2. LABORATORY DEVELOPMENT THROUGH QUALITY CIRCLE APPROACH

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Abstract

This paper presents the work carried out by Quality Circle at Automobile Engineering Department of Rajarambapu Institute of Technology, Sakharale, to develop a demonstration setup of Electronic Ignition System of two wheeler in Automobile Electrical and Electronics Laboratory of the same department, aimed at better understanding of practical concepts of automotive ignition systems.

Due to lack of demonstration setup, the experiment on electronic ignition system was being conducted merely theoretically earlier, which resulted in poor understanding of concept and working of the system. During this period, 28 meetings were conducted and 12 step QC methodology was applied in order to find the solution. QC tools such as Pareto diagram, Cause – effect analysis, why-why analysis were used effectively. As a part of solution, the Quality Circle fabricated a demonstration setup of electronic ignition system which helped students in understanding the system practically. The solution was implemented for final year Automobile Engineering students over a period of two months after which follow-up and review was taken which showed increased response of students in terms of attendance, understanding and better performance in viva. Also, it resulted in effective utilization of practical hours.

The case study offered benefits to the Quality Circle members in terms of recognition at institution, regional, national and international level, attitudinal change and joy of creative fulfillment. Moreover, it emphasized the importance of team work. The case study was presented at International Convention on Quality Control Circles and won the Gold Medal for the same.

Keywords: *Quality Circle, demonstration setup, electronic ignition, QC tools*

1.0 Introduction

We, at Rajarambapu Institute of Technology, (RIT) are conducting the Quality Circle activities from the last 15 years for improving quality of technical education at our institute. Quality Circles of our institute have participated at various chapter and national conventions over the years and bagged prestigious prizes over there. Two of our Quality Circles have represented the institute at international level at international conventions in 2005 & 2007 at South Korea, Beijing, China respectively.

As a part of Quality Circle activity at Department of Automobile Engineering, the problem was undertaken with regard to the poor response of students to study -type

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experiments. Standard Quality Circle tools were used and the problems were identified. It was decided to focus on an experiment on Electronic Ignition System which was being conducted in Automotive Electrical & Electronics Laboratory. While conducting an experiment on Electronic Ignition system, it was observed that involvement of students was poor and the level of understanding of the system was not satisfactory. This owed to fact that the experiment was study-type and students were being imparted with mere theoretical knowledge about the concerned system, using conventional teaching methodology. This resulted in poor perception of principles / concepts of the system. Also the teacher would be unable to create interest among the students.

On this backdrop, as a part of solution, a demonstration model of Electronic Ignition system was developed by following 12 steps QC methodology, in the span 12 months. Adequate follow-up was taken and the solution was standardized. The implementation of the solution resulted in active participation of students during practical hours, with increased knowledge level about the system.

2.0 Problem Solving Methodology

Standard 12 step QC methodology was decided to be adopted for identification & solution of the problem undertaken and is presented in the following (Table-1).

2.1 Identification of Problems

Brainstorming, as a tool, was used and in all, 51 problems were identified. The problems were categorized as student related, staff related and institute facility related. The category wise breakup is as follows.

2.2 Selection of Problem

Student, being at the center of teaching - learning process, it was decided to focus on student related problems. Further, 6 out of 21 problems were identified in the view of laboratory development. So as to choose 1

Category	No. of Problems
Student related	21
Staff related	13
Institute facility related	17

Table 1 Problem Categorisation

Sr.No.	Problem	Availability (10)	Time (10)	Facility for Development (10)	Possible Expenses (10)	Alternate Solution (10)	Attachment with Modern Concept (10)	Total (60)
1	A	9	10	10	10	9	10	58
2	B	2	3	2	2	1	4	14
3	C	5	3	4	2	3	5	22
4	D	2	3	3	4	5	3	20
5	E	5	4	3	4	3	6	25
6	F	2	3	2	3	3	4	17

Table 2 Problem Ratings (Data Collection)

amongst the 6 problems, rating method was used and based upon the weightages, histogram was plotted. (Table-2).

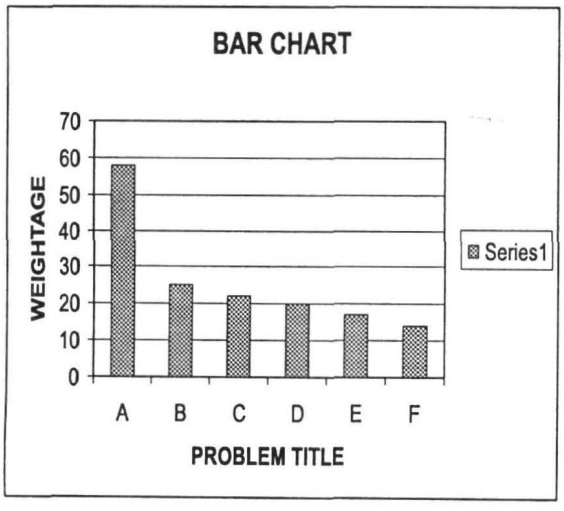
a. Poor response of students to study type experiments

b. Lack of CAD/CAM facility

c. Non conduct of experiment on electronic injection system

d. Unavailability of experimental facility for determination of calorific Value of fuel

e. Non availability of experimental facility for clutch performance testing



f. Non availability of experimental facility for structural vibration analysis.

2.3 Problem Definition

The process flow diagram was used to locate the problem area and the problem area emerged to be with Automobile Electrical and Electronics laboratory. While conducting an experiment on electronic ignition system, as a part of curriculum of the subject Automobile Electrical and Electronics for final year Automobile Engineering course, it was realized that students couldn't relate with the concepts and working of the system due to mere theoretical treatment. The very nature of study-type experiments resulted in lack of perception and enthusiasm among the students during the practical hours. Hence, it would be a challenge for the teacher to, ensure proper understanding of the students, as well as to make the sessions interactive. The members of Quality Circle sat together and formed the problem statement as **"Poor response of students to study-type experiments".**

2.4 Analysis of The Problem

It involves data collection with regard to various aspects of the problem. 4W-1H principle was used to collect the data about the students, staff, laboratory, the concerned system etc. The major findings were:

i) Experiment should be made more interesting to motivate and involve students.

ii) Experiment is needed to be designed in such a way as to utilize practical hours fully.

iii) Visualization of concepts is essential to understand practical significance of electronic ignition system.

iv) Provision is required to be made to identify electronic components easily.

v) Mutual inductance principle should be made clearly understandable by some means.

vi) Automobile Electrical and Electronics Laboratory has a scope for enrichment.

vii) Experiments should be either demonstrative or performing rather than study type to draw concrete conclusion at the end.

2.5 Cause and Effect Analysis

The major causes towards the problem such as; student, teacher, laboratory facilities and environment were identified. Some of the sub causes identified under each head were lack

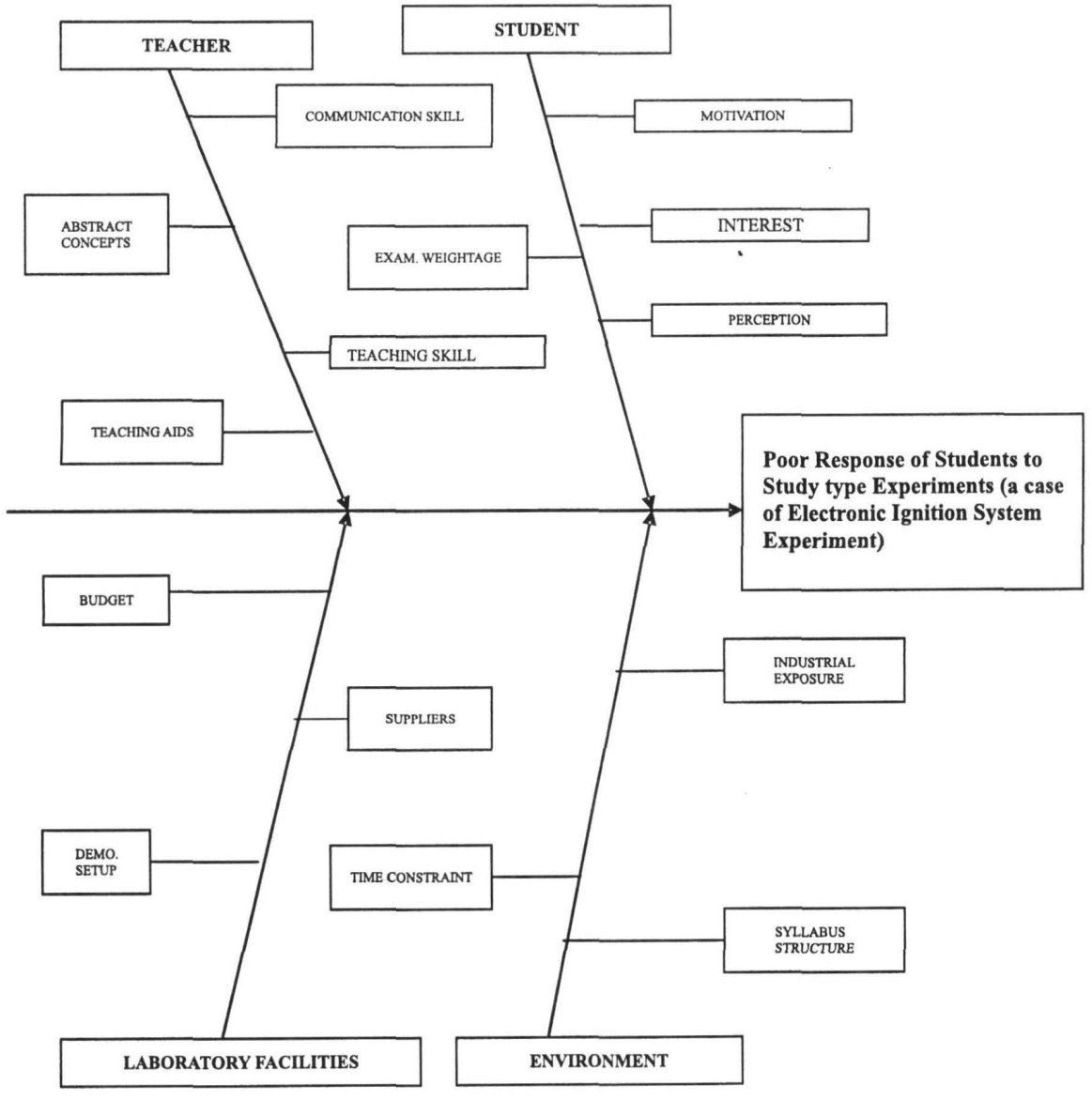


Fig. 2 Cause – Effect Diagram

of interest, lack of perception, lack of teaching aids, syllabus structure and non availability of demonstration setup etc. The concerned cause and effect diagram is shown below:

2.6 Root Cause Analysis

Why-Why analysis was used as a tool wherein series of why-why questions were asked, starting with problem to the sub causes. This led to the following root causes:

- Unavailability of demonstration setup
- Lack of teaching aids

2.7 Data Analysis for Root Cause

Data analysis for the root cause helps in finding out vital few causes from the trivial many. It enables to take a decision about measures to be taken for reducing occurrences of these vital few causes which are most critical towards the effect. Pareto chart was plotted on the basis of percentage contribution of causes towards the effect. It is clear from figure that three major causes are lack of demonstration seup, lack of interest and teaching aids which together contributes 60 % of total incidence of causes. Table 3, shows percentage contribution of causes towards the effect. Pareto chart based on the data in Table 3 is also shown in fig. 3 below.

Cause	% Contribution
Lack of interest	20
Exam Weightage	5
Communication skill	6
Self motivation	6
Teaching aids	15
Syllabus structure	9
Industrial exposure	8
Time constraint	6
Lack of d emonstration setup	25

Table 3 Data Analysis

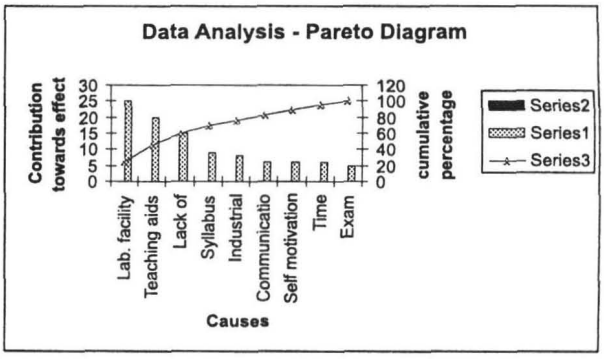


Fig. 3 : Pareto Diagram

2.8 Development of Solution

After having found the root causes, brainstorming session to come up with possible alternative solutions, was conducted. These include:

1. Developing demonstration setup of electronic ignition system
2. Showing Charts of electronic ignition system
3. Showing cut section of the system
4. Power point presentation for better understanding
5. Use of multimedia resources
6. Visits to service shops

Voting method was used for selecting the best alternative solution amongst those mentioned above. Actual demonstration setup being the most effective option, it was decided to go for the same. To begin with, a conceptual design was prepared and survey was made of existing electronic ignition systems on two wheelers. The specifications of the individual components were collected and accordingly, drawing of the system was prepared. This was followed by preparation of budget, getting it sanctioned by management and then purchase of components. In accordance with the design, the fabrication of the system was carried out systematically in the institute workshop.

Magneto ignition system adopted consists

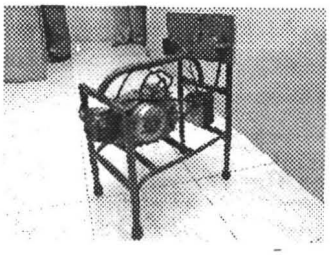


Fig. 4 Photograph of Solution Developed

of its own current generating system and doesn't require battery. Manual efforts provided at handle are magnified by chain drive and GPD gear. This causes rotation of the crankshaft,

supported by bearings and hence magneto. All other electronic components like coil, CDI unit were mounted on a wooden board for demonstration purpose. A steel frame was designed and fabricated so as to mount the whole system.

2.9 Foreseeing Probable Resistance

Some resistances were foreseen towards developing the solution. It was difficult to complete the solution within the stipulated time frame. The members decided to work after regular working hours to complete the same. Also, the expenses to be incurred on the solution were comparatively high for which the higher authorities were approached and the approval was taken.

2.10 Trial Implementation and Performance

Before final implementation of the solution, a trial was thought to be necessary; hence, a trial demonstration was taken for a batch of final year students and feedback was taken which helped us to identify lacuna, if any in the system. It seemed that the students were satisfied with the demonstration setup which encouraged to go for regular implementation of the solution.

2.11 Regular Implementation

A milestone chart was prepared so as to ensure timely completion of the tasks involved in the regular implementation. The tasks included designing the experiment, getting it approved by Head of the Department and conduct of the experiment. This has enabled to conduct the experiment on Electronic Ignition System with the help of this demonstration setup in the laboratory.

2.12 Follow-up and Review

After regular implementation, the follow-up and review was taken as a feedback from the students. A questionnaire as depicted in fig. 5 (page no. 14) was designed for the same and got it filled up by the students. The feedback received was,

- Better understanding of concepts and working of the system
- Enhanced participation of the students during practical hours
- Lack of understanding of voltage building process.

3.0 Conclusion

Over the years, quality Circle concept has been deployed successfully in industries, but, there are few instances, wherein it has been implemented in a technical institute for academic purposes. We, at department of Automobile Engineering at RIT, have made a sincere effort to implement the Quality Circle for the betterment of teaching-learning process in the department.

Student's unresponsiveness during the practical hours in the laboratory was realized and it was decided to focus the efforts on finding the solution that will make the laboratory session interesting. A Setup for electronic ignition system was designed and fabricated for two wheeler which could be used for demonstration in the laboratory. This facilitated better understanding and active participation of the students during laboratory hours. Also, this resulted in effective utilization of practical hours and a step towards laboratory development. The faculty members of the Quality Circle worked cohesively and experienced fruitfulness of team work.

The Quality Circle activity, if implemented systematically and effectively, in the process of imparting technical education may fetch wonderful results in the form of enrichment of quality of technical education and leads to participative learning.

4.0 Acknowledgement

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Quality Circle – "ASSURED"

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Quality Circle - " ASSURED "

Feedback Form – Students
(for follow-up/review)

1. After having demonstration on developed Electronic Ignition System? are you satisfied?
   Yes / No
2. Are you satisfied with developed Electronic Ignition test setup?
   Yes / No
3. Can you draw concrete conclusion at the end of demonstration on Electronic Ignition System?
   Yes / No
4. Do you feel that you have understood principle of Electronic Ignition System?
   Yes / No
5. Can you identify different components with their function with this setup ?
   a) All of them b) Some of them c) None of them
6. Have you fully understood working of Electronic Ignition Sytem after demonstration?
   Yes / no
7. Can you correlate piston position and crank angle with respect to ignition timing?
   a) Yes b) No
8. What you will suggest for further development into the present setup?
   1) Fix the set up on a stable stand
   2) Have a setup for measurement of voltage developed by spark plug
   3) Change the position of spark plug
   4) Indication of ~~crank~~ piston position at which spark occurs

Students name & signature Pushpendra Singh Rajput
Pushpendra Rajput

Fig. 5 Sample Feedback Form

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