Journal of Engineering Education Transformations ,
Volume 31 , No. 2, October 2017, ISSN 2349-2473, eISSN 2394-1707

Student Quality Circle: Skilful Learning Environment

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Abstract: Quality circle is one of the platforms which improve growth of the employees in an organization. It is small group of employee with same organization coalesce, identify problems in workplace and the help of solving them with innovative ideas and improve the quality growth of organization. This paper represents a case study on skilful learning to improve quality of Engineering. The aim of this paper is to enhance student's individual and group learning capabilities of technical and logical reasoning skills like working in team and Project Management skills. development, technical and logical reasoning skills, good team relationship and Project Management skill. In this paper, we have applied various learning activities of standard in the form of quality Circle adapted in department of Computer Science and Engineering for year 2015-16. These activities are designed and implemented to improve the attainment of Programme Outcomes (POs) along with placement of department. Results are analysed to demonstrate that the adapted methods improved the learning capabilities of students.

Keywords: Skilful Learning, skills, Course Outcome(CO), Programme Outcome(PO) etc.

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1. Introduction

From local centres to distant corners of Earth, the depths of the oceans to space, Engineers have always hunted to exceed hurdles, defeat challenges and erect opportunity that improves life in our part of the universe. Hence, now a day, skilful Engineer with upgraded technology is the basic requirement of the corporate world. As the technology rapidly changing we need to upgrade ourselves by recent trend in engineering fields and reflect existing trends that industries currently working within the syllabus regularly. We have the syllabus with updated technology in academics to build a skilful Engineer. However, recruitment is not as good as actually should have. Engineering students learns most of the basic technical courses, workshops, webinars and professional skill development courses in their curriculum. The courses of the curriculum will teach the conceptual knowledge but there is lack in the curriculum to apply them. We need to put more importance on high-end quality engineering careers. Many software corporations hire engineers from any field and make them fit for their job after a couple of month's training. Ex: At IIIT-Delhi they are having a precise curriculum in Computer Science and Engineering; they believe that it should be to train the students for more revolutionary work in technology and product companies, research, and novelty and entrepreneurship [1]. Hence, the skill development is very important to engineering students other than their curriculum.

Software industry requires skill full engineers with ready product to work in their workforce. In reality, less than 20% of engineers are employable for software jobs [2][3]. In The third edition of the National Employability examination report, they found that 18.33% of the engineers are employable; in reality 18.09% of them get a job. 91.82% of them lack programming and algorithmic skills, 71.23% are lack soft skills, 73.63% lack English speaking and comprehension skills and 57.96% have poor critical thinking and quantitative skills. Skilful Engineering Education in India faces different challenges like technical Profession, demanding skills for global workforce, are like science, mathematics, engineering, technology, statistics and data analysis skills [4]. To enhance student employability they must have Academic Knowledge, Practical Intellectual Skills and Professional Skills [5].

Students are academic oriented where they lack in thinking ability skills, technical skills, project management skills and communication skills. Best Practices are the solution to transform engineering Education. Quality Circle is the media through a group of employees come together, identify problems and try to resolve them and helps for the growth of organisation [6].

A set of skills make an individual more likely to safe and sound and be victorious in their adapted profession to promote themselves, the personnel, the society and the economy. Every student has their own weakness. Some of the students may lack in communication skills but good in technical skills and vice versa. Some of the students may lack project management and Teamwork skills. Companies will recruit those candidates that have all the skills, in-line with that we have identified some problems within students which also affect on less recruitment in institutions.

List of problems identified by Quality Circle members are:

1. Technical skills
2. Logical Reasoning
3. Project Management skills
4. Critical Thinking
5. Team Work skills
6. Soft skills

In this Paper, section 2 contains Problem identification and definition. Section 3 shows execution plan and implementation of various activities like Hackathon, Programming contest, Project Forum, Aptitude tests and soft skills etc. Finally, result and analysis of activities conducted for students.

2. Problem Identification and Definition

After getting a list of problems from all employees the Brainstorming session was carried out, According to the importance, effect and benefits of problems, each problem is categorised in class A, B and C. Class 'A' shows the problems related to the students, class 'B' shows Infrastructure facility related problems and apart from this, all other problems added into class 'C'. The lists of problems circulated to Quality Circle members and ask them to rate the problems out of 5 and rating based Analysis is carried out. According to Rating based Analysis shown in Table 2, we found out students are lagging in different skills.

We collected the data onto the problem facing in the department with different aspects from faculty, students, lab in-charge and lab attendants. With the help of that data, we analysed the problem thoroughly. Figure 1 shows a Cause & effect diagram of teaching and learning process. It helps to visualize the location of problem with it and affects on the other elements in same process.

Table 1: List of Problems recognized using Brainstorming strategy

Sr. No.	Problem Statement	Classification in A, B and C
1	Communication gap between students and teacher	A
2	Visual displays of quantitative information	B
3	Students lack in Presentation skills	A
4	Less number of class rooms	B
5	Lack of skilful learning	A
6	Wastage of electricity	B
7	Care for Care takers	C
8	To bride the new trends in CSE	A
9	A class room dynamics and effective utilization of tutorials, Lecture sessions and Laboratories	B
10	Less no of sponsored projects	A
11	Less no of research based projects	A
12	Lack in algorithmic skills	A
13	Quality of report writing	A
14	Less no of Publication in different conferences	A
15	Visual displays of quantitative information	B
16	Effective teaching - learning Process: National and International Practices	B
17	Effective Audio-Video streaming in the class room	B
18	Developing digital notice board in class room	B
19	Introduction to the learning process for teaches and trainers	C
20	Teaching - Learning Process: A Discussion of Models	B

A-student related Problems
B-Infrastructure and Facility related Problem, C-Other

From the Diagram can conclude with the following list of the problem:

1. Improper guidance
2. Faculty Negligence
3. Lack of communication skill
4. Loss of interest of students in lectures and experimentation.
5. Improper utilization of equipments.
6. Loss of knowledge and judicious skills.
7. Lack of project management skill.

Students fail to spot the opportunity to practical application of theoretical concept.

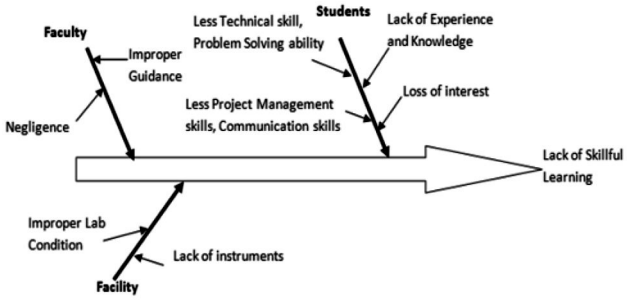

Figure. Cause & effect diagram

We found the following problems faced by students and identify the reasons to resolve it

1) Student's less involvement in technical skills: Students are slow to adapt to quickly learn new things, concept, and languages.

2) Less problem solving ability: Students lack in logical & critical thinking. They are unable to apply disparate concept for solving the problem.

3) Lack team work skills: As students are adapting to new environment they lack negotiation skills, resolving conflicts and time constraints.

4) Lack in communication skills: Most of the students are from the rural background and vernacular medium.

By going through all above mention problems and to find out solution, we designed the following Problem statement:

"Lack of skilful learning adversely to affect on various aspects such as, student's basic knowledge and skills, practical performance, Problem solving ability, project quality of students and Educational quality"

The objective of this paper is:

1) To develop working knowledge and Technical skills of the students

2) Enhance Problem solving ability and Communication skill within students.

3) Build a Project management skill and team work strategy in students

3. Implementation

We have executed several activities to build up skills within students. Every activity was carried out for twice in a month. Table 3 shows plan of best practices put into action for skilful learning.

A. Hackathon

A hackathon is a gathering where programmers work together on code in an acute manner over a squat period of time. Time period of Hackathons is at least a few days or over a weekend but, should not extend more than a week. While working on a particular project, full freedom is given to the developer to implement their ideas.

Hackathon strategy can be applied to open source projects and especially noted in the context of OpenBSD development. The word hackathon is coming from the words hack and marathon, where a hack is used in the sense exploratory and investigates programming.

The Outcomes of Hackathons are:

CO1. Learn Linux skills to solve real scenarios of the area of Linux administration and development.

CO2. Design innovative solutions to a given problem using interactive techniques within specified time.

CO3. Able to work in Team

We have implemented Hackathons in Linux Operating System Course. Linux is subject where it

keeps the student's learning interactively and joyful, as the subject is itself system side and contains huge number of commands, scripts and system calls. Students feel hesitation and fear to learn the linux programming because:

1) Early inputs for the students given by their seniors or friends saying that the subject is very tough and it is monotonous.

2) It contains huge number of commands to remember.

3) User friendly for system programmers not for beginners.

4) Required systematic approach or training to learn.

We have conducted a Hackathon method to overcome the fear and make them learns joyful. How to remember the commands? It's one of the biggest problem because, linux itself it has more than thousands of commands. Hence it is difficult to remember for the students as well as teacher also. Solution to this was to solve the different command based scenarios of the class and answer should be given by the students.

Table 3. Plan of best practices to achieve skilful learning

Skill Type (Action plan)	Activity	Outcomes of the activities
Technical Skills (twice in month)	Hackathons Programming Contest	**1)** Ability to quickly learn new concepts, languages, Technologies and best practices **2)** Ability to connect new challenges with old problems and past experience **3)** Able to work in Team **4)** To develop algorithmic skills **5)** Build up endurance
Problem solving ability(twice in month)	Aptitude tests	**1)** Logical and critical thinking **2)** Ability to apply incongruent concepts for solving a problem **3)** To apply numerical reasoning skills in the analysis and interpretation of data. **4)** To perform well to qualify screening tests in campus selection process and competitive examinations. **5)** To describe various quantitative factors and values in business communication.
Project management skills and Team work (twice in month)	Project Forum	**1)** Ability to work in team **2)** Ability to have leadership skills **3)** skills to negotiate and resolve conflicts **4)** work in time constraints and with responsibility
Communication skills (twice in month)	Group Discussions	**1)** To participate and express themselves in various conversational situations **2)** To interpret the non-verbal behaviour of people **3)** To develop skills needed for communicating effectively **4)** To develop importance of good telephone etiquettes and improve voice quality **5)** To organize their thoughts before the oral delivery of content **6)** To develop level of critical thinking

Some of the scenarios for Hackathon are:

1) Make a list of the programs you run as an ordinary user, including everything from a calculator applet to a major office suite. Look for equivalents at http://www linuxrsp.ru/win-lin-soft/table-eng or http://www.linuxalt.com. Is there anything you can't find? If so, try a Web search to find an equivalent.

2) Read more about two or three Linux distributions by perusing their Web pages. Which distribution sounds most interesting for use by office workers who does email and word processing?

3) Research the features of two or three open source programs that interest you, such as Apache, LibreOffice, and Mozilla Firefox. Do the feature lists seem complete? Are there features missing that are present in commercial counterparts?

4) Try at least two different desktop environments. Use each desktop environment for your normal computing tasks for a day or two so that you can decide which you prefer.

5) At a Linux shell prompt, type uname -a, lscpu , and cat /proc/cpuinfo. Compare the output and try to determine your CPU's capabilities. In particular, can it run 64-bit applications, and is your current distribution a 32-bit or 64-bit distribution.

A. Programming contest

In this activity, we announce problem statement once in two week. Problem statements are belonging to logical thinking, technical skills and Algorithmic Skills. This activity is a group activity which helps students to work in group, share knowledge among the group members and built endurance within them. Students have to solve that problems and upload it on Moodle server. Student who has uploaded a correct answer with minimum line of code will be winner. Winner will be chosen on the basis of First Come First Serve manner. Winner will praised by gifts. Finally, at the end of year we have conducted Programming contest "Master Mind" for different programming languages to analyse student's interest and growth in technical skills, algorithmic skills and thinking ability. We have analysed performance of students by taking the feedback before and after conducting the activity.

Outcomes of Programming Contests are:

CO1. To develop algorithmic skills

CO2. Able to think critically

CO3. Ability to connect new challenges with old problems and past experience

CO4. Able to work in Team

CO5. Build up endurance

Also we have conducted "ThinkSTEAM" event to learn and present innovative ideas in Science, Technology, Engineering, Art and Mathematics field. This activity helps students to improve their problem solving skills, able to apply theory concepts into practice.

B. Project Forum

Forum is one the best technique to share knowledge and ideas between the students and faculty members. If any Student facing some difficulties in projects, mini projects, theory courses or experiments etc. then they place their queries on forum and others can solve them or provide some alternatives or suggestions. Forum is accessible to students anywhere and anytime within campus. It helps to develop a new environment for improving quality of project by creating project related interest within students. As everyone can see the communication on forum, all the students will get aware of various technologies used for different projects.

Outcomes of this activity are:

CO1. Ability to work in team

CO2. Skills to negotiate and resolve conflicts

CO3. Ability to have leadership skills

CO4. Work in time constraints and with responsibility

CO5. Ability to Share the knowledge

C. Aptitude tests

Aptitude of the student is the one of the important criteria to get place in reputed industry. As per the compony point of view, their employee should think critically at any situation. E.g. if compony going through some problems then how the employee will face that situation by skilfully conceptualizing, analysing, applying, synthesizing, and evaluating information to arrive at strong conclusion with some supporting evidences.

Every employee whether an engineer, design engineer or chief engineer, must have critical thinking capacity. This kind of profession depends on brief study and rational decisions making, by going through the structural process of thought we come to final conclusion. There are some decisions which have codes and some design principles to guide them, decision relating Cost etc. this type of decisions are carried out openly to be discussed and find out proper solution to them.

To improve students' aptitude and Critical thinking we have arranged the experiments. The questions asked in these tests are based on real life problems facing by industries, the problems based on forecasting, find out alternative best solution for given scenario and so on.

Outcomes of Aptitude tests are:

CO1. Able to think critically on given problems.

CO2. Ability to apply incongruent concepts for solving problem

CO3. To apply numerical reasoning skills in the analysis and interpretation of data.

CO4. To performs well to qualify screening tests in campus selection process and competitive examinations.

CO5. To describe various quantitative factors and values in business communication.

D. Soft skills

The students will be able to how to establish harmony in personal and official relationships to understand, evaluate and accept responsibilities and to create ways to solve a conflict. This activity helps to identify the barriers of forming teams like isolation, non-cooperation, non-cohesiveness etc.

In the early stages it is observed there is high intensity of isolation, inhibitions, shyness and fear. The self esteem is low in many cases and there is demarcation between over confident and low confident ones. The process involves convincing for team efforts, letting them solve their differences, sulking etc. However a significant change in their understanding and acquiring team skills. Surprisingly the one who are quiet, shy suddenly emit out of their shells and demonstrate healthy team and leadership qualities. We have implemented different activities for a quality of a programme. These activities like Games and role play that are advantageous to improve technical skill, problem solving ability, Team skill etc.

Outcomes of this activity are:

CO1. To participate and express themselves in various conversational situations

CO2. To interpret the non-verbal behaviour of people

CO3. To develop skills needed for communicating effectively

CO4. To develop importance of good telephone etiquettes and improve voice quality

CO5. To organize their thoughts before the oral delivery of content

CO6. To develop level of critical thinking

All above mentioned activities are helps to improve students overall growth. future employee should have technical skills, soft skills and critical thinking skills so that they also able to take major decisions with strong defeat which will helps for the growth of the organisation along with the growth of themself.

1. Result and analysis

We have divided analysis part into four categories. Firstly, we have calculated Course attainment of individual activity, then calculated Final year project attainment and mapped all these outcomes with Program Outcomes and Program attainment is evaluated. Finally, we have analysed growth in Placement.

A. Attainment of Individual Activity

We have analysed performance of activities by taking feedback from students before and after conducting the activity. We have taken 20 students according to their academic record. Of them 30% students are from slow learner category, 40 % students from average category and 30% students from scholar

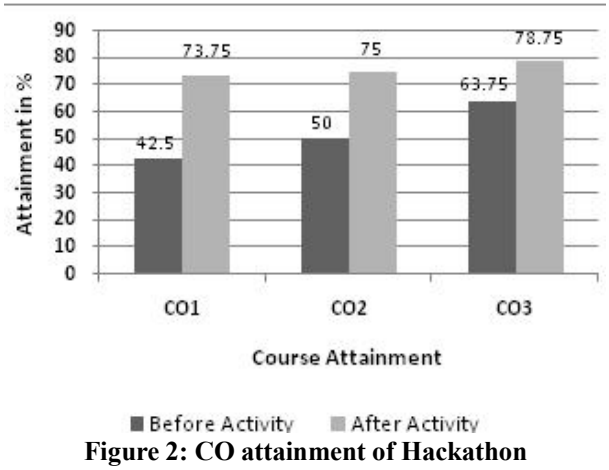

Figure 2: CO attainment of Hackathon

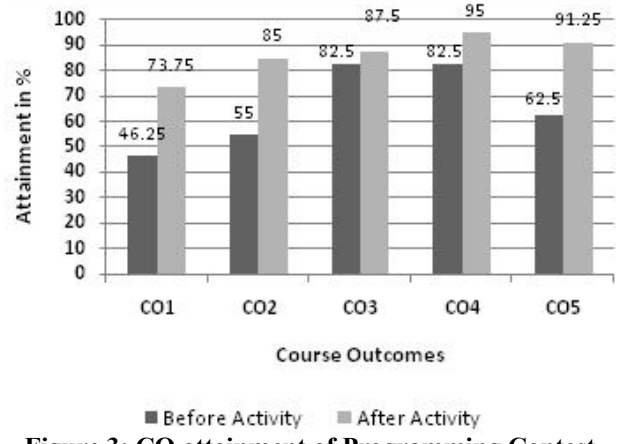

Figure 3: CO attainment of Programming Contest

category. Figure 2 shows attainment of Hackathon Activity. From the graph we analyse that before conducting the activity Course Outcome (CO) attainment was 52.08% and after conducting it is improved up to 75.83%. Due to this activity attainment is enhanced up to 23.75%

Figure 3 shows attainment of Programming Contest. From the figure we analysed that, due to this activity attainment is enhanced 20.75%

Figure 4 shows attainment of Aptitude Tests. From the data we observed that before conducting the activity CO attainment was 41.458% and after conducting it is improved up to 79.37 %. Due to this activity attainment is enhanced 37.916%

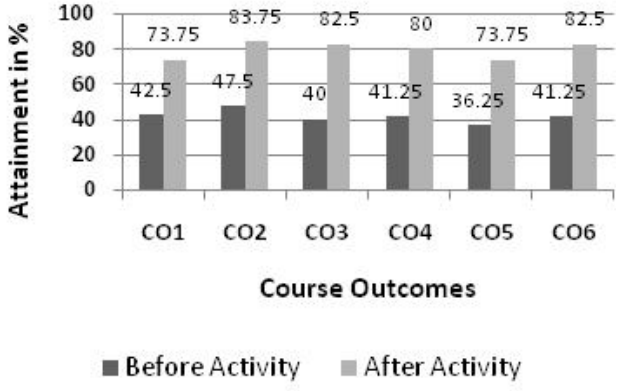

Figure 4: CO attainment of Aptitude Tests

Figure 5 shows attainment of Project forum. From the data we analyse that before conducting the activity CO attainment was 60.25% and after conducting it is improved to 80.75%. Due to this activity attainment is enhanced up to 20.5%

Figure 6 shows attainment of Soft Skills. From the data we observe that before conducting the activity CO attainment was 46.667% and after conducting it is improved to 81.458%. This activity improved attainment up to 34.8%.

The above all mentioned methodologies helped students to upgrade their knowledge and skills. These activities directly effects on improvement of Course outcomes of final year projects and Placements.

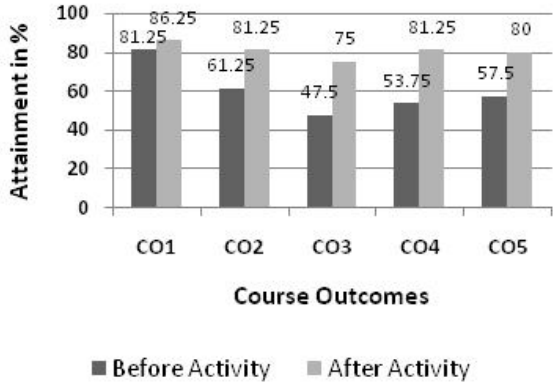

Figure 5: CO attainment of Project Forum

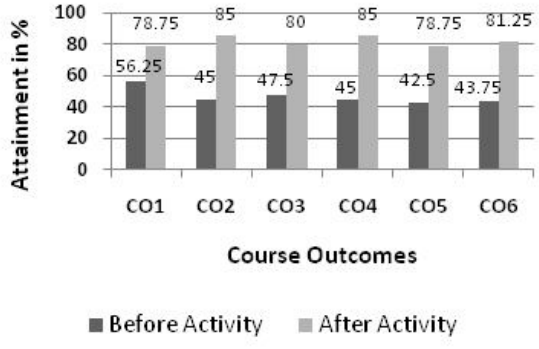

Figure 6: CO attainment of Soft Skills

A. Final Year Project Attainment

Initially, we have computed CO attainment by direct and indirect method afterwards, evaluated the overall proportion of CO attainment

1. CO Attainment by direct Method

Evaluation of students is done by applying formal assessment method which generally refers to the regular assessment. In this method, we have used existing data from student's marks obtained in the course, for example from the all presentation, work quality, novelty and project report etc.

Course Outcomes (CO's) defined for projects are:

CO1. Apply knowledge of computer science for real world problem

CO2. Possess Professional, Practical and reflective practitioner skills

CO3. Upgrade and apply the knowledge through continuous learning

CO4. Effectively apply Design Thinking Processes and Template to structure learning life cycle in the development of a prototype

CO5. To develop project management and time management skills

CO6. To formulate a process whereby to keep the end-user or customer in mind throughout the project lifecycle.

In general, the following formula is used for CO attainment calculation is:

$$For\ individual\ COs\ attainment\ \% = \left(\frac{Average\ of\ secured\ marks}{Max\ marks}\right) * 100$$

Table 3: CO Attainment in academic years 2014-15 and 2015-16 using Direct Method

Course Outcome (%)							
		CO1	CO2	CO3	CO4	CO5	CO6
2014-15	Project Phase-I	73	74	70	70	70	70
	Project Phase-II	84	84	80	80	80	83
Overall Attainment		79	79	75	75	75	77
2015-16	Project Phase-I	73	81	77	81	84	77
	Project Phase-II	87	82	86	87	85	87
Overall Attainment		80	82	82	84	85	82

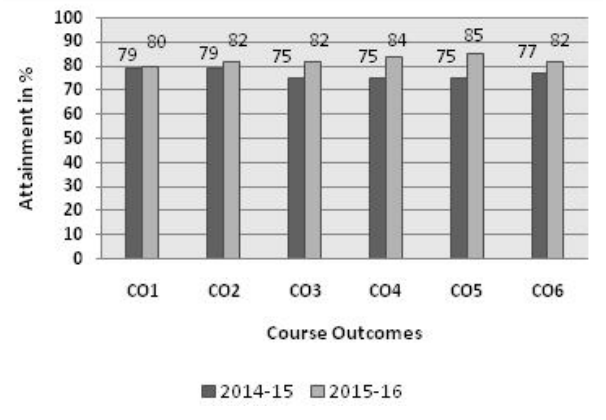

Figure 7: CO attainment by Direct Method

We have drawn graph based on above figures to show the comparative analysis of CO attainment. From the graph we examine that CO3, CO4 and CO5 are drastically improved.

2. CO Attainment by Indirect Method

After conducting these all activities we have taken feedback from students. Table 4 shows a CO analysis by Project Phase I & II for academic year 2014-15 and 2015-16.

Table 4: CO Attainment in academic years 2014-15 and 2015-16 using Indirect Method

Course Outcome (%)							
		CO1	CO2	CO3	CO4	CO5	CO6
2014-15	Project Phase-I	68.73	69.0	66.2	69.58	71.00	69.35
	Project Phase-II	73.2	69.8	68.3	66.9	70.69	75.3
Overall Attainment		**70.96**	**69.4**	**67.25**	**68.24**	**70.84**	**72.32**
2015-16	Project Phase-I	73.68	74.56	71.49	72.37	73.68	71.93
	Project Phase-II	77.60	81.25	79.65	76.04	79.17	77.08
Overall Attainment		**75.64**	**77.90**	**75.57**	**74.20**	**76.42**	**74.50**

We have drawn graph based on above figures to show the comparative analysis of CO attainment.

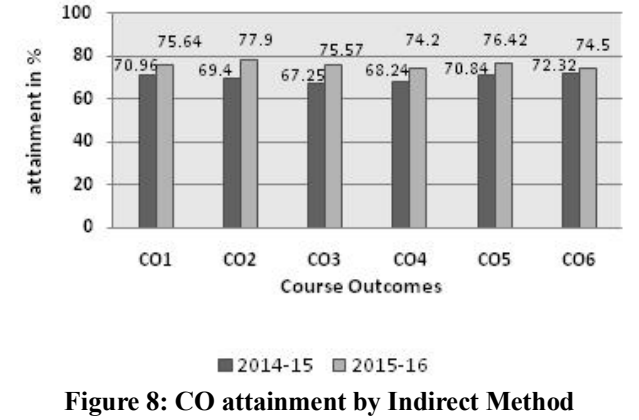

Figure 8: CO attainment by Indirect Method

3. Overall CO Attainment

Finally, we have calculated the overall proportion of CO attainment, where 80% weightage is given to first method which is based on direct attainment and 20% weightage to indirect method. Hence, the overall CO attainment is shown as below.

For academic years 2014-15 and 2015-16 CO attainment in percentage is shown in figure 9. Graph concludes that, CO attainment for an academic year 2015-16 has been notably

improved as compared to an academic year 2014-15. As we have implemented different activities like Programming Contest, Project Forum and Aptitude during academic year 2015-16 it shows that these activates helps students to share their knowledge easily with other students to resolve their project related problems. Soft Skills Programs also helps students to improve the quality of project reports and presentation skills.

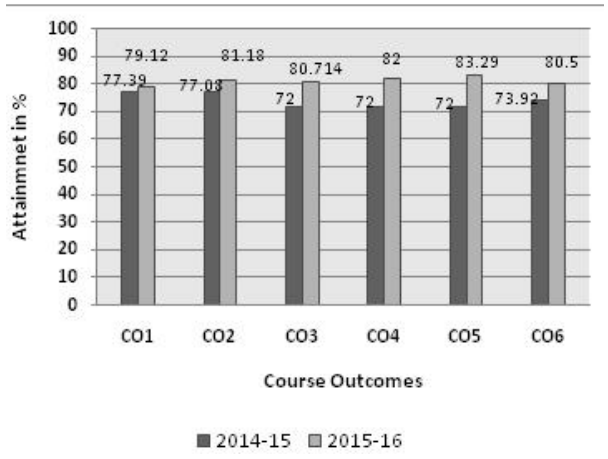

Figure 9: Overall CO attainment

A. Programme Outcome (PO) Attainment

The activities conducted under the Quality Circle also helps to improve Programme Outcomes of the Curriculum 2012-16. Programme Outcomes are designed with consideration of Graduate Attributes published by NBA. Program Outcomes set for Computer Science and Engineering Department are:

PO1. Apply knowledge of mathematics, science, engineering fundamentals and computer engineering to solve complex engineering problems.

PO2. Identify, formulate and analyse real world problems to reach substantial conclusions using computer science and engineering concepts

PO3. Attain proficiency in analysing data and designing solutions to the problems.

PO4. Demonstrate principles and practices for software design and development.

PO5. Select and apply appropriate techniques, resources and modern engineering tools to complex engineering activities.

PO6. Demonstrate the knowledge to solve contemporary issues using contextual knowledge.

PO7. Understand the impact of professional engineering solutions in societal and environmental contexts.

PO8. Demonstrate professional skills and ethics.

PO9. Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.

PO10. Communicate effectively in written and oral form in professional and societal context.

PO11. Demonstrate knowledge and understanding of the engineering and management principles.

PO12. Upgrade the knowledge and skills through continuous learning and higher studies.

We have mapped Course Outcomes of each activity with Program Outcomes of Computer Science and Engineering Programme which is shown in Table 3.

PO Attainment is calculated using CO attainment of every course included in curriculum. In general, the following formula is used for PO attainment calculation is:

$$PO\ Attainment\ \% = \frac{\sum_{i=1}^{n} CO\ Attainment}{n}$$

Table 3. CO-PO Mapping

Name of Activity	Course Outcomes	Programme Outcomes
Hackathons	CO1	PO2
	CO2	PO3
	CO3	PO9
Programming contest	CO1	PO3
	CO2	PO 2,PO3, PO6, PO7
	CO3	PO2, PO5, PO6
	CO4	PO9
	CO5	PO12
Project Forum	CO1	PO7, PO9
	CO2	PO10
	CO3	PO9
	CO4	PO8
	CO5	PO10, PO11, PO12
Aptitude tests	CO1	PO 2,PO3, PO6, PO7
	CO2	PO6, PO12
	CO3	PO2, PO3
	CO4	PO12
	CO5	PO8, PO9, PO10, PO11, PO12
Soft skills	CO1	PO6, PO7
	CO2	PO8, PO9, PO10
	CO3	PO10
	CO4	PO10
	CO5	PO12
	CO6	PO 2,PO3, PO6, PO7
Final Year Project	CO1	PO1, PO2
	CO2	PO3
	CO3	PO12
	CO4	PO1, PO12
	CO5	PO8, PO11
	CO6	PO10, PO11

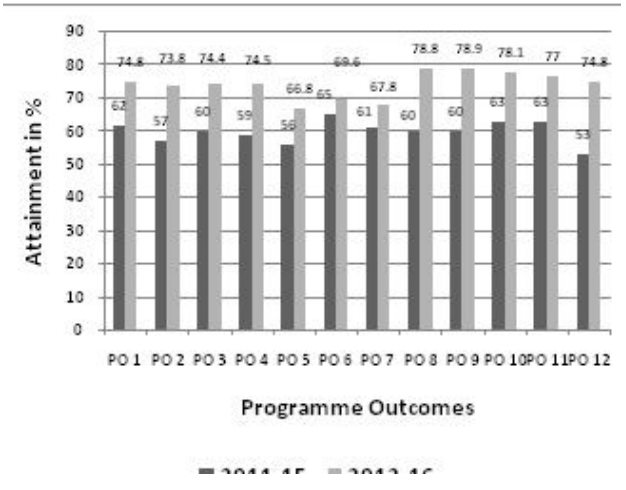

Figure 10: Overall PO attainment

The Figure 10 shows PO attainment of Curriculum 2011-15 and 2012-16. According to graph we say that the attainment of curriculum 2012-16 is significantly grows than PO attainment in 2011-15. There is total 14.19167% improvement in Programme Outcomes.

4. Placement Improvement

Every employer needs a candidate that having multidisciplinary technical skills, critical thinking skills, leadership skills and soft skills. We have trained students in all the aspects with the intention of employer demands and try to develop a skilful Engineer. We have compared placements from academic year 2012-13 to 2015-16 and we examine that, results of all activities help out to acquire better placement in year 2015-16. From above graph observed that, placement in 2015-16 is notably improved.

Table 3. Improvement in Recruitment

Year	No. of students registe-red	Student placed On Campus	Student placed Off Campus	On Campus %	Off Campus %
2015-16	54	35	1	64.814	1.851
2014-15	55	32	2	58.181	3.636
2013-14	33	5	10	15.151	30.303
2012-13	63	8	17	12.698	26.984

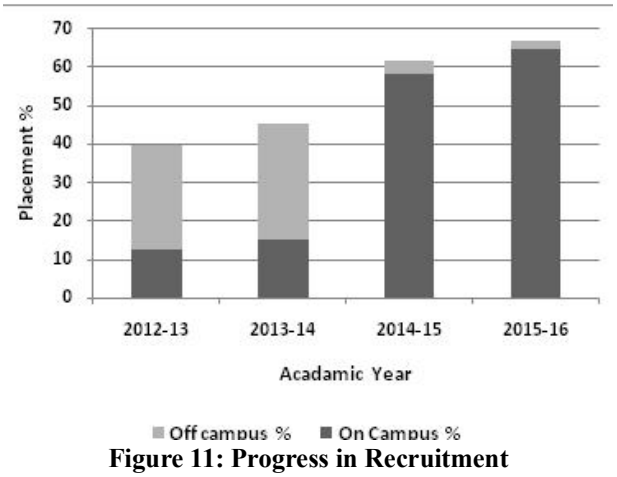

Figure 11: Progress in Recruitment

5. Conclusion

Skilful engineer is the basic requirement of the corporate world. All activities mentioned in this paper helps to improve Programme Outcomes and placement of students in industry. In academic year

2015-16 placement and Programme Outcomes has enhanced up to 5% and 14% respectively. With the adopted innovative techniques, the attitude of the students towards overall learning, specifically basic knowledge, addition to this technical and soft skills and thinking ability has been considerably improved. This led to the motivation among the students the important aspects of practical and analytical experimentation. Also, it helped them to inculcate and imbibe the Skills, like Project management, team working, refined organizing, presentation and methodical problem solving ability. Finally, this culminates to happiness through continuous learning and development.

Acknowledgement

This research was supported by Rajarambapu Institute of Technology, Sakharale. We are thankful to our colleague Prof. A. R. Jakhale who provided expertise that greatly assisted the research. We have to express out appreciation to the Quality Circle members Prof. S. R. Poojara, Prof. S. U. Mane, Prof. D. P. Kshirsagar and Prof. M. N. Mulla for sharing their pearls of wisdom with us during the course of this research.

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