

A Low Risk Hybrid Teaching Methodology for Improving the Motivation Levels of Students: A Casestudy on Digital Image Processing Course

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Abstract: The motivation levels of the contemporary engineering students to sit and learn in a traditional classroom is relatively low, due to the exposure of new technologies since their childhood. They don't believe in totally classroom study and have little patience to sit long hours in the classroom, as they see alternative ways of learning outside the classroom. Hence, there is need for devising new pedagogy techniques which can motivate them to attend the class, and at the same time, to study outside the classroom and out of institution hours. However, the age-old pedagogy method of deductive learning and class room teaching can't be thrown away all of a sudden. So a low risk method of teaching is required for the universal acceptance by the students and by the authorities. In this paper, a hybrid low risk teaching methodology is considered for the undergraduate course of Digital Image Processing for the students of Electronics and Communications Engineering (ECE) specialization. Three topic wise active learning activities: quiz, group discussion and simulations were devised and implemented along with the traditional classroom teaching. A course end survey was conducted at the end of the course. The responses to the survey clearly showed that the motivation level of the students significantly increased after the implementation of

active level methodologies. The significant increase in the marks obtained in the II internal examination also confirm the effectiveness of the hybrid technique used. The results are very much encouraging to the teacher, to implement the proposed technique in the next semester also as indicated by the students.

Keywords: Motivation, Learning style, Classroom teaching, Activity specific, Teacher specific questions.

1. Introduction

Learning is a universal phenomenon of living beings and brings permanent changes in them in one or the other way. Human Learning is the act of acquiring new, or modifying and reinforcing, existing knowledge, behaviour, skills, values, or preferences and sometimes involves information synthesis. Thus, learning is a process, rather than a collection of factual and procedural information. Human learning occurs through interaction with the environment, education or training. Learning through formal education is highly enhanced by motivation, either intrinsic or externally motivated.

The people are strongly motivated to learn things, only when they clearly perceive a need to know [4], when they see it useful-in short term or in near future [6], when they can use it to create impact on others. In many cases, motivation also drastically reduces the time for learning a thing. Each individual perceives the same environment in a different way and thus has

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his/her own style of learning a thing. A Learning style refers to how individuals prefer to organize and represent perceived information [5]. The learning style includes the strategies of managing/ organizing the information, as well as the ways to implement these strategies.

Learning involves two stages. First stage is the reception or perception in which external information (gathered through the senses) and internal information (introspectively obtained) become available to the individual. This material is filtered through the mental structures already existing in their mind in the form of prior knowledge, beliefs, fears, misconceptions, prejudices, and preconceptions [4]. The second stage is the processing which includes moving, relating, doing something active while learning. These are the things starting from simple memorization or reasoning (inductive or deductive), reflection, and introspection or interaction with others. If the new information is consistent with the above structures, it would be integrated into them. If it is contradictory, no learning takes place. The overall outcome is that the content is either learnt or not learnt. Thus the learning process is very complex and ultimately dependent on the learner's state of mind and his/her motivation level rather solely on the external factors such as teacher and his teaching skills. Preaching by the teacher or policing by the institution for the purpose of making the students physically present in the class makes no sense and just useless, unless student is at least partly motivated. The motivation of the student is in return linked to his/her learning styles [1,2,10]. Students learn in many ways— by seeing (visual) and hearing (auditory); acting and reflecting (kinaesthetic); logical reasoning and intuition; memorization, visualization, building mathematical models and drawing analogies.

In view of these new discoveries, the new pedagogies based on learner-centric teaching have been proposed [3,4, 6,7,11,12,13]. However, the adoption of the new teaching methodologies by engineering institutions has been very slow than required due to some apprehensions of the teachers. This is due to several reasons: fear of syllabus incompleteness, less pass percentages, more preparation time to reduce active contact hours, more effort and time to formulate the learning activities. Many teachers already have the old lecture notes. In case of shifting to new teaching methodologies, they are invariably forced to prepare and use PPTs to reduce instruction hours, which they are not interested

in. There is resistance from the students also to the new methods of teaching due to the reasons: more work for students outside the instruction hours, and fear of failure in the course due to new method of learning [5, 6].

2. Related Work

Very few papers were reported in the literature on the active learning strategies applied to the courses of electronics and communications engineering. In [14] a self-assessment methodology was proposed while implementing an active learning process in electronics and electrical drives. Active learning strategies were reported for four courses of electronics i.e. Logic Circuits, Signal and Systems, Digital Systems, Processor Architecture in [15]. The new strategies used were oral presentations role-plays, case studies and Students had shown high interest in the classes and the activities. In [16], the circuit simulation software Multism was used to simulate several electronics circuitry comprising power sources, clocking circuits, passive components, diodes, transistors, integrated circuits, virtual equipment and instruments. In [17], hands-on laboratory experiments for the course of Electronic Design Automation. However, in all these, the reported techniques were same as traditional laboratory experiments or mini-projects, though they were reported as active learning techniques. In the present study, the digital image processing course is considered for devising active learning strategies.

The Author taught the digital image processing course for undergraduates five times including the current semester. The first and the second time (i.e. before 1995), the teaching methodology was traditional classroom teaching using only chalk and board. The third time (i.e. in 2003) teaching was again traditional but overhead project and black board were simultaneously used. Fourth and Fifth times (i.e. after 2013), blackboard and power point presentation (PPT) were used. In all these cases, the class pass percentages were between 92 and 97. However, the interaction of the students in the class room was not encouraging and generally limited to only few students. This prompted the author (when teaching the course fifth time) to implement some kind of active learning methodology, which is of low-risk nature and without discarding the traditional classroom teaching. The low risk hybrid method was devised so as avoid any kind of student dissatisfaction and disapproval from authority. The technique is hybrid due to the fact

that PPT and black board were simultaneously used for all instruction hours throughout the semester, and also due to the amalgamation of traditional deductive teaching methodology with the active learning methodology which could attract the participation of all students in the class with high motivation.

In this paper, the proposed and implemented hybrid low risk teaching methodology is presented and its results are discussed. The rest of the paper is organized as follows. In section 3 the Hybrid Teaching Methodology implemented for digital image processing course is detailed. In section 4 the two strategies followed to assess the motivation levels of the students are discussed. Some limitations and problems observed while implementing this methodology are also discussed in this section. In section 5 the conclusions are drawn based on the results. Future work to improve the proposed method is also presented.

3. Hybrid Teaching Methodology Implemented

Traditional teaching methodology of deduction was used. A total of 68 lecture periods, each of 50 minutes were engaged to complete the syllabus. There are two spells of instruction one before the first internal examination and the other before the second internal examination.

In each spell, the traditional deduction teaching methodology was implemented. Both the PPT presentation and Blackboard were used for all the lectures. The teacher sent the handouts of at least one unit in advance to all students. This is to motivate at least some students towards self-learning. After the completion of each unit of syllabus, the subject review was conducted using the active learning strategies.

A. Activity based Active Learning Strategy

After completion of each unit of syllabus, 2 or 3 teams conducted the following activities.

1. Topic wise quizzes
2. Topic wise Group discussions
3. Topic wise Simulation studies

The total class strength of 58 students was divided into small teams. each of 6 to 7 students, thus making 9 teams in total. Initially nine team representatives are selected on voluntary basis, then these representatives in return asked to form their own

teams. The advantage of this team forming strategy is the maximization of interaction within the team, as students must have considered the individual comfort level of interaction, proximity of their location of stay, etc.

Quizzes:

The batch conducting the quiz didn't participate in the quiz but acted as the quiz master. The Topics of Digital Image Processing used for Quizzes are given Table 1. All the quiz questions were shared to the entire class in the whatsapp group at the end of each quiz.

Table 1. Sample Topics of Digital Image Image Processing used for Quizzes

Team No	Topic
1	Noise only Restoration
5	Degradation only Restoration
7	Edge Detection
8	Edge Linking and Boundary Detection - Global Processing
9	Edge Linking and Boundary Detection- Local Processing
10	Thresholding: Local, Global, Variable, Adaptive
6	Morphological Operations
2	Image Redundancies
3	Lossless Compression
4	Lossy Compression

Group Discussions:

The following rules were followed for group discussions:

1. Each team gave the presentation for 20 min followed by 10 min Q&A session by other groups.
2. Daily two teams gave the presentation.
3. The teams participated voluntarily in the following order.

The topics (in Table 1) for the group discussions were jumbled to make each team study a different topic for quiz and group discussions, to maximize the review of the syllabus.

Simulations:

Simulations using Matlab were given by the teacher to each team, topic wise. The number of experiments done by a team is two, one in first spell and the other in the second spell of instructions. Each

team did simulations with the help of online material and teacher on fundamental blocks such as 2-dimensional filter/convolution, image resizing, edge detectors, line detectors, point detectors, 2-dimensional transforms, color space conversions, etc. After the simulations, each batch presented the simulation procedure, code and results to the total class and clarify the questions, if any. The simulations (code and results) were shared in the WhatsApp groups to the entire class.

In all the activities, the teacher acted as a moderator and resolved any controversy or ambiguity of answers. The teacher also resorted to traditional blackboard explanation to clarify the concepts on the fly during activity sessions, whenever required.

A. Communication between Teacher and Students:

Two WhatsApp groups were created to maintain perfect timely communication among the students and the teacher. The first group was formed with the teacher and the ten team representatives, while the second group comprised all the students in the class. The teacher posts the topic names and scope of each topic in the first group. All the details and schedules of the activities were discussed and finalized by the representatives in the first group and communicated back to the teacher, member of the first WhatsApp group. This method is devised to handover the total ownership of learning outside the class room to the students. In this way, the team representatives are also obligated to put efforts to pull the dull or unmotivated students in their own team also into learning process.

The active learning activities decided in the first group were then posted in the second WhatsApp group by the group administrator, who is also one of the team representatives. In this way a fair, smooth and unbroken communication was maintained among the students and, between the teacher (the author himself here) and the students, even out of campus and out of institution working hours. It is a bit hectic and a disturbance for the teacher, as students sometimes messaging too many doubts while framing the activities. This disturbance was more initial stages of activity planning, for first few activities, but later came down drastically as the students learnt the mind of the teacher and learnt the very purpose of these activities.

B. Assessment of New Methodology

To find the effectiveness of the new hybrid methodologies, two strategies for assessing the motivation level of the students were devised:

- i. Course end survey
- ii. Comparison of marks in the two internal examinations.

The student survey was conducted by the author with two categories of questions, first one on the teacher's pedagogy skills to check whether the content is delivered to the students appropriately using both PPT and blackboard, and the second one on the active learning activities used. Sample questions were given below.

Category 1: Teacher Specific Questions

1. Did the teacher give a good view of the course (its role & relation with other subjects) in the entire curriculum?
2. Did the teacher fill confidence in you and motivated you to study the course?
3. Did the teacher explain the concepts clearly with practical examples?
4. Did the teacher's instructions help you to fill the gaps in the previous subjects I have studied?
5. Did the teacher's industrial experience help you to understand concepts in better way?
6. Did the teacher design the activities which helped you to understand the subject effectively?
7. Do you like to have this teacher in the next semester also?
8. Which teaching methodology did you like most: 1. Chalk/Board, 2. PPT, 3. Chalk/Board & PPT, 4. Chalk/Board, PPT & Classroom Teaching?

Category 2: Activity Specific Questions

1. Which of the Active Learning Activities you liked most (1. Quiz, 2. Group Discussion, 3. MATLAB Simulations)?
2. How do you feel about these active learning methods compared to traditional classroom

listening?

3. How was your team experience in preparing for the activities?
4. How was your experience interacting with your classmates while conducting the activities?
5. Do the simulations helped you to understand concepts more clearly?
6. Do the activities improved your interpersonal skills and filled confidence in me?
7. Would you like to have this activities in the next semester also?

The second assessment of a student is done by comparing his/her marks in the two internal examinations.

4. Results and Discussions

In this section the attainments related to Active Learning based activities: the quiz, the group discussion and the simulations are discussed. The indirect effects of group discussion and the simulations are captured in the course end survey, while the progressive effect of the quizzes is discussed below.

The team scores of quizzes are shown as bar diagrams in Fig.1. The score (count on y-axis) is the number of questions answered by a team, and same scores are tabulated in the Table 2. It may be noted down that the total numbers of questions in the quiz are increased from 42 (quiz 1) to 77 (quiz 9), the total questions being 548. This indicates that the teams got maturity in conducting the quiz program and hence could accommodate more and more questions, as the time progressed. A bar is missing in each of the plots; this missing bar corresponds to the team that (quiz master) that has conducted the quiz. In Table 2, the score of this team is shown as '-' and the score of quiz master is shown in the bar in the 10th location (last bar in each plot) that corresponds to the entries in the last row of Table 2. Large variations in the bar heights are observed for the first four quizzes, meaning that some teams were performing well while others were poor in performance. However as the time progresses i.e. fifth quiz onwards, the relative variations have come down i.e. all teams performed almost equally, which is a positive sign of learning by the entire class. The variation was only one question for the last two quizzes. The score of quiz master diminished from

quiz 1 through quiz 9 i.e. 6, 4, 3, 2, 1, 1, 1, 0 and 0 respectively. This indicates that the questions unanswered by the teams decreased significantly, as time progressed.

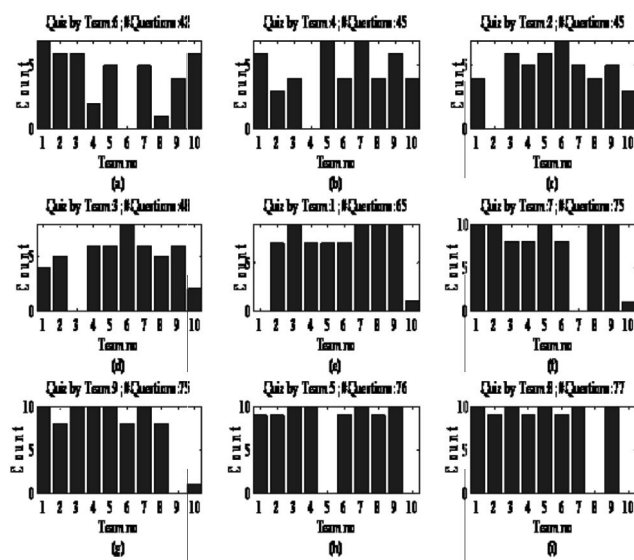


Fig. 1. Team Scores of Quiz programs

The student responses to Category:1 and Category:2 questions of the course end survey are given Tables 3 and 4 respectively. The answers to the questions were subjective in the scale of 1-5, 1 being the lowest rating (poor) and 5 being the highest (excellent). The entry in the table is the number of students given a particular rating. In Table 3, very good and excellent rating was given by 10 and 46 students as a response to question 1. Put together 56 out of 58 rated above 3, meaning that 96.55% of the class felt that, are teacher gave a good view of the course and its role in relation to other subjects in the total curriculum. The remaining 2 students rated good, not a bad rating for this question. The question 7 was answered 'Yes' by all, indicating that all have endorsed the author's delivery mechanism of the content. For question 8, all voted for fourth one i.e. hybrid method implemented by the author: uses of Chalk/Board and PPT combined with regular classroom teaching.

In the Category 2, the student response was unanimous, all rated the highest (excellent). This clearly shows that all the students starting from the slowest learner to the fastest learner owned the activities, involved in the activities and got motivated along with the self-motivated students. Similar thing was expressed by the team representatives. It is similar to a collaborative learning.

Table 2. Student Performance in Quizzes

Bat No	Qz 1	Qz 2	Qz 3	Qz 4	Qz 5	Qz 6	Qz 7	Qz 8	Qz 9
1	7	6	4	4	-	10	10	9	10
2	6	3	-	5	7	10	8	9	9
3	6	4	6	-	9	8	10	10	10
4	2	0	5	6	7	8	10	10	9
5	5	7	6	6	7	10	10	-	10
6	-	4	7	8	7	8	8	9	9
7	5	7	5	6	9	-	10	10	10
8	1	4	4	5	9	10	8	9	-
9	4	6	5	6	9	10	-	10	10
QM	6	4	3	2	1	1	1	0	0

*QM means Quiz Master

Table 3. Responses to Category:1 Questions

Q.No	Poor 1	Satisfactory 2	Good 3	Very Good 4	Excellent 5
1	0	0	2	10	46
2	0	0	4	6	48
3	0	0	1	9	48
4	0	0	6	14	38
5	0	0	0	5	53
6	0	2	5	20	31

For the question 1, the answers were distributed. The quiz was liked by majority i.e. 60.34% of the class, followed by group discussion 17.24% and lowest one being 13.80%. The quiz is liked most as it is relatively easy to prepare and conduct, and it is also a familiar activity to them. The answer to question 7 was 'Yes', indicating that all welcomed this methodology

The preparation for these three active learning activities not only increased the knowledge base of the students in the image processing course, but also the tremendous awareness of team work, collaboration and interpersonal skills among the individual team members and among the 9 teams of the entire class, as expressed by the team representatives and the students.

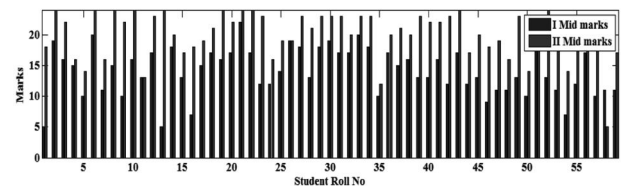
Table 4. Responses to Category : 2 Questions

Q No	Poor 1	Satisfactory 2	Good 3	Very Good 4	Excellent 5
2	-	-	-	-	-
3	0	0	0	0	58
4	0	0	0	0	58
5	0	0	0	0	58
6	0	0	0	0	58

Assessment 2: Comparison of marks in internal examinations

The marks obtained by the students in the two internal examinations are shown as a multiple bar

diagram in Fig. 2, blue and brown representing bars representing the marks obtained in I and II internal exams respectively. It is very clear that every student got more marks in II internal examination compared to those of I internal examination. This indicates that AL activities really worked positively to increase the motivation levels of the students. Another observation from the breakup of marks of each student is that significant improvement has been achieved by all students both in subjective and objective papers of II internal examination.

**Fig. 1. Marks obtained by students in two internal examinations**

The other benefits of these activities are:

1. Competition among students in the learning process
2. Equal opportunity for both shy and slow learners to present themselves to the others, while conducting these activities.
3. As the teams are voluntarily formed, no opportunity of regrets or escapism for the students to participate in the activities.
4. People with low attendance also got motivated to learn at home some of the missed topics.

There were some practical problems in the implementation of these activities:

1. When a team is asked to give a topic seminar of 20 minutes as a part of group discussion, all members in the team used to divide the content among themselves. Occasionally, when one or two team members are absent, then nobody could present their part. Hence gaps in the presentation was observed. However the situation was corrected later by handing over the responsibility of filling the gaps by others in the team.
2. The team representatives faced the problem of coordinating some introvert members in the team, who wanted to avoid to face the class during the presentation; Rarely they were absent for some group discussions also.
3. The teacher had no opportunity to evaluate the individual team members separately, in this

methodology.

4. Most of the students liked the quiz activity, and teacher found some difficulty in motivating them to participate in group discussion/presentation.

5. Conclusions and Future Work

In this study, a low risk hybrid method of teaching was devised and implemented for the undergraduate course of Digital Image Processing for ECE students. The active learning (AL) based activities: quiz, group discussion and simulations were primarily considered for reviewing the course content after the completion of each unit of syllabus, which was taught using the traditional classroom teaching. The response to the student survey conducted at the end of the course and the significant improvement in the student performance in II internal examination clearly shows that students were highly motivated to learn by the hybrid method used, and all the students opted for the same method for the next semester also. In the process, the students also acquired several interpersonal skills like team work, respecting the professional ethics and confidentially, communication and presentation skills, justification of their view point, controlling the class, etc. All students including the unmotivated and slow learners were pulled into the learning process, as they became competitive among themselves to demonstrate their skills (more than the knowledge in the course) to the total class. This drastically improved their motivation for learning. It may be observed that there is no shortage of time for such an implementation of active learning (AL) activities, because most of the work done by students was outside the class room, except for the time to conduct the activity in the classroom. The usage of PPT drastically reduced the unproductive time of the teacher i.e. time for drawing plots and some equations. It also reduced the chalk consumption by 60%-70%, thus drastically reducing the air pollution in the classroom. As the course involves displaying images, before and after applying an operation or algorithm, the PPT was very effective for this course. The blackboard was used mostly for derivations and to explain, whenever a student asked for a clarification.

Main limitations of the proposed method are: no opportunity for teacher to evaluate the individual team members and some difficulty in motivating the introvert team members to participate in group discussion/presentation.

Work is in progress to modify this method to alleviate the limitations and devise modifications to accommodate for the learning styles of individual students, and still without totally sacrificing the deductive classroom teaching.

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