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A Qualitative Analysis on Management Studies for Engineering Students

Jyoti R Munavalli[1], P. A. Vijaya[2], Priya R Sankpal[3]
[1]Asso. Prof. ECE Department, BNM Institute of Technology, Bangalore
[2]Prof. & HoD, ECE Department, BNM Institute of Technology, Bangalore
[3]Asst. Prof. ECE Department, BNM Institute of Technology,
[1]jyotirmunavalli@bnmit.in jyothimunavalli@gmail.com,
[2]pavmkv@gmail.com
[3]priyarsankpal@bnmit.in priyarsankpal@gmail.com

Abstract: This study demonstrates that studying management and entrepreneurship curriculum is an important component during engineering. A pre-survey was conducted to understand the preconceived knowledge about management and entrepreneurship among students. Later, after the completion of the course, a post-survey was carried out to observe the improvement in knowledge and the awareness about these concepts. A qualitative method was used in which 150 survey samples were collected and analyzed. A comparative study of pre- and post-surveys was carried out. Findings show that a course on management in the curriculum have given engineering students a lot of insights to their career growth and stimulated to think on the opportunities of becoming entrepreneurs.

Keywords: management skills, entrepreneur, engineering, education, leadership, communication.

1. Introduction

Over the years, engineering education has evolved a lot. There has been upgradation in technical subjects to bridge the gap between industry and academia. Innovation Management, Problem Based Learning, Engineering Management, Industrial Economics and Management concepts have been introduced over a period of time((Sita L. Bhadargade 2020; Angela van Barneveld 2015) . It is observed that engineers escalate in their career to higher positions but lack managerial skills like communication skills, leadership qualities, motivation, strategic thinking, project and time management skills, which are essential in the working environment for maintaining coordination among different people in the organization.

The engineers with excellent technical skills also struggle because of not having management skills like planning, organizing, controlling and coordinating, teamwork, leadership etc. In most of the organizations, teams suffer because of lack of communication, lack of adaptability to change and poor time and resource management (Dymsza 1982). In this era of start-ups, it's even more essential that engineers engage themselves in practicing management skills. So, a management course during their engineering curriculum would help them understand people management. Not only for managerial skills but exposure to management concepts gives opportunities of understanding the operations management, entrepreneurship, project management and how technology can be used in these domains((Refaat 2009; Glauco da Silva 2015) . The literature on this topic shows that engineering management study is an important area for undergraduate students((Palmer 1999) .

Jong-Teak Seo
Kookmin University, korea
suho1793@hanmail.net

This study was aimed to understand the effectiveness of disseminating management concepts to engineering students. This study highlights how students gain knowledge that could be used later in their career and how it motivates the youth to become entrepreneurs. This is a qualitative study which analyzes how management studies for engineers creates awareness of various skills and opportunities available. There exists studies that evaluate the effectiveness and outcomes of any concepts/subjects in curriculum ((Rennie et al. 2018). The quality of teaching, assessment and feedback influence on the teaching framework are gauged (Sutherland et al. 2018). There are studies that have been conducted where management is thought to engineering students using learning by doing rather than conventional learning. The topics are taught by assigning organization of events and conferences so that students learn by doing (Silva 2002). Case studies are normally used in management classes to explain the concepts. Action research approach was used by authors(Contreras Pacheco 2017). Also, many interactive methods have been used in teaching management concepts (Rambocas and Sastry 2017) Simulations and hackathons are used to teach management to make teaching-learning process more interesting ((Salas, Wildman, and Piccolo 2009; Maaravi 2020).

As our first contribution, we report a constructive education experience based on the case-teaching method and innovative methods, where theory and practice are integrated. As our second contribution, we report a change in awareness on management skills and the way the students perceive and implement them. We show that there is a drift in the level of perceiving management concepts in students, before and after the course. The paper is organized as follows: In Section 2, we describe Methods and Materials, Section 3 presents Results and Riscussion, and Section 4 presents the Conclusion.

2. Methods and Materials

This study dealt with engineering students' perspective on management studies. The study design is as shown in Fig. 1. In this study, a pre-course survey was conducted to access the understanding and awareness about management among students. Over a period of four months, the course on management and entrepreneurship was taught. Number of case studies and activities (individual and team) were used to teach the course. Later, a post-course survey was collected.

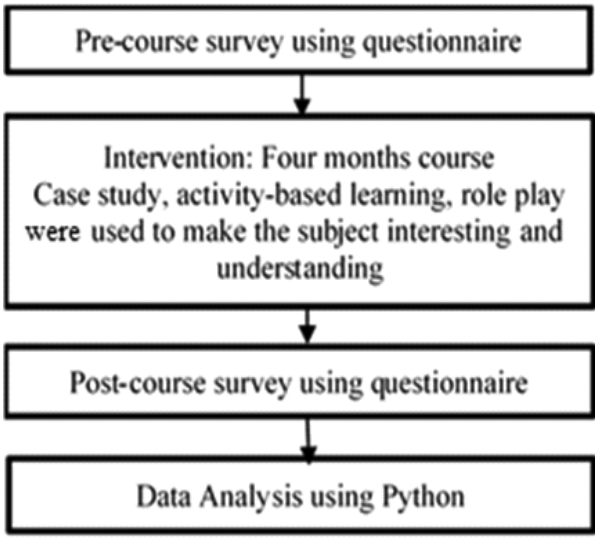

Fig.1 : Study Design

Both surveys had questionnaire. Pre course survey had 14 questions and post course survey had 20 questions. First 14 questions were same in both pre

Table 1 : List of questions from questionnaire

Sl. No	Questions
1	Do you think engineers need to study management? a. Yes b. No c. don't know
2	Do you know any of the management skills? a. Yes b. No c. don't know what it is
3	Do you know any of the management Tools? a. Yes b. No c. don't know what management tools are
4	What management means to you? a. To become Manager b. to grow to higher position in your field of interest
5	What you know about management? Descriptive answer
6	Do you know about career options/opportunities for engineering management? a. Yes b. No c. not aware
7	Are you aware of the job profile or the earning of engineers in management profile? a.<10L b. 10L-20L c. >20L d. don't know
8	What is management? a.A skill b. an art c. a science
9	What you want to become? (software/hardware) a. developer/designer b. testing c. marketing d. specify if none of these
10	Where do you see yourself after 10 years into career, whatever you chose in above question? a. Team leader b. Project lead c. same developer in different company d. don't know
11	What leadership qualities should an engineer have? a. Technical skill b. management skill c. communication skill
12	If given choice/chance, could you have Startup Company? a. Yes b. No, I don't know what it requires for a start-up
13	Do you know what entrepreneur means? a. Yes b. No
14	Do you have all the information about how to begin your own start-up company? a. Yes b. No

survey and post survey so as to analyze the difference in students understanding, knowledge and perspective about management. The questionnaire is as shown in Table 1.

A pre-course survey was conducted in the beginning of the academic semester. This survey aimed to analyze and understand the current perspective of students about management and the awareness about the management as a course and its application in real world. A questionnaire, as a part of survey was distributed to students and the related information was collected. The students were not allowed to discuss but were supposed to give out their individual perspective. The pre course survey was followed with four months of class room teaching that involved activity-based learning, case studies and written assessments.

The teaching learning process was made interesting by incorporating innovative methods to make students understand concepts of management and its applications. Few of the innovative/activity-based learning methods used in disseminating the course are: Case studies, Role plays, Survival strategies and Model making.

Case Studies: Case studies provide interesting perspective of real-life business and enable students to engage in self-learning and effective report writing. Topics covered related to real life applications included need for planning & steps in planning, Leadership and management Functions. Case studies on various topics aid in developing skills in strategic analysis.

Role plays: With role play, students get the opportunity to practice skills which they might not use on a regular basis i.e. using skills such as negotiating, reasoning, debating when they are in hypothetical situations. Students learn to adapt to changing business situations and this in turn brings in their creativity/innovativeness to forefront.

Role playing also enables verbal communication skills and interpersonal skills.

Survival Strategies: In this activity students are given a list of things that they should choose on priority when they are stuck in a midst of any circumstance. The task is split into two stages. Initially the students prioritise individually and later involve in group discussion. Using the grading method students arrive at the final solution.

Such activities sharpen the decision-making skills in students.

Model making: In this team-based activity, students were asked to build a model with limited resources in the stipulated time. Teams were asked to build a model with limited resources provided (ex: waste paper, scissors and/or transparent tapes). Teams were asked to a prepare a plan to build the model and complete the task with the associated instructions. At the end of the activity all the models were evaluated based on the plan submitted earlier and certain parameters such as Sturdy, time management, team management, delegating work, creativity or design, and waste management. This activity helps in developing/enhancing creative thinking of students. Students develop team spirit, communication skills and decision making. Also, it helps in creating awareness of leadership qualities. Students were able to appreciate the concepts and steps involved in strategic planning.

Rabbit-Stone-Archer: This activity involves student to pose in three different ways based on their leader's orders. This activity enables coordination, directing and team work skills in students.

Many other activities were conducted for other topics of management. At the end of course, a post-course survey was conducted to measure the effectiveness of the management course in students. The survey was also used to analyse/gauge the understanding ability and management knowledge perceived by engineering students. The study was aimed to answer: how the course has changed the student's perspective about management, if at all. The research tool was designed based on the course content and general awareness about management. The questions were easy to understand and double-barrelled questions were avoided. Few questions in post-course survey remained the same as in pre-course survey while others were changed based on the relevance. The tool was tested on a pilot sample to understand the potential problems in conducting the study.

The study design applied non-random sampling as the aim is to observe and analyze the outcome of management studies/course for engineering undergraduates. In this study, 150 students took both pre as well as post surveys. 10 students took only one

survey; either pre or post, so these samples were excluded from the study. The sample size (150) was calculated with 95% of confidence level for the population of 160 with 2% of margin of error. The questionnaires collected were in the paper form so they were converted to digital format. Therefore, all the entries from the questionnaires were carefully transferred to excel sheets for further analysis and Python was used for data analysis. The entries were cross-verified for correctness. Subsequently, the data was analyzed based on answers to the questions.

3. Results and Discussion

Fourteen questions were common in pre-survey and post-survey questionnaire and additional six questions were added to post-survey. Answers to all these questions were obtained and analyzed. These questions were based on detailed management concept and applications so these were not included in pre-survey (before the course) but were included in post-survey (after the course). In this section, we present the results obtained based on the questionnaire. The answers to the same questions were compared in both the surveys to identify the understanding of students before and after the course. Question no. 5 in the survey was: What you know about management? Answer to this question was in given in a descriptive way in post-survey. During pre-survey, most of the students didn't answer this question and some students mentioned only about time management. So, this question is excluded in comparison.

The awareness about management and its study was found to be 56% before the course and 100% after the course awareness and its importance were known to all the students (see 1a,1b,1c in Fig.2). All though few students knew the importance of management concepts before the course, most of them did not know about any management skills (2a,2b,2c) and management tools (3a, 3b, 3c).

Some of them said management means to become manager while others said it means to grow to higher position in the field of interest (4a, 4b). Before the course, students were not knowing about career options in engineering management but post course most of them had knowledge about the opportunities (6a, 6b, 6c). The course provided with the information about the job profiles in management for engineers and the pay package (7a, 7b, 7c, 7d). Question 8 was: is management a skill, an art, a science. Though option

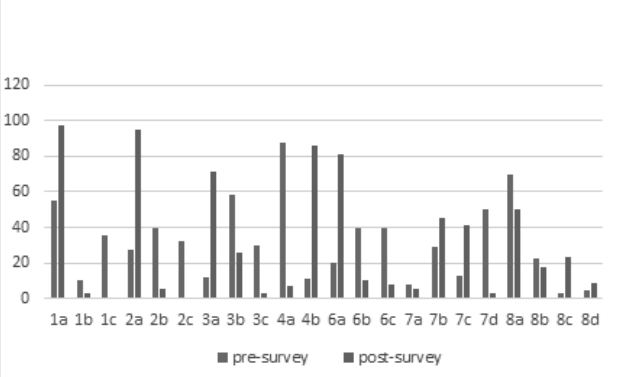

Fig.2: Comparison of pre-survey and post-survey (questions 1 to 8) data (in %)

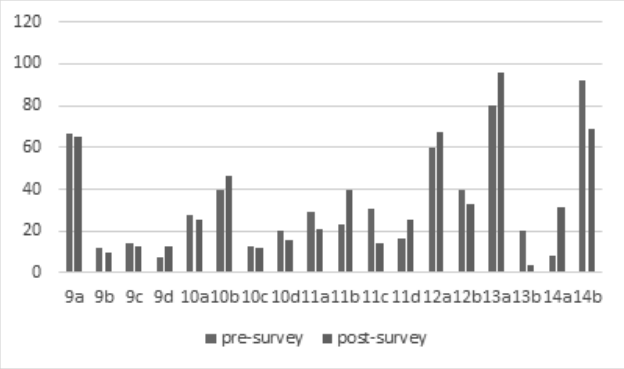

Fig. 3 : Comparison of pre-survey and post-survey (questions 9 to 14) data (in %)

4 was not given yet students marked management as all the given options (8a, 8b, 8c, 8d).

Most of the students aspired to become developer/designer compared to managerial level (9 in Fig. 3). Before the course most of them had answered as to remain developer in different or same company, but after the course there is an increase in the number of students who aspire to become team leader and project lead. This indicates the students are now interested in taking up the management roles (10). Students believed that engineers with good technical and communication skills can become effective/influencing leaders, post the course it was evident for them that management skills are also required for evolving as a leader. Few students marked all the three skills are leadership skills (11). Another interesting question was asked to students that do they want to have a start-up company. There was increase in 'yes' in post-survey compared to pre-survey. This was because the students studied in detail about the entrepreneurship and the support given to them by government institutions. The students were equipped

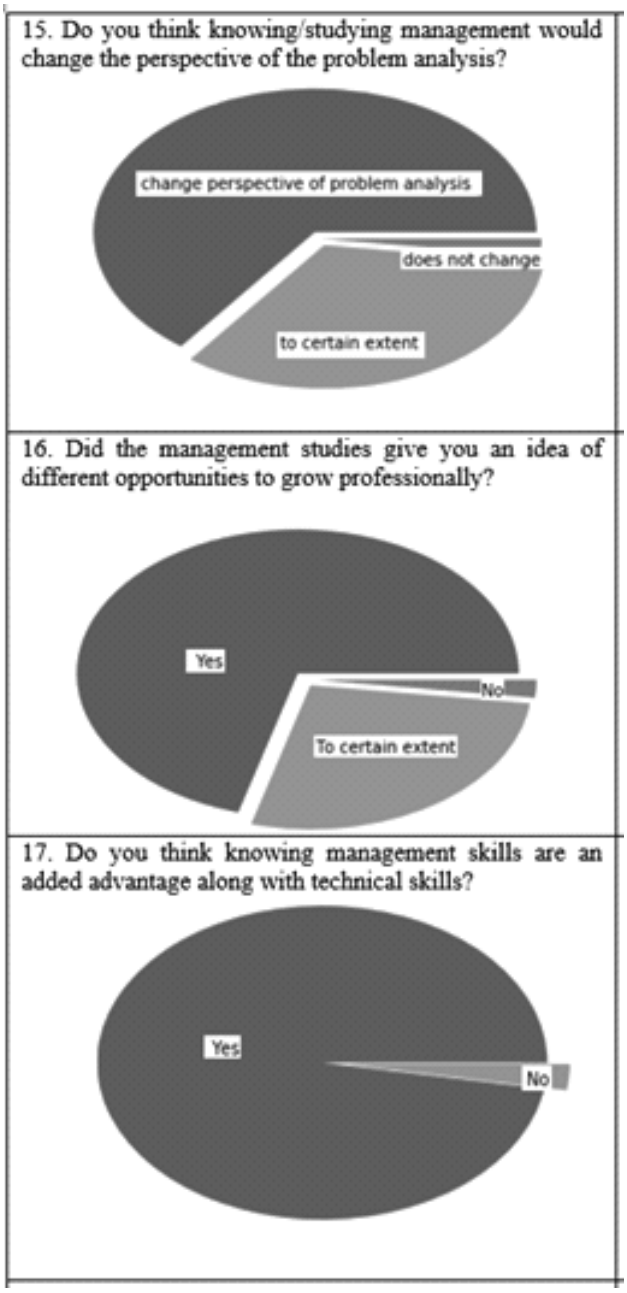

Fig. 4. Response in post-survey for questions 15 to 17

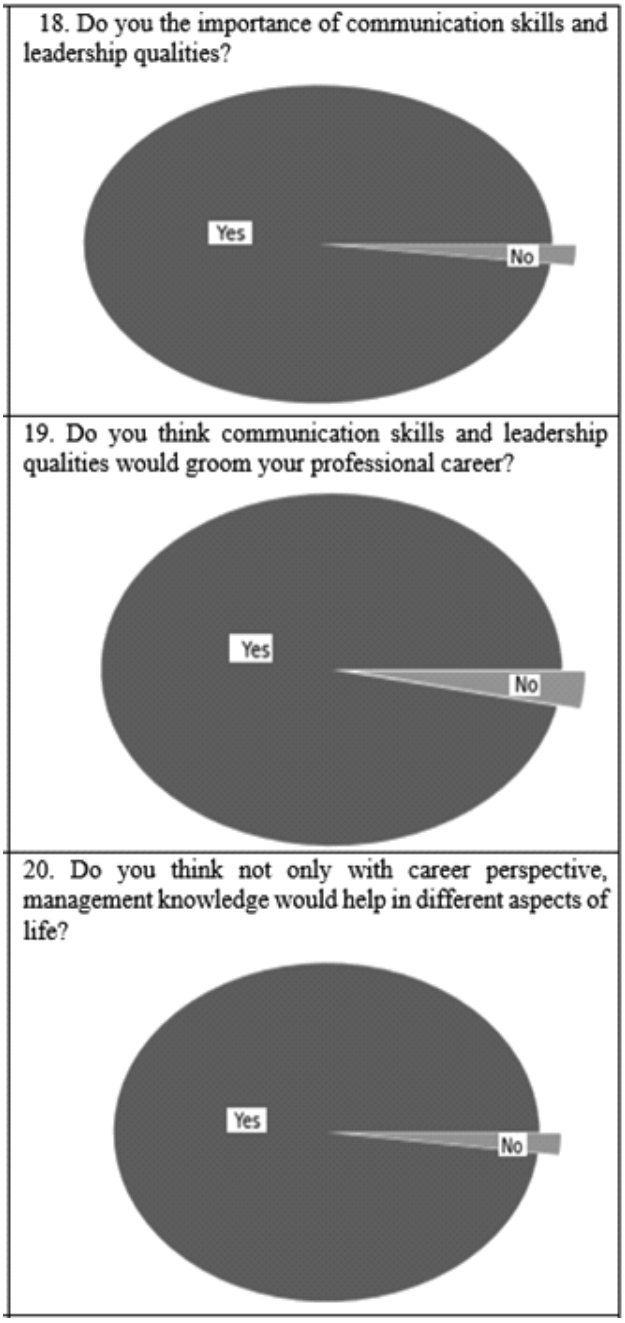

Fig.5 : Response in post-survey for questions 18 to 20

with information about beginning an own start-up company (12,13,14). Questions 15-20 were asked only in post-survey to analyze the understanding of the management concepts and its applications. The responses are as shown in Fig. 4 and Fig 5.

Around 65% of students agreed that knowing/studying management would change the perspective of the problem analysis and 33% said to certain extent whereas only 2% didn't agree. It was observed that 70% of students told that management studies gave them an idea of different opportunities to grow professionally. Around 97% of students agreed that knowing management skills were an added advantage along with technical skills and only 2.7% didn't agree. Question 18 was on the importance of communication skills and leadership qualities to which 97% of students agreed its important. Not only that but 98% of students acknowledged these qualities groom professional careers. 98% of students accepted that management studies not only help in career but also in personal aspects of life as its lessons are directly applicable to all aspects of life.

4. Conclusion

The objective of this study was to analyze the knowledge of engineering students about management. So, the study conducted surveys before and after the course. The analysis shows that before the course, students were not aware of management concepts and its applications. But post the course, students believed that engineering course makes proficient technically and scientifically, but the course on management makes them to think purposefully & strategically thus honing their technical skills further. The management studies gave engineers a lot of insights to their career growth and stimulated to think on the opportunities of becoming entrepreneurs.

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