations of technical institutions & programmes according to specified norms and standards as recommended by AICTE council. NBA has introduced a new process, parameters and criteria for accreditation. These are in line with the best international practices and oriented to assess the outcomes of the programme. To achieve the outcomes effectively, the technical institutions are moving towards student centric education from teacher centric education.

To obtain the real outcome, it becomes necessary to implement learner centric education ideas which include implementing active learning strategies. One promising approach is to deliver the course content using Flipped Classroom (FC) and thus freeing class time for active learning and improving higher order

thinking skills. The use of ICT tools facilitates the active learning more. The effectiveness of flipped classroom is explored among undergraduate students and reported that it is more beneficial for students. [1].

It is suggested that students' academic success, and their engagement and interest in engineering, can be enhanced by refinement of an integrated instructional design framework. [2] The authors also believe that this positive outcome is a result of alignment of online preview of lectures, face-to-face student/instructor and peer interactions, discussions, hands-on activities, combined with several active learning strategies infused into the class.

It is proved that the inverted classroom allowed the instructor to cover more material, students participating in the inverted classroom performed as well or better on comparable quiz and exam questions and on open ended design problems and while students initially struggled with the new format, they adapted quickly and found the inverted classroom format to be satisfactory and effective [3] . It is believed that it was the alignment of online lectures, face-to-face student/teacher and peer/peer interactions, combined with the active learning component of the flipped classroom that led to these improvements [4]. The flipped classroom is proved to be an extremely effective paradigm for teaching signal processing [5].

Also, the learners today make use of digital aids such as desktops, laptops, mobiles along with high speed internet. Google, Twitter, facebook, Youtube and Whatsapp have become a part of student life in sharing and getting ideas. They are more active in creating and participating in blogs and wikis. It is evident that ICT tools are now a part of education [6]. Hence, these ICT tools can be used better in the better implementation of FCs and active learning methodologies. ICTs, collaborative learning and social networks are not only the basic tools for an effective learning but also act as a basic platform for enhancing a scaffolding learning. [7]. A new opportunity for learning by enhancing students' learning process through interactive digital media is also studied [8].

Learning Management Systems (LMS), social networks and blogs are indispensable for the efficient application of innovative learning methodologies [9]. Discovery-learning approaches are better suited to tangible user interfaces (TUIs) than traditional "tell-and-practice" approaches [10].

This paper illustrates the improvement in learning by implementing FC with proper planning and implementation using ICT tools. It is done as a case study in the elective course 'Soft Computing' at Thiagarajar College of Engineering, an autonomous institution affiliated to Anna University at India.

Initially for a batch of students, teacher centric learning is attempted for a course outcome in the course "Soft Computing". Here the role of lecturer is a leader or authority. Knowledge required in the course is transmitted to students from instruction from a teacher. The emphasis is given on learning correct answers. For another set of students, the same course outcome, the content delivery method is implemented with student centric learning implementing FC and active learning strategies with ICT tools. The outcomes are accessed and compared for both the set of students.

## 2. About The Course

The course taken for case study is '14EEPS0- Soft Computing' which is an elective course for B.E Electrical and Electronics students at Thiagarajar College of Engineering, an autonomous institution affiliated to Anna University at India.

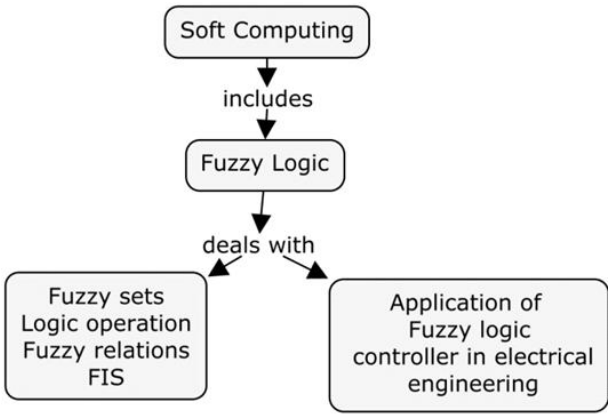


**Fig. 1 - Part of the Concept map of the course "Soft Computing"**

The syllabus of the course under study covers three soft computing techniques including fuzzy logic, neural networks and genetic algorithm and the concept map illustrating the Fuzzy logic part of the syllabus is given in Figure 1.

The Table 1 defines the course outcome addressed in this paper, its Bloom's level, Proficiency expected and expected attainment of the course outcome. Proficiency expected is the percentage marks to be obtained in that particular CO by each student to be counted towards the attainment of CO. Expected attainment explains the percentage of students expected to attain the expected proficiency.

**Table 1. Outcome Addressed**

| CO No. | Course outcomes | Bloom's Level | Expected Proficiency (%) | Expected attainment of course outcome (%) |
|---|---|---|---|---|
| CO 3 | Apply fuzzy logic control techniques for the given Electrical engineering problem | Apply | 90 | 75 |

## 3. Motivation To ICT Based Flipped Classroom

The course is initially handled for the sixth semester under graduate students of the batch 2014-2018 and the content delivery methods includes lecture with discussions, lecture with software demonstrations including simple active learning techniques like brainstorm, main map, one minute paper, Think – Pair –Share etc. One minute paper is done usually at the mid of one hour class when the students seems to be tired in grasping the concepts continuously. There are many effective ways for students to create brainstorms of ideas. Working with pairs or in small groups tends to be effective because students stimulate each other's thought processes. Encouraging students to think out of the box and to delve into a topic using this technique often has unexpectedly positive results. Think – Pair –Share – which got more positive feedbacks as really true learning takes place when they started thinking , then discussing with peers and share with others as well as facilitator. Though the students of the batch passed the course, they feel hard to design a control based on soft computing methods since they lack hands on training experience.

For better understanding, it is required that the students themselves should apply the concepts they understand from the demonstrations of the facilitator to attain the course outcome. In the normal classroom session, these higher order skills are developed by giving assignments. The disadvantage is this idea is more time is required for evaluating the assignments and suggesting better ideas for every student. If this activity is held within the class, some common suggestions may be given across the class and it reduces the efforts of facilitator. This motivated to the introduction of Flipped classroom. The idea can be better handled with the use of ICT tools.

The Teaching/Learning resources that are available easily for access are Black board, computerized lecture hall with smart board which can be used for audio, video and multimedia presentations, clickers, Laboratory hardware, Simulation software, free wifi within the college campus.

Hence, it becomes comfortable for the faculty in-charge handling the course to get out the advantage of Wiki space, web contents, Social media, Mobile learning. Institutional software CAMU also supports various teaching learning activities and planning. The software is used to submit the assignments online.

While introducing a new course, it is an important thing to develop a passion and interest towards the learning of the course. As students found fond of using their mobile phones, a social group is created through mobile and video lectures are circulated among the students. Discussion forum is created in wikispace for open discussions including the muddiest point and clarifications. It addresses solutions to the concepts which the learners feel difficult with.

It also gives pavement to peer instructions and peer review effectively. Using these ICT tools, active strategies are implemented in an organized fashion and it helped the students to get clarified quickly and learning happens fast.

## 4. Implementation of Flipped Classroom Using ICT Tools

Planning of Flipped classroom strategy is as follows. As a pre-requisite, basics of Fuzzy logic are taught. Development. A video is created under creative common licence and uploaded in youtube "Solving a problem using Fuzzy logic in a MATLAB environment" where the development of Fuzzy Inference System (FIS) for a specific application is

explained. Though there are numerous tutorials available online, students show more involvement if their own teacher explains them in their regional language. A 8:50 minutes video is created which demonstrate the creation of FIS file for an application in MATLAB

Tools used to create and distribute the video material are MS Power point – To present the concepts, MATLAB – to show the simulation of Fuzzy logic inference system for a practical application, Screen cast- o- matic – To screen cast and to develop a video, Whatsapp and youtube to disseminate the video, Google forms for peer assessment and conducting quiz. Students are instructed to view the video file uploaded in youtube before the in-class activity and to answer the questions given in Google feedback form. URL is provided through Whatsapp and Wikispace virtual class group. Oral information is also provided four days before the in -class activity. The students are also instructed to bring at least one MATLAB installed laptop per team at the day of in-class activity.

The students view the video with the provided URL. Questions are generated in a multiple choice pattern in google form which can be answered by seeing the video and the students are instructed to attend the same before coming to in-class activity session of a flipped class. This is to ensure that they have seen the video and able to interpret it. Twenty teams are identified in prior.

The description of the in-class activity planned for two hours is provided in table 2. The instructor is supported by two teaching assistants in this activity.

**Table 2. In-class Activity**

| Activity No. | Activity | Time (Mins) |
|---|---|---|
| I | Students are grouped with three members per team. Thus 20 teams are formed. Each team generates team name. | 5 |
| II | Think – Share – Finalize – Report : | |
| | Think : Students should individually think of an electrical problem for which Fuzzy logic can be applied | 7 |
| | Share : Students share their thought process with their team mates | 10 |
| | Finalize: Students select one of the best problems | 3 |
| | Report: Each batch reports the instructor with the finalized problem and instructor helps them to fine tune. | 15 |
| III | Development of FIS in MATLAB: Matlab simulation file is created and the parameter effects are analyzed using Laptop with the assisting of instructor. Results of parameter analysis are also recorded. | 35 |
| IV | Preparation of report and upload in wiki space virtual classroom: Problem statement, input and output decisions, rule base for FIS formation is clearly defined along with the screenshots of FIS development. Results and discussions are stated. | 25 |
| V | Peer As sessment (Sample process ): Peer assessment is done using mobile device. Rubrics for evaluation are defined and one sample assessment is made. | 17 |
| VI | One minute paper: Students are instructed to provide open feedback on flipped classroom activity in online discussion forum . | 5 |
| | Total | 120 |

To complete activity V, assessment strategy is given in table III and the rubrics for assessment is provided in table 4.

**Table 3. Peer Assessment Strategys**

| Group ID | Group Name | Groups to assess |
|---|---|---|
| 1 | EEEians | 2 , 3 , 4 |
| 2 | Smarties | 3 , 4 , 5 |
| 3 | ……. | 4 , 5 , 6 |
| 4 | …… | 5 , 6 , 7 |
| .. | …… | --------- |
| 19 | …… | 20, 1 , 2 |
| 20 | …… | 1, 2, 3 |

In this strategy, one group will assess three peer groups and as a whole, each team will be assessed three times by peer and one time by instructor.

Team work (involvement in team) is assessed by instructor in the basis of interaction of group members (as observed in the entire session).

Thus, In-class assessment of the learning outcome is done through Peer assessment and Facilitator assessment.

**Table 4. Rubrics For Assessment**

| S. N | Parameter | Good (5) | Average (3) | Below average (1) |
|---|---|---|---|---|
| **1** | Selection of problem | Practical real time electrical problem | Electrical problem but not so practical | Non electrical problem |
| 2 | Selection of input and output parameters | Well defined parameter ranges w ith justification | Parameter ranges specified without justification | Parameters ranges are wrong. |
| 3 | Selection of methods | Proper selection with justification | Proper selection without explanation | Improper selection |
| 4 | Results presentation | Perfect interpretation of results | Results without interpretation | No proper results |

## 5. Discussions on Results

The case study is performed on the students of Electrical and Electronics Engineering during the even semester of 2016-17.The number of students in the class dealt with the above subject is 60 (Batch I). This FC using ICT tools usage are practiced and tested with these students. The same subject was also studied by another section of students (Batch II) of the same batch as a teacher oriented learning where most of the syllabus was covered by lectures and demonstrations using MATLAB tools. Table 5 specifies the details of the content delivery methods adopted and the role of both teacher and students.

Table 6 gives the details of the weightage given for feedback in the rating of five point scale.

**Table 6: Weightage Given For Feedback**

| J | Strong ly Agree (SA) | Agree (A) | Neutral (N) | Disagree (D) | Strongly Disagree (SD) |
|---|---|---|---|---|---|
| $W_j$ | 5 | 4 | 3 | 1 | 0 |

The feedback questions and the equation for satisfaction index are as follows :

Q1. I can explain the concepts of Fuzzy logic to others

Q2. Out of class activities contributed to my learning

Q3. I can apply the Fuzzy concepts in future

Q4. I am able to design Fuzzy logic controller for an electrical problem

Q5. I am able to work with Fuzzy logic based complex systems

Figure 2 provides the data of the number of students who have given feedback in different scale points for the selected five questions. Using these feedback data Satisfaction index is calculated using Equation 1

**Table 5. Content Delivery Methods Adopted**

| | What teacher does? | | What student does? | |
|---|---|---|---|---|
| Activity no. | Batch -II | Batch - I | Batch -II | Batch - I |
| 1. (Day 1) | In-class activity: Lecture with demonstrations using MATLAB software and Power point presentations. Validate the understanding of the students using tests. Provides out of the class assignments | Out of class activity: Creates video Lecture with demonstrations using MATLAB software and Power point presentations and provides out of the class material. Valuate the students understanding . All these tasks are done out of the class. | Listens and takes notes, write procedures on note book | Go through the out of class material. Attend a feedback test to ensure the learning from the material. |
| 2 (Day 4) | Out of class activity: Evaluate and comments on the assignment work done by the students. | In-class activity: Provides In class assignment, Evaluate and comments on the work done by students | Submit the assignment on Fuzzy logic controller using MATLAB software and submitted the report. | Develop the Fuzzy logic controller using MATLAB software and executes and finds the result and justify the results |

$$SI = \frac{\sum_{i=1}^{NQ}\sum_{j=1}^{NS} No.of\ students\ with\ jth\ response\ for\ ith\ question\ X\ W_j}{Total\ students\ X\ number\ of\ questions X Max\ weightage} \quad (1)$$

Where NQ-Number of questions (5 here)
NS- Number of scale chosen (5 here)
Wj - Weight for jth point scale

The resultant SI is calculated from the survey taken by all the students and it is represented in figure 3. It is seen that SI for FC batch is 0.686 and conventional batch is 0.546, where ideal satisfaction index is 1. The index 1, 2, 3 in figure 3 represents ideal SI, SI of batch-I and SI of batch-II respectively.

Another set of students (Batch -II) are not provided with the out of the class activity, Instead the out of the class activity is done inside the class. Students are taught conventionally how to develop Fuzzy logic FIS using a demonstration within the class. The in class activity performed in FC is given as an assignment activity for these students. The Same four days are given to submit their assignment. The results of Rubrics based assessment is presented in table VII. The results represent the total marks obtained by all the teams in both the batches for each parameter of the developed rubrics. It is evident that the marks obtained by batch - I is more than the marks obtained by batch -II due to the active participation of students in FC.

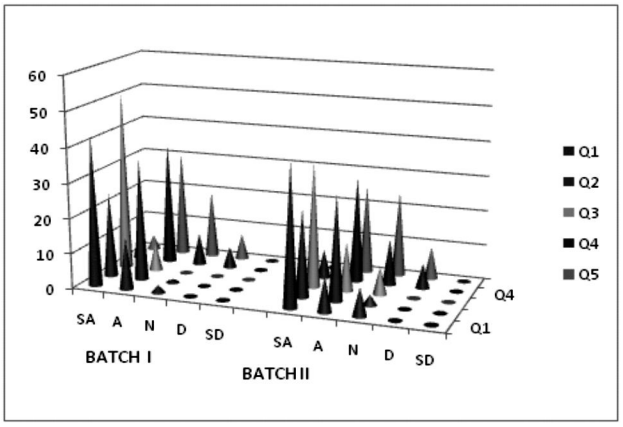


**Fig. 2 - Number of students who have given feedback in different scale points for the selected five questions**

When students are tested with HOTS inside classroom, they found comfortable when a facilitator assists them. When they are doing so outside the classroom, there is a possibility of wastage of time due to the lack of skilled facilitator to work along with. Also there is problem in the work weightage of team members. Involvement of member in submitting the assignment is unknown for the evaluator.

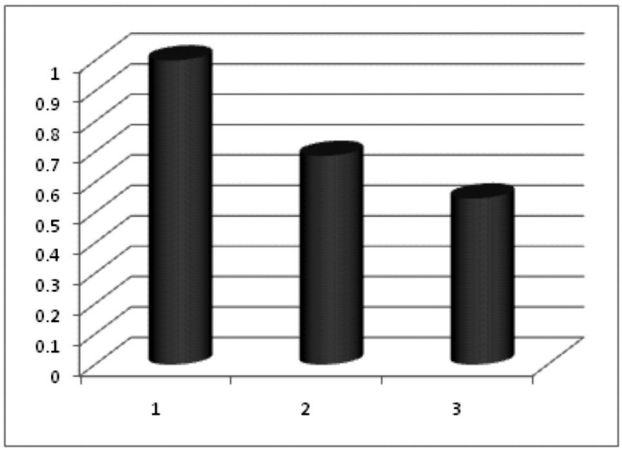


**Fig. 3 Satisfaction index Case 1: Ideal; Case 2: Batch -I; Case 2: Batch -II;**

**Table 7 Results Of Rubrics Based Assessment**

| S.No | Parameters | Batch - I (Total marks of 20 batches) | Batch – II (Total marks of 20 batches) |
|---|---|---|---|
| 1. | Selection of problem | 80 | 74 |
| 2. | Selection of input and output parameters | 94 | 82 |
| 3. | Selection of methods | 94 | 80 |
| 4. | Results presentation | 80 | 80 |

## 6. Conclusion

Perhaps teacher centric sort of teaching, results in competitive and individualistic mentality of students. The students who undergone Flipped Classroom are very active in the class room, enjoyed with the strategies used and felt okay with the assessment methods. FC can be made effective with effective use of ICT tools. The assessment of group activity and the satisfactory index obtained from the feedback of students for the selected course outcome justified the requirement of active strategies using ICT tools in learning a course. It is evident that FC with the use of ICT tools enhances the understanding and performance of the students.

## References

[1] Hao, Y. (2016). Exploring undergraduates' perspectives and flipped learning readiness in their flipped classrooms. Computers in Human Behavior, 59, 82-92.

[2] Yelamarthi, K., & Drake, E. (2015). A flipped first-year digital circuits course for engineering and technology students. IEEE Transactions on Education, 58(3), 179-186.

[3] Mason, G. S., Shuman, T. R., & Cook, K. E. (2013). Comparing the effectiveness of an inverted classroom to a traditional classroom in an upper-division engineering course. IEEE Transactions on Education, 56(4), 430-435.

[4] Kim, G. J., Patrick, E. E., Srivastava, R., & Law, M. E. (2014). Perspective on flipping circuits I. IEEE Transactions on Education, 57(3), 188-192.

[5] Van Veen, B. (2013). Flipping signal-processing instruction [sp education]. IEEE Signal Processing Magazine, 30(6), 145-150.

[6] Molnár, G. (2015, January). Teaching and Learning in modern digital Environment. In Applied Machine Intelligence and Informatics (SAMI), 2015 IEEE 13th International Symposium on (pp. 213-217).

[7] Duță, N., & Martínez-Rivera, O. (2015). Between Theory and Practice: The Importance of ICT in Higher Education as a Tool for Collaborative Learning. Procedia-Social and Behavioral Sciences, 180, 1466-1473.

[8] Gan, B., Menkhoff, T., & Smith, R. (2015). Enhancing students' learning process through interactive digital media: New opportunities for collaborative learning. Computers in Human Behavior, 51, 652-663.

[9] Canaleta, X., Vernet, D., Vicent, L., & Montero, J. A. (2014). Master in teacher training: A real implementation of active learning. Computers in human behavior, 31, 651-658.

[10] Schneider, B., & Blikstein, P. (2016). Flipping the flipped classroom: A study of the effectiveness of video lectures versus constructivist exploration using tangible user interfaces. IEEE transactions on learning technologies, 9(1), 5-17.