

A Model for Effectual Collaborative Learning

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Abstract--- *The availability and popularity of advanced communication tools has led to widespread use of social media, web, and virtual communities among students. There is significant increase in expectations of students in entire process of learning driven by innovations in ICT. The changing face of ICT has brought about the fulfillment of knowledge communities and made an important impact on forms of Collaborative Learning. This paper presents a model for effective collaborative learning driven by innovative use of ICT and group collaboration. The model consists of major five steps: Formation of groups, Classroom activities for the group, Activities on social media, Weekly Activities, Group presentation. The study was conducted over a period of three months for Computer Networks class and the results show thorough preparation of subject and continuous monitoring of groups has resulted in better class participation, greater academic achievement and excellent student satisfaction. Successful groups were able to identify the skills they acquired -technical, behavioral and interpersonal skills which will help them to survive in a professional working environment. Not all groups derived benefits from the collaborative learning environment. Issues related to individual motivation, openness to feedback and lack of generic skills led to their poor performance. The results of this study suggest that, the challenges in implementation of collaborative learning can be met by effective use of proposed guidelines in the model. This paper recommends further trials of model for different subjects and courses.*

Keywords--- *Collaborative Learning, ICT, Cognitive Learning, E Learning, Social Media*

I. INTRODUCTION

EXTENSIVE research in teaching pedagogy and educational psychology has shown need for improvement in teaching methodology adopted in classroom teaching. Many researchers have criticized traditional teacher-led method of teaching as 'it transforms students into receiving objects' [1]. In order to change this trend, a teacher has to continuously adopt innovative techniques to improve class participation. One major problem in Indian institutes is less number of students attending classes and tendency of students to neglect

purely conceptual subjects such as computer networks, principles of management and Operating Systems. Major concern is adoption of interesting and innovative methods which will bring the student back to classes and motivate them to actively participate in the classroom. The new philosophy that a professor should apply is - learn with the learner. It is observed that classroom learning improves significantly when students participate in learning activities with small groups of peers [6] [7]. The amalgamation of collaborative learning and ICT can be used as an enabler to effectively enhance the classroom behavior of students.

Collaborative learning is a type of active learning that takes place in group of students [3]. It centers on the students' discovery, study and use of information in a collaborative manner, rather than an instructor simply lecturing and the students individually, passively taking notes [2] [3]. Their analysis generally requires interpretation, assessment, evaluation, comparison, synthesis, and so on [4].

Research shows that, students learning in groups encourage each other to ask questions, put forth their opinions, motivate and improve the learning skills [5]. These benefits can only be achieved by forming well functioning teams and encouraging them for active participation through the use of ICT. Merely forming groups and changing the seating arrangement of students will not help to implement collaborative learning in practice.

The methodology adopted in this paper is not just restricted to a single project or presentation, the activity was carried out during the completion of entire course of Computer Networks for MCA (Master of Computer Applications) First Year students. In this paper, we propose methodological model for effective use of ICT and implementation of collaborative learning in order to achieve effective classroom teaching. This paper is divided in 6 sections: Section 2 presents an extensive literature review, section 3 analyses the current scenario and provides an insight into innovative techniques that can be used to overcome the limitations, section 4 describes the methodology adopted, and in section 5 we discuss findings of the study. Finally, section 6 gives the conclusions and an insight in future works.

II. LITERATURE REVIEW

The basic aim of teacher teaching any subject or course is to improve academic achievements of students. A teacher has to implement different methods in order to enhance student's performance and create interest in the subject with the help of dynamically changing technology. Research shows use of Collaborative Learning methods can be considered as an effective way of improving student's learning,

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communication, interpersonal and behavioral skills [10]. It has also been observed that experience in collaborative education is helpful in one's psychological development also [9]. Researchers also suggest that, collaborative and cooperative learning prepares a student in such a way that they can adapt themselves in any workforce where team work is necessity [11].

ICT is working as a catalyst for improving the learning and teaching process. Effective use of ICT in collaborative learning environment will help to improve the process of lecture delivery from a teacher's perspective and participation in lectures from a student's perspective. Effective implementation of Cooperative learning is a difficult task for the teacher and will pose various challenges for him. Researchers have warned that simply forming groups of students and telling them to cooperate would not produce the desired outcomes [5] [10]. A set of fixed parameters must be defined to encourage students to actively participate in the learning processing [8]. The parameters should be based on the individual accountability, willingness to work in groups, functioning of group, processing of group, and overall communication and skills at individual and group level[8] [10]. These parameters can act as a precondition and should be considered for individual and group evaluation and will help real learning to occur.

Teaching a diverse group of students with different cultural background and demographics in a collaborative learning environment is another tough task. The diversities of students are based on the specialization area in graduation, locality, the graduation institute and subjects studied in graduation. As far as Mumbai University is concerned most of subjects taught in MCA are already taught in graduation, only difference is the depth at which the subject should be taught in post graduation courses is high. So it is important to consider all these issues before devising a strategy to implement collaborative learning.

III. ANALYSIS

For the completion of many university courses, one of the criteria for appearing the final university exam is minimum attendance. It's compulsory to attend classes and labs for the specified duration of the course. The institutions provide world-class infrastructure and follow the traditional teacher led teaching model. The model is widely accepted, but with changing trends in information and communication technology, and availability of ease of information many students find traditional approach unexciting and dull. This is leading to either poor attendance of students or students attending classes to meet the minimum attendance criteria. This is applicable for most of the conceptual subjects but not for programming language courses.

We analyzed the trends of attendance of students for past two years in the subject of CN. Figure 1 shows the attendance trend of students for duration of course. The graph shows the average attendance of entire class per three weeks from the beginning of course. It was observed that student like to attend classes in beginning of semester and their attendance declines

in last one to two months. This happens because once student satisfies minimum attendance criteria, they feel its not necessary to attend remaining classes.

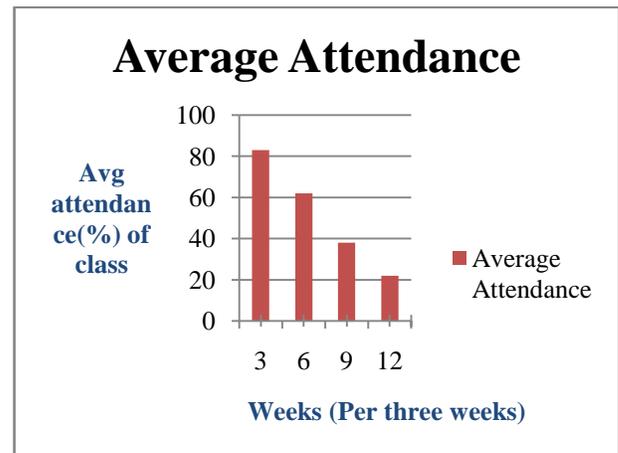


Figure 1: Average Attendance of Students per Three Weeks

In order to identify reasons for poor turn up of students their feedback was taken about teaching methodology adopted and expectations from classroom teaching model. The Feedback was basically collected on five factors

1) Quality of Teaching Methods 2) Interest in subject 3) Simplicity to understand 4) Practical understanding of terms 5) overall rating. The responses were collected on a five-point Likert scale ranging from 1-poor, 2-below average, 3-average, 4-above average, to 5-good. Figure 2 shows the analysis of student responses.

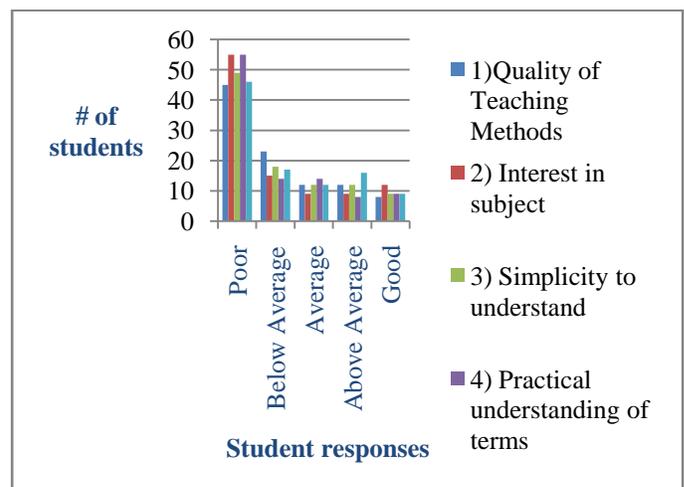


Figure 2: Students Feedback

The major observation of graph indicates that maximum number of students rated teaching methods as poor and only approximately ten percent students found the methods good. Hence, it is clear that students find traditional teacher led learning methods less interesting and this is leading to their poor attendance. In turn this affected the overall performance of students in university exams which resulted in poor grades of students. Apart from this, students concentrate more on just clearing the university exam and they are not technically

strong in the subject. This has a long term impact as students do not understand the subject thoroughly and are technically incompetent in the subject. It is necessary to motivate students and encourage them to attend classes. The key factor is to make sessions more interesting and enhance the quality of teaching and learning process by letting the students to actively participate in classroom activities, through Collaborative Learning.

IV. METHODOLOGY

The activity was carried out in the computer networks subject. The subject is a part of three year master of computer applications course and students get 5 credits for the course. The subject was taught over a period of three months and every week there were three sessions of 2 hrs each (two theory and one lab sessions). The total strength of class was 57. The entire activity was divided into following phases.

- *Phase 1. Formation of groups*

The first week was devoted to formation of groups and deciding names of individual teams. A random number generation strategy on roll number of students was used to divide them in groups. Each group comprised of 7 students with an exception of one group with 8 students. The seating arrangement was changed as per the group and same seating arrangement was followed for rest of the sessions.

The second activity for week one was to decide names of the teams. In order to decide the name of the team, students in a particular group, had to listen carefully and concentrate in session. A set of two cheat codes was given to students in order to identify the terms that will help them in deciding the name of team. Cheat code was designed in such a way that it will give hint to identify technical term explained in class. The entire session and slides were planned in such a way that the terms based on the cheat codes will be revealed in a timely manner. The student had to just raise their hand as soon as they crack the code.

Table 1: Sample Cheat Codes

Sr No	Cheat Code	Term
1	“Developed the most popular internet language”	Tim Berners Lee
2	“Imparting or exchanging of information or news”	Communication
	Team Name	Tim’s Communicators
1	“Known as Father of Internet”	Vint Cerf
2	“A new method, idea, product”	Innovation
	Team Name	Vint cerf’s Innovators

Table 1 shows a set of sample cheat codes and the expected answers. As shown in table first cheat code resulted into a noun and second cheat code into technical term. Combining the two terms team’s name was formed. As shown in first example, the identified team name was “Tim’s Communicators”.

This helped to increase student’s interactivity in the class and out of the eight teams 5 teams were correct in their first attempt, whereas rest of the teams took more than one attempt.

The overall observation of this activity was students were motivated, enthusiastic and excited to crack the code. The direct benefit of the activity was student’s active participation in class. Apart from this, it helped to increase attentiveness of students and enhance their analytical skills.

- *Phase 2. Braniac (The Quiz Master)*

Week 2, 3 and 4 was devoted to quiz. The quiz was divided in two parts 1 a group quiz, 2 individual quizzes. The sessions for course were planned in such a way that an interesting question will appear, the answer to which was based on what they studied in the session. A time of 2 minutes was given to solve the question and write the answer on a personalized answer sheet which was already provided. All the answer sheets were collected at the end of the session. A total of three questions appeared in each session that is a total of 6 questions per week.

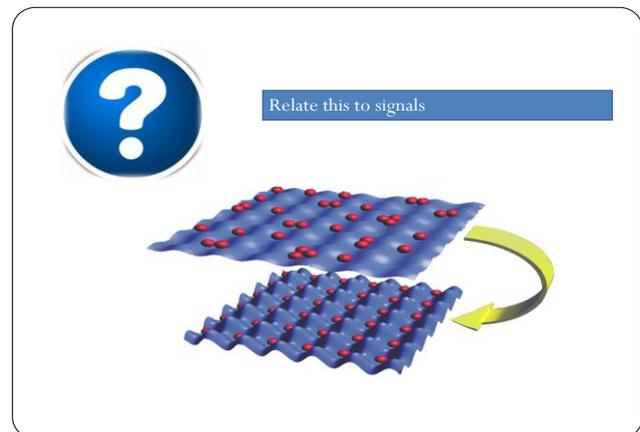


Figure 3: Sample Quiz Question

Figure 3 shows a sample group quiz question. This question was related to signals topic in computer networks. The image shows two representations, one showing scattered red objects and other showing regular equidistance red objects. Thus image one represented Aperiodic signal and image 2 represented Periodic signal. All questions were designed in similar manner to make experience of attending class more interesting. All such questions appeared on a regular interval on the slides in every lecture and the answers were collected in the same class. The criteria used for the evaluation was attendance of individual members of the group and the correct answers given by each group. On the basis of the calculated results top three teams were decided .One representative from each group appeared for the individual one on one quiz. The total points

earned from individual quiz was added in overall group performance. This helped to create a sort competitive environment in the class.

The individual quiz was divided in five rounds with four sections based on the topics covered in week and 1 round based on the topics covered in the week. As shown in table 2, for the first round, each participant had to identify the person based on the photo of person. These photos and persons were referenced in the class and the questions were related to the pioneers in networking field. The image shown in the example is of Claude Shannon who invented the bits theory. Round 2 concentrated on sums and round 3 of the quiz was to just define few terms studied during the week. These two rounds were designed to study how well students understood the concepts and analyze their numerical abilities.

In order to check the comparative skills of the students, next round was to compare different terms. The last round was designed to encourage students to study topics not mentioned in syllabus but related to subject. The round was General Knowledge about computer networks. This resulted in students doing extensive study of innovations in computer networks worldwide as well as in India. The sample question is about the software export zone in India which is in Mumbai.

Table 2: Sample rounds and questions in the quiz

No	Round	Question
1)	Identify the Person	
2)	Solve the Sum	A Periodic signal completes one cycle in 0.001s what is the frequency
3)	Define the Terms	Synchronization
4)	Differentiate	Analog and Digital

5)	General Knowledge	Where was the first software export zone in India setup? – Name the city and zone name
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- *Phase 3. Group activity*

Groups underperforming in first four weeks groups were given another chance to improve their performance. A group discussion was given to such group at the end of session and the result was added to the consolidated total. The topic for the group discussion was impromptu and was based on the topic covered in that class .For example, one of the topic for group discussion was “OSI Model: Success or Failure”. Another topic was “IPV6 vs. IPV4”.The activity was carried for next two weeks and only bottom four teams participated in that. The grading criterion for top four teams was only attendance. This was done just to maintain the spirit of teams and encourage them to improve their performance.

- *Phase 4. Group presentation*

In the beginning of week seven students were given a presentation topic. Again, the presentation topic they had to decide on the basis of cheat codes given to them, answers to which the students got on the basis of class slides. The students who identified the topic correctly got extra points. Out of 8 groups 5 identified the topics correctly. The presentation was just a practical application of networking concepts with a demo for which they had to effectively use Information Technology and research the topic. For example, One topic was “Installation and Implementation of Fibre Optic Networks” and students researched on organizations using Fibre optic cables. A case study was presented on the topic. Another topic was” Set up of WiFi network” and to explain this student used MET organization Wifi network as an example. The help on each presentation was provided to all groups in timely manner using social media. It was observed that only four students don’t use any kind of social media and don’t have facebook account, a closed group on facebook was created of which the teaching faculty was member and administrator . The discussion on facebook led to many innovative ideas from students. Those ideas were well formulated and identified as a potential for deciding the final projects. During the same weeks students were introduced to Packet Tracer and were given hands on experience in a virtual networking environment. Packet Tracer is a Virtual Networking Environment designed by Cisco Systems and widely used to explain concepts of computer networks.

- *Phase 5. Group Project*

Last 4 weeks were devoted to a project in which students had to implement a virtual network for a large scale organization using Packet Tracer. The size of the organization varied from thousand to five thousand users. In order to design these networks, students design a small scale network with application of individual Computer Network protocols. Figure

4 shows a small scale network designed using the tool. The network shown in the picture is an implementation of Dynamic Host Configuration Protocol (DHCP).

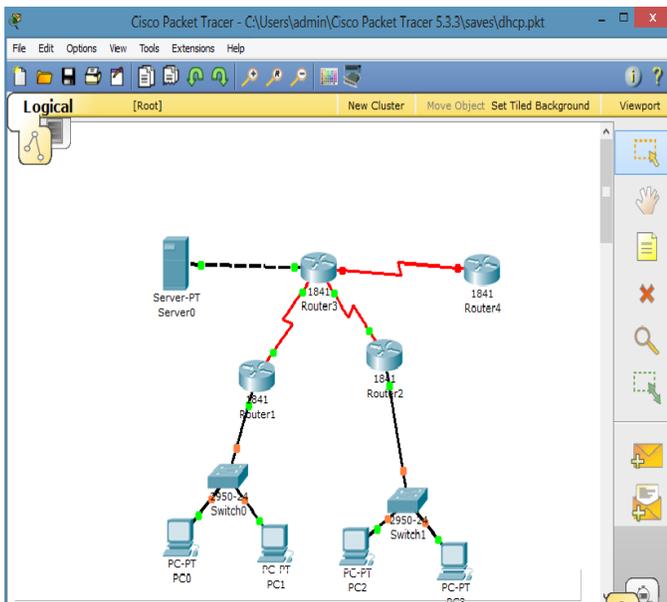


Figure 4: DHCP enabled Network

The same example was scaled up to design a larger network with more number of computer nodes and implementation of IPV6 and firewall by one of the group as project. All the projects were similar to such project with differences in topology of network and implementation of protocol.

Again, the discussions related to projects were carried out in timely manner on a closed facebook group. After a lot of discussions a formal model of project management in this case waterfall model with few customizations was used. Apart from the social media, a popular mobile chat service whatsapp was used in this case .A group of students was formed on whatsapp which provided very useful way to handle the communication.

V. FINDINGS

The evaluation criteria to assess the groups are divided into two categories. The technical skills acquired and functioning of the groups.

We tracked and monitored the gain in technical skills on the basis of

Tc1 Student’s individual learning outcomes and group learning outcomes

Tc2 Student’s written test performance and application on concept in the class activities

Tc3 Self evaluation of students

Tc4 Technical competency of students

In the latter part we analyzed the group behavior of students and their performance as a cohesive team. The major aim of the study is to improve the attendance, participant and satisfaction of students. Based on this the group evaluation criteria is defined as

- Gc1 Attendance of individual students
- Gc2 Active participation
- Gc3 Interaction of group members
- Gc4 Interaction of group members using social and mobile media.
- Gc5 Overall functioning of the group

Based on the defined criteria a weekly record of student’s performance was maintained and the groups were categorized in to different types. A grading system similar to the credit system of university was followed for example each week total scores were divided on the basis of 1 to 10 grade scale(1 being the lowest and 10 being the highest) and the overall teams score was aggregate of grades secured by individual teams over the period of entire activity. The Evaluation was done on the basis of all five phases’ performance. Table 3 shows identified group types. Groups between 0-4 grades were defined as Underperforming or Ineffective whereas groups securing 9-10 grades were considered as Effective or Successful. Table 4 gives a Tri weekly consolidated grade wise assessment of students and gives an average per week grade. The results show growth in performance of teams with few exceptions.

Table 3: Identified Group Types.

	Group type	Description	Evaluation
1	Ineffective or Underperforming	The group fails at all levels of collaborative learning	0-4
2	Average	The group’s overall performance is just admissible	5
3	Sufficient but imprecise	The performance is Ok but can be improved	6-7
4	Well Considered	The performance is satisfactory and can meet the expectations	8
5	Successful or Effective	The performance is satisfactory in all departments	9-10

Figure 5 shows per three week wise consolidated results of each of the groups. The assessment is done every three weeks and the results r determined on the basis of defined evaluation criteria. The graph shows identified group types per three weeks. For example, after first three week’s assessment two teams were identified as underperforming or ineffective whereas two teams were well considered and rest of the teams was above average. Towards the end of the course the trends were different wherein most of the teams were average or Sufficient but imprecise. It was also observed that few

categories were having no teams. It can be clearly understood from the graph that, the collective efforts of student's improved towards the end of the course.

Finally these categories were analyzed against various factors like 1) attendance 2) university exam results 3) practical results and 4) viva voce exam. It was observed that groups having grade above four overall have cleared exams and only three students failed in exam (2 in theory and 1 in viva). It was

also observed that the average attendance of students improved as compared to last few years. The average attendance of the class was above 85 percent throughout the course.

Table 4: Grades of students per three weeks

Team Name	Tri week 1	Tri week 2	Tri week 3	Tri week 4	Average
1) Tim's Communicators	8	7	10	8	8.25
2) Vint cerf's Innovators	5	5	7	6	5.75
3) Broadband Transmitters	1	2	4	5	3.25
4) Shanon's Visioners	5	4	6	7	5.5
5) Baran's switchers	5	5	8	6	6
6) Reliable Carriers	1	3	4	3	2.75
7) Einstien's Researchers	8	6	8	9	7.75
8) Social Entertainers	5	5	5	5	5

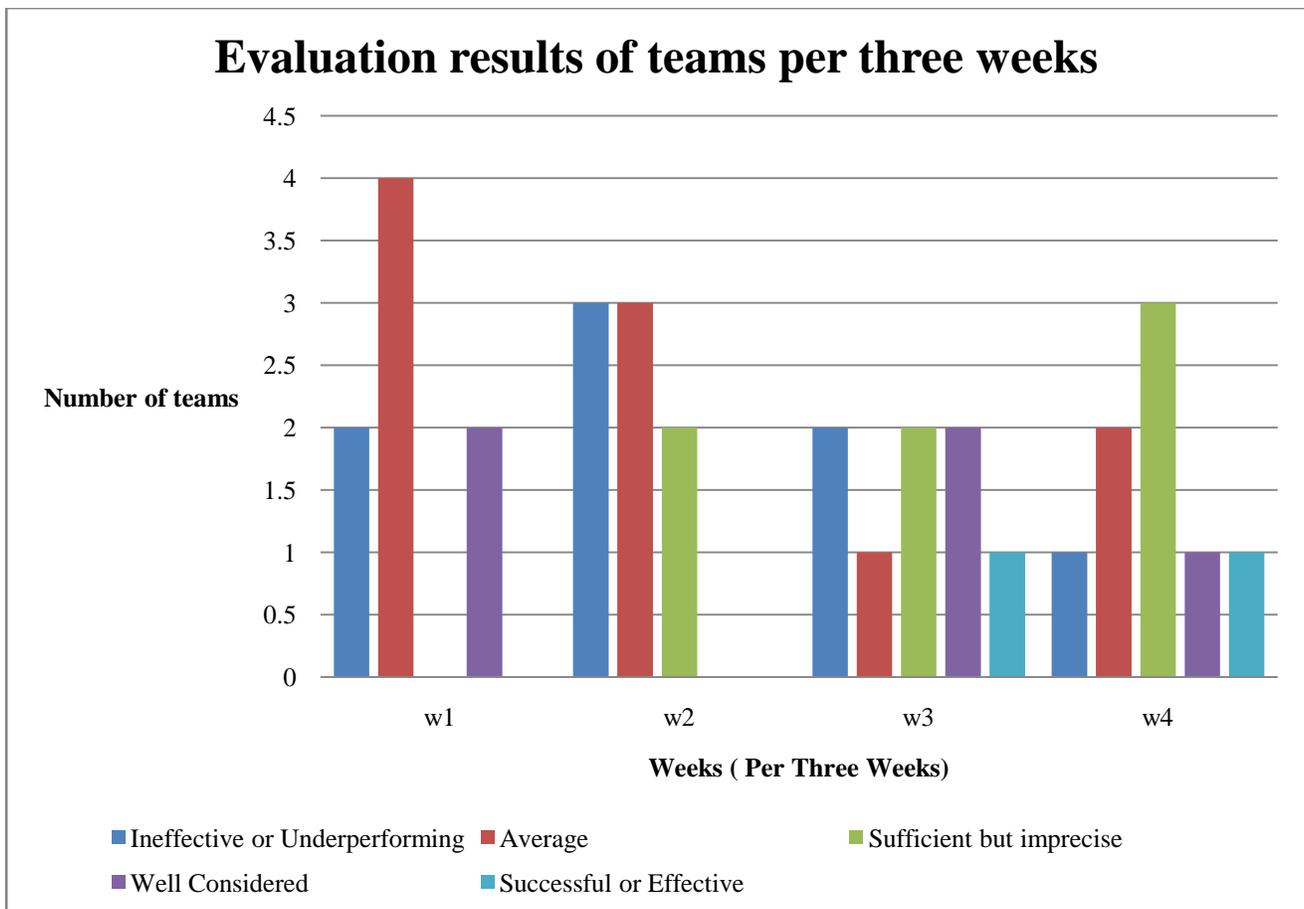


Figure 5: Comparative Evaluation of Groups per Three weeks.

VI. CONCLUSIONS

The paper presents an approach to effectively use collaborative learning. The methodology tries to integrate the existing learning models with the latest trends in ICT in order to present a practically implementable approach to enhance student's class participation and academic achievement. The methodology is applied on computer networks subject and given better results with a proven skills improvement and students active participation. This helped to keep the interest of student in traditional teacher led classroom learning and increased the overall attendance of the students. The results of students in university exams, practical exams and projects were improved. We feel the testing of such methodology on other subjects with subject specific modifications will provide A way to enhance students overall academic achievement and change students attitude towards teacher led learning. At the same time it will help to make the teaching learning process more challenging and interesting.

REFERENCES

- [1] Freire, P., "Pedagogy of the Oppressed, New York: Continuum", 1970.
- [2] Slavin, R., Cooper, R. "Improving intergroup relations: Lessons learned from cooperative learning programs". Journal of Social Issues, 55 (4), 647-663, 1999.
- [3] "Collaborative Learning: Small Group Learning Page.", <http://www.wcer.wisc.edu/archive/cl1/cl/doingcl/dyadic.htm>, November 11, 1997.
- [4] "Collaborative Learning. University of California-Berkeley." <http://teaching.berkeley.edu/bgd/collaborative.html>
- [5] Johnson, D., Johnson, R. Holubec, E., "Circles of learning: Cooperation in the classroom (3rd ed.)." Edina, MN: Interaction Book Company, 1990.
- [6] Brown, A. & Palincsar, A., "Guided, cooperative learning and individual knowledge acquisition". Knowledge, learning and instruction (pp. 307-336), 1989.
- [7] Thomas, R. "Evaluating the Effectiveness of the Internet for the Delivery of an MBA programme.", Innovations in Education and Training International, 37 (2), pp. 97-102, 2000.
- [8] Nurmela, K., Lehtinen, E., Palonen, T., "Evaluating CSCL Log Files by Social Network Analysis", Proceedings of the Int. Conference on Computer Support for Collaborative Learning, Stanford, California, USA, pp. 434-442, 1999.
- [9] Barros, M. & Verdejo, M., "Analysing student interaction processes in order to improve collaboration. The DEGREE approach". Int. Journal of Artificial Intelligence in Education, 221-241, 2000.
- [10] Koschmann, T., Kelson, A., Feltoovich, P., & Barrows, H. Computer-supported problem-based learning. In T. Koschmann (Ed.), CSCL: Theory and Practice of an Emerging Paradigm (pp. 83-124), 1996.
- [11] McManus, M., & Aiken, R. "Monitoring computer-based problem solving". Journal of Artificial Intelligence in Education, 6(4), 307-336, 1995.



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