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Improving Engineering Teaching Practices through Kaizen

M. N. Kishore[1], P. N. Jyothi[2]
[1]*Assistant Professor, Dept. of Management Studies, K. S. School of Engg. & Management, Bengaluru, India*
[2]*Professor, Department of Mechanical Engineering, K. S. School of Engg. & Management, Bengaluru, India*

***Abstract*: Preparing engineers to the corporate world is one of the difficult tasks and need for innovative teaching practices to the teach the students by the faculty members. Hence searching for new teaching practices, a Japanese concept called kaizen evolved in our minds. By using this kaizen concept in teaching how better to improve their knowledge and skills to face the corporate world. There therefore this paper discusses the concepts of kaizen and how it can be implemented in teaching engineering subjects. We considered cross sectional study with 50 sample size for analysis purpose. The data are collected by distributing questionnaires to the engineering faculty members of various disciplines respectively. The study aims at continuous improvement in faculty teaching which is analyzed and interpreted. An attempt has been to understand the teaching ways by use of kaizen concepts.**

***Keywords*: Engineering, Kaizen**

1. Introduction

Kaizen is a management approach, introduced by Japanese for continuously improving different phases of life. Kaizen is derived from two Japanese words Kai means change / Continuous and Zen means improvement/ better. So as per this concept, there should be small continuous improvements in our lives day by day. The concept of Kaizen is that it an on-going and never ending improvement process, which can be used anywhere, Efficiency has to be increased and accidents are to be minimized like in home, Industries, Hotels, schools etc. Kaizen was first used in Toyota Production system, for making the things to work the way they are planned to. It first created the atmosphere for continuous improvement by changing the view of the employees, educated them about this continuous improvement process and advantages of using this concept, made them to change the method of doing their tasks in a better way. Using Kaizen, environment will be created in a company where in the individuals or the team proactively works for improving the manufacturing process

The concept of Kaizen cannot be used in a single day, it is step by step process, wherein people involved like management, and employees are encouraged and motivated to make small changes in their day to day task performed in the work area. Overall effect of all these small value-added changes can bring significant improvement in the working processes. For this to happen, the all the employees and their leaders within the company should be committed to use Kaizen philosophy. Through Kaizen concepts, Improvements can be achieved at very little or without any expense. Employees are encouraged to improve the working efficiency using the available resources/ Infrastructure effectively, instead of making unwanted investments on the resources/infrastructure. Kaizen makes very complicated process to very simple without using very complicated and expensive techniques/ machineries, the employees here are made to focus on very small but important aspect influencing the firm's efficiency. Now a day, all most all the industries are using Kaizen technique and driving force for this is competition with other competent firm. If not used, then the firm becomes absolute even if it has good will and the competitor firm will overtake it in the market. Kaizen not only educate employees but also motivates them to think and solve the problem related to work area in most simple and effective way. Till now Kaizen is used in industries for improving the overall efficiency of the firm. This paper discusses the practice of Kaizen concepts in teaching practices at engineering colleges.

2. Literature review

Lachlan [1], in this paper explained how TQM is successfully used in any production system to produce quality products with zero defects. He also discussed how these TQM concepts can be used in educational Institutes. Teachers can use ``zero defects" Crosby model or Deming model. Teachers using Crosby model may focus only on achieving excellent students examination results without giving much importance to content taught, while teachers using Deming model may focus on a continuous improvement in teaching methods they follow while teaching students , other tasks performed by teachers in the college and how to evaluate the quality of their own work. Results concluded that use of TQM will continuously improve the quality of teaching, which encourages students become creative thinkers as needed by this ever-changing Technological world.

Emiliani [2] discussed how the Kaizen concepts can be used in business schools. Use of kaizen process, resulted in rapid improvement, without creating any difficulty to most important stake holders i.e. students. These were value addition without effecting student's freedom. The team members associated with Kaizen identified the key areas like purpose and learning,

technology, class room etc. Improvements were using kaizen concepts and finally evaluated the improvement opportunity selected. As value addition changes with time and technology Kaizen must be repeated at regular interval, which will ensure that teachers and the institution will be committed to continuous improvement, quality and excellence. Therefore, educational institutes using Kaizen will be ahead and competitive with other Institutes

Chelicera Sid Nair [3], in his article discussed how student satisfaction data can be used to start continuous improvement in any educational institute. Data related satisfaction and feedback about a subject were collected, from the data collected, few identified staff teams were asked to identify the areas for improvement and focus on making the changes which results high impact on student learning. Finally, systematic quality improvement initiative was developed for improving quality of student learning. William, [4], in his paper reviewed use of lean concepts in higher education. Lean in higher education is most significant method that can be used to improve the academic and administrative activities. These improvements are effective at the department level or throughout the institution. But adapting these concepts will be a big challenge to the institution as it requires committed management, organizational learning at institutional levels and most important cultural changes within the workplace.

Kaizen is an approach which leads to continuous improvement as a result of simple ongoing positive changes at the work area. The Kaizen's principle is to bring changes in small activities in an economical way as advised by the person who is doing a task on a day-to-day basis. It does not indicate sudden changes but small continuous improvements. Many leading industries have adopted this concept effectively. The following are few cases, which prove the Kaizen concept as most effective tool that can be used in improving efficiency. Toyota, Japanese automotive manufacturer company that started using Kaizen and growth of this company proved that, results are most extremely effective and are responsible for making this method familiar. In this firm, Kaizen is used to improve the workplace, permitting every individual employee to identify areas for improvement and give best solutions. The focused activity surrounding this solution is often referred to as a kaizen blitz, while it is the duty of each employee to use the improved standardized procedure and eliminate waste from within the local environment. Use of Kaizen starts at an early stage of design and proceeds to production line and continues through its lifetime of use by a process of consent known as Nemawashi.

Most famous car manufacturer -Toyota was using Kaizen. Ford Company also started using the Kaizen philosophy in 2006, when Alan Mulally and Mark Fields both continued using the kaizen principles helped them in gaining greater advantage in their industries. Ford focused on implementing practices which results in effective processes thus minimizing the wastages and reducing the time, hence the repeated process has been reduced tremendously with most efficient manner. This result orient strategy lead to the driven of new and improved products, which built more efficiently as well as fuel-efficient. After nine years of incremental improvements under Kiazen, Mulally took Ford from the edge of bankruptcy to the forefront of the US automotive innovation charge in one of the greatest corporate turnarounds in history

Nestlé is most Renowned, Trustworthy Food and Nutrition Company, which gives us the best example of how Kaizen can be used by different industries as per their requirement. In this case, a food industry, which is the most important firm in the world, has adapted Kaizen. It used very seriously one of the aspects of Kaizen- Lean production resulting in most effective improvements resulting in lesser wastage by reducing time and materials wastage on their processes. Lean production is mainly focused on finding the different ways not only to reduce waste, but also in finding methods to best use the space available, the resources on hand and the best utilization of talent and technology the company has in their fund. The Mayo Clinic is a nonprofit medical research group. Mayo Clinic, after observing the growth of Toyota, it closely studied how Kaizen was used in complex manufacturing operation in order to improve their practices. This motivated them to use Kaizen concepts for to health care. The industry of health is also very complicated and by adapting Kaizen philosophy can be make the process and simple. This health care group used this Kaizen for the best use of resources, procedures used, waiting times, handling of patient records, etc. This made a huge positive difference when compared to other healthcare organizations worldwide.

Lockheed Martin is the most famous American global aerospace, defense, security and advanced Technologies Company. It was the chosen as one of Industry Week's "Top 10 Plants" in 1998. During the period 1992 and 1997, the company was able to reduce its manufacturing costs by lowering their defect rate per plane; and also by lower its delivery time from 42 months to just below 22. For using lean manufacturing, one of aspects of kaizen philosophy, Lockheed Martin was awarded the Shingo Prize for Excellence in 2000. Another notable accomplishment was in the area of material management, where they were able to reduce the time to move parts from receiving to stock from 30 days to just four hours. In 2010, Lockheed Martin developed its Joint Air-to-Ground Missile (JAGM) system while at the same time they held multiple Kaizen events at their Florida and Alabama plants in order to improve the way that the JAGM is manufactured itself. US companies have made changes in their manufacturing practices, in order to see themselves as one of the competitor in the global market. To achieve this goal, they started using various advanced techniques like JIT, TQM, FMS lean manufacturing, process improvement, and DFMS. The main objectives of all these techniques are to the reduce cost, improve quality, reduce cycle time, and increase flexibility on the factory floor. Boeing Commercial Airplane Company has been using this Kaizen

concept and achieved the dream of its successes.

3. Research methodology

- *Objective:* The research paper is designed to assess teaching through kaizen process in field of engineering for purpose of continuous improvement in teaching practices. The study identifies the factors of kaizen concept that to be implemented in teaching areas.
- The exploratory study and cross sectional study were applied with minimal degree of researchers' interference; where data collected from various department faculty members of engineering colleges.
- *Sources of data:* The primary data collected from questionnaire survey and interviews of respondents and secondary data collected from published and unpublished sources such as journals, text books and company websites.
- *Population:* Engineering colleges across South Bangalore
- *Sampling Type:* Simple Random Sampling is used to carry out the research; where engineering faculty members are distributed with questionnaires and followed by interviews for analysis purpose.
- *Sampling size:* 50 faculty members
- *Scope of the study:* The study is restricted to engineering colleges of South Bangalore. The educational qualification of respondents are restricted either M.Tech. or pursuing or completed Ph.D.
- *Limitation of study:* The study is limited to few concepts of kaizen and respondents may be biased. A part of teaching practices through kaizen are briefed stated in this study.

Hypothesis:

H0: No impact of kaizen on teaching practices

H1: Impact of kaizen on teaching practices

Assuming level of confidence =95 %, the table value is Z tab=1.96.

Table 1
Comparison of subject training (ST) and theoretical knowledge (TK) in practice

Particulars	Subject training	Theoretical knowledge in practice
Always	8	35
Occasionally	27	11
Rarely	15	04
Very Rarely	0	0
Never	0	0

The Chi-square analysis done by using Minitab 16 version software and tabulated as below.

Chi-square analysis

ST	C2	C3	C4	Total
	8	27	15	50
	21.50	19.00	9.50	
	8.477	3.368	3.184	
TK	35	11	4	50
	21.50	19.00	9.50	
	8.477	3.368	3.184	
Total	43	38	19	100

- By Minitab, the Chi-Square value is 30.059 with degree of freedom is 2.
- By comparing the Z table value (1.96) with Z actual value (30.059), the null hypothesis should be rejected and Alternate hypothesis accepted. i.e. there is an impact of kaizen on teaching practices.

Table 2
Comparison of ICT technologies and resources for continuous improvement

Particulars	ICT	Resources
Always	23	15
Occasionally	19	27
Rarely	04	08
Very Rarely	0	0
Never	04	0

ST	C2	C3	C4	C5	Total
	23	19	4	4	50
	19.00	23.00	6.00	2.00	
	0.842	0.696	0.667	2.000	
TK	15	27	08	0	50
	19.00	23.00	6.00	2.00	
	0.842	0.696	0.667	2.000	
Total	38	46	12	4	100

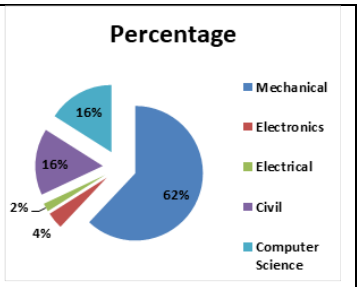
- By Minitab, the Chi-Square value is 8.409 with degree of freedom is 3.
- By comparing the Z table value (1.96) with Z actual value (8.409), the null hypothesis should be rejected and Alternate hypothesis accepted. I.e. there is an impact of kaizen on teaching practices.

4. Data analysis

A. Demographic variables

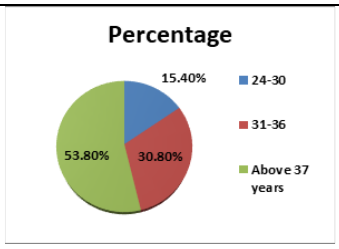
Departments

Particulars	No. of respondents	Percentage
Mechanical	31	62
Electronics	2	4
Electrical	1	2
Civil	8	16
Computer Science	8	16
Total	50	100



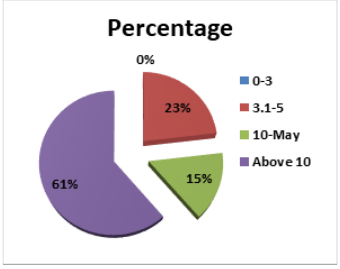
Age (years):

Particulars	No. of respondents	Percentage
24-30	8	15.4
31-36	15	30.8
Above 37 years	27	53.8
Total	50	100



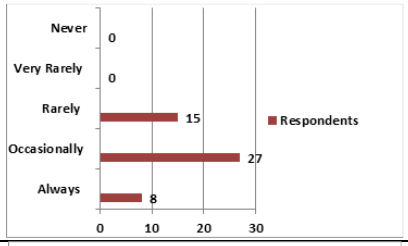
Experience (years):

Particulars	No. of respondents	Percentage
0-3	0	0
3.1-5	12	23.1
5-10	08	15.4
Above 10	30	61.2
Total	50	100



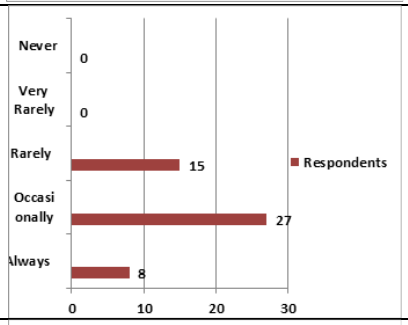
Subject training attended by faculty members

Particulars	**No. of respondents**	**Percentage**
Always	8	15.4
Occasionally	27	53.8
Rarely	15	30.8
Very Rarely	0	0
Never	0	0
Total	**50**	**100**



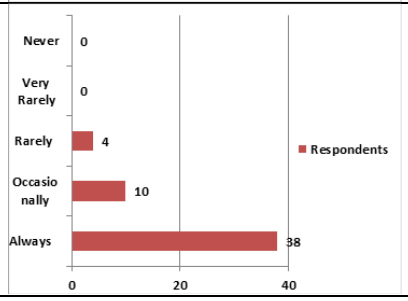
Engineering Theoretical knowledge in practice

Particulars	**No. of respondents**	**Percentage**
Always	35	69.2
Occasionally	11	23.1
Rarely	04	7.7
Very Rarely	0	0
Never	0	0
Total	**50**	**100**



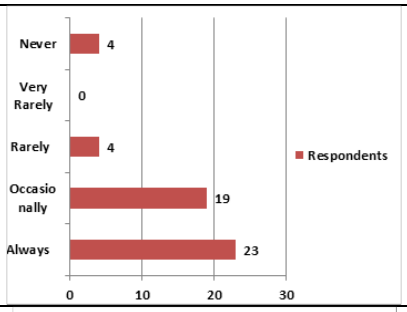
Faculty members towards problem based learning and student centered learning in teaching

Particulars	**No. of respondents**	**Percentage**
Always	38	76.9
Occasionally	10	15.4
Rarely	04	7.7
Very Rarely	0	0
Never	0	0
Total	**50**	**100**



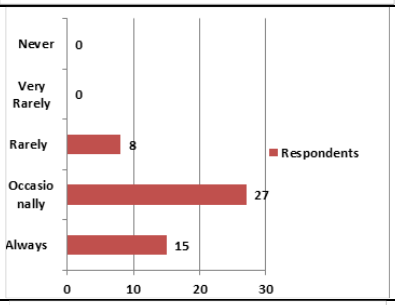
Use of ICT technologies (videos, ppts, simulation and so on) for teaching?

Particulars	No. of respondents	Percentage
Always	23	46.2
Occasionally	19	38.5
Rarely	04	7.7
Very Rarely	0	0
Never	04	7.7
Total	50	100



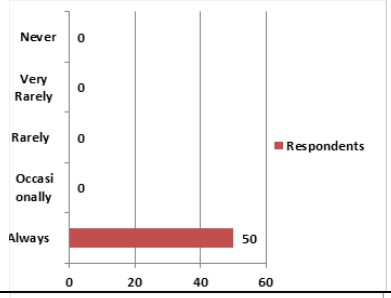
Use the resources (like Library, e-journals, technical magazines and so on) for continuous improvement in the subjects?

Particulars	No. of respondents	Percentage
Always	15	30.8
Occasionally	27	53.8
Rarely	08	15.4
Very Rarely	0	0
Never	0	0
Total	50	100



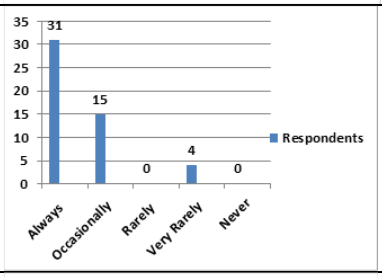
Encouraging students for raising questions related to subjects

Particulars	No. of respondents	Percentage
Always	50	100
Occasionally	0	0
Rarely	0	0
Very Rarely	0	0
Never	0	0
Total	50	100



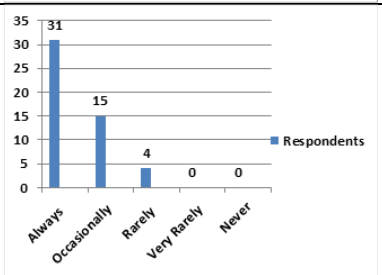
Faculty members interested in group learning for self-improvement

Particulars	No. of respondents	Percentage
Always	31	61.5
Occasionally	15	30.8
Rarely	0	0
Very Rarely	04	7.7
Never	0	0
Total	50	100



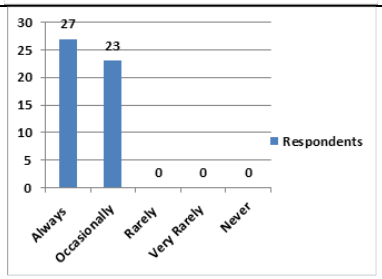
Showing interest in interdisciplinary subjects

Particulars	No. of respondents	Percentage
Always	31	61.5
Occasionally	15	30.8
Rarely	04	7.7
Very Rarely	0	0
Never	0	0
Total	50	100



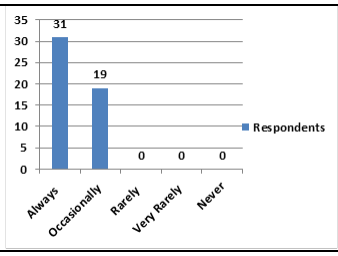
Use of kaizen concepts in teaching

Particulars	No. of respondents	Percentage
Always	27	53.8
Occasionally	23	46.2
Rarely	0	0
Very Rarely	0	0
Never	0	0
Total	50	100



Feedback from peers and students regarding subjects

Particulars	No. of respondents	Percentage
Always	31	61.5
Occasionally	19	38.5
Rarely	0	0
Very Rarely	0	0
Never	0	0
Total	50	100



5. Implications

The data collected with limited faculty members of limited colleges. The findings obtained may be insufficient and limited scope of results. Therefore, the sample size has to be increased for further mathematical treatments by the researchers and to fill the gaps.

The following are the findings are collected from the respondents and shown in above tabulation.

- Majority of the respondents are from mechanical department and the age over 37 years with a year of 10 years in teaching.
- Most of the faculty members attended the subject training occasionally. Hence the members are motivated to attend the number of training programs in order to enhance their subject knowledge and skills in their respective fields.
- As 69.2 % says that they make use of engineering knowledge in real time applications; this shows positivity of faculty members towards the subjects. Hence much more practical applications can be learned and has to be taught to students.
- From the study, problem based and students learning are encouraged by the faculty members. Therefore, more innovative practices to be adopted for continuous improvement required to perform constantly for the welfare of the students.
- Use of ICT technologies and resources are not incorporated with teaching to the maximum extent. So, the management must initiate and support the technological infrastructure, and provide training to the faculty members for enhancing their knowledge where further used to be in teaching the students.
- Group learning and interdisciplinary approaches always yields better results of acquiring knowledge and skills to the faculty members and can assist to the students' community in all ways. A platform should be created at college level to discuss the new and interdisciplinary concepts periodically through using ICT, workshops, seminars, presentations, micro blogs and so on.
- Feedback always plays an important role in self-improvement and makes us too towards perfection. All faculty members should welcome the feedback in positive approach.

6. Conclusions

We conclude that:

- Maximum subject training programs should be happened at department level.
- Innovative techniques should be used for better teaching styles
- Adoption of ICT technologies should be made mandatory to understand the concept in an easy and simple way.
- Motivating the faculty members for group learning
- Handling Interdepartmental subjects should be encouraged.

Kaizen, if implemented in teaching can do wonders in the education field. Hence more research should be conducted in improving of the teaching styles for the welfare of the students.

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