Stakeholder Feedback System for Curriculum Design and Improvement – A Case Study

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Abstract: With the increase in the number of universities and autonomous institutes there is a need of developing suitable curriculum and its updates to maintain the quality of education and increase employability. This is very challenging especially for engineering education in Information technology and Computer Engineering, as the technology changes too fast and the nature of job market keep changing accordingly. This poses a practical problem to keep-up a matching pace of change in academics. To keep the quality of education at par with reputed institutes at national and international level the regulators like All India Council of Technical Education (AICTE) and National Board of Accreditation (NBA) of Indian Government provide norms and guidelines on implementing curriculum following Outcome Based Education (OBE). This paper examines the stakeholder's expectations for the type course modules included during the 4-year study of the B.Tech program, affecting the teaching learning approach and the outcome. The use of a feedback system from stakeholders has been presented which can be used for the design and improvement of course curriculum. The idea and concepts have been explained by taking the B.Tech IT program's curriculum development as a case study for implementing the new autonomous syllabus as an improved version of the existing university curriculum.

Keywords: Engineering Curriculum, Employability, NBA, Outcome Based Education, Course Outcome and Program Outcome, Stakeholders, Feedback

1. Introduction

The C.V. Raman College of Engineering, a 20 year old institute, is operating as autonomous college since 2014 while maintaining its affiliation to Biju Pattnaik University of Technology (BPUT), Odisha. As part of the autonomy it is capable of formulating and changing its curriculum. It is in the Outcome Based Education (OBE) accreditation path, with four engineering programs NBA certified as per the OBE method and the other four programs are in the process of getting certified. The challenge is to formulate a curriculum which will achieve its vision, mission and goals while satisfying the expectations of all stakeholders. This paper provides an insight as to how the Information Technology (IT) department of C.V. Raman college designed and used a stakeholders feedback system to define a new and improved curriculum for the autonomous B.Tech program over the one prescribed by BPUT.

2. Background and Motivation

Curriculum design needs to follow certain norms and guidelines recommended by regulators; institutions and professional bodies associated with engineering curriculum design (see ACM curricula 2008, AICTE norms & standards for Engineering Degree, Dayaratnam committee recommendation). It should be well designed and comparable in content to institutes of higher learning to be able to get approved by the program's Board of Studies (BoS), institute's Academic Council (AC), the Autonomous institute's Governing Board (BoG) and BPUT, the affiliating university. There has been several study and recommendations for preparing an engineering graduate program syllabus specifically in the Information technology domain (see MoE BC 2013, O'Grady, IMaCS NSDC report 2011, Chhem & Khoo 2001). Design of curriculum becomes an extremely challenging task as it has to satisfy the expectations of various external and internal stakeholders (Fig 2.1).

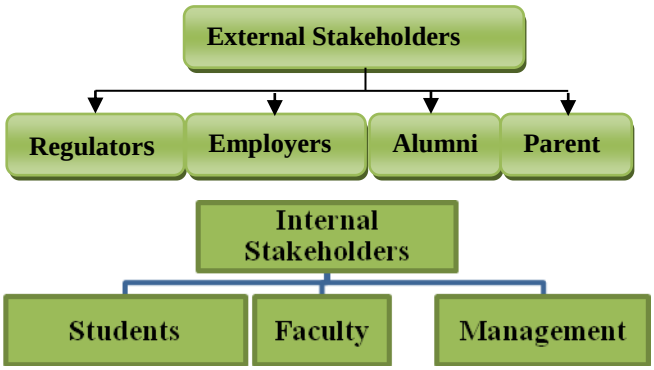

Figure 2.1: External and Internal Stake holders for the B.Tech IT program

In the OBE method certification guideline NBA (see NBA website- accreditation document) has provided 12 generic

program outcomes (PO) for graduate programs. These are (1) Engineering knowledge, (2) Problem analysis, (3) Design/development of solutions , (4) Conduct investigations of complex problems, (5) Modern tool usage, (6) The engineer and society, (7) Environment and sustainability, (8) Ethics, (9) Individual and team work, (10) Communication, (11) Project management and finance, (12) Life-long learning. Additionally the program specific outcomes (PSO) for the IT B.Tech program have been defined as; (1) Apply IT concepts and manage technology change (2) Practice design principles (3) Identify IT solutions (4) Implementing IT projects effectively. The curriculum has to provide input to the teaching-learning-assessment method which will help in measuring all the PO and PSO. In other words it needs to have all the elements which when covered by the teaching learning process will provide the capabilities defined in the PO and PSO.

The curriculum should be able to impart the skills required by the IT and IT oriented service and product industries (employers) to be able to make the graduating students employable. In other words it should assure employability to the students, and satisfy the parents' interest. At the same time it should be able to build a strong knowledge foundation so that aspiring students can go for higher studies in the country or outside (alumni). In general it should foster an attitude and ability of continuous or life-long learning among the students so that they are able to achieve proper career growth.

As per the vision and mission of the institution (see web site - C.V. Raman College of Engineering, Bhubaneswar) the curriculum must provide world class education to the students, associate itself with industry and academia, encouraging research and development. Considering the interests of the faculty and technical staff the curriculum structure and content should be built with suitable pre-requisites, provide adequate laboratory and tutorial components and the corresponding contact hours to be able to satisfy the coverage of the course content. The curriculum structure should also provide the assessment method and the credit for each course. Additionally, if the curriculum provides the scope of dealing with slow and fast learners a critical objective of teaching learning method is satisfied.

Understanding the expectations of the internal stakeholders can be carried out through interactions and meetings. The academic administration structure of BoG, AC, BoS and the institute's management bodies which oversee the academic activities of the institute provide adequate mechanism in getting inputs and feedback. Additionally the IT department conducting the B.Tech Information Technology program has set up Course Coordinators, Program Coordinators and Program Assessment Committees (PAC) to oversee the teaching learning delivery and assessment. This hierarchy can be utilized for getting the internal stakeholders inputs. However, reaching the external stakeholders to collect their expectations and feedback requires a different approach.

The NBA guideline for PO attainment measure recommends computing the attainment by both direct and indirect methods. The direct methods are measurements taken from the assessment or evaluation method prescribed in the course curriculum and academic regulations, while the indirect methods requires to be built on collecting opinion regarding the PO attainment from large number of employers, graduating students (at Exit time), alumni (minimum 2-3 years in employment) over few years and deriving the PO attainment after application of suitable rubrics. The data acquisition tools used is normally a questionnaire, where the survey can be conducted online or offline mode. This provided us a motivation to use the similar approach for getting required inputs from the external stakeholders for the initial design of curriculum for the autonomous system. The same method can be used for validating the curriculum changes and affecting future improvements in a continuous manner.

3. Feedback Design

A. Alumni Survey

Though Alumni are not stakeholders as per strict definitions, they possess belongingness to the institute, and form an extremely useful source for practical suggestions regarding the employability and employer issues. The alumni survey format questionnaire is designed in such a way that they can be mapped to the POs and PSOs. The survey format we used contained 16 questions that the student will provide score in a 5 point Likert scale. Apart from this we provided space for free comment on "the programme and its graduates in terms of their professional qualities and on any specific areas of strengths and weaknesses, and to suggest any improvements to our program of study".

B. Graduate Exit survey

The graduating students get the highest impact of the curriculum in force and the corresponding teaching learning method. Therefore the graduate survey questionnaire contains several dimensions. These are Quality of Faculty, Quality of Facilities, Quality of Support Services, Curriculum and Instruction, Overall Program Experience**.** Again the overall program experience has many sub parameters that can be mapped to the POs and PSOs, and the student is asked to score on a 5-point Likert values at the time of exit from the college. Finally, they are requested to provide comments or suggestions on the program in terms of professional qualities and on any specific areas of strengths and weaknesses, suggestions for improvements to our program of study. Specifically they are requested to (1) List the courses within the Program from which they benefitted the most (2) Which courses provided them best practical experience, (3) anything that they felt was lacking.

While the first part of the alumni survey and graduate exit survey provided major inputs for measuring PO attainment, improving the faculty, facility, infrastructure, and validating the utility and satisfaction level of the existing course structure, the free comments and suggestions were used exclusively for getting critical feedback regarding the redesign of the curriculum courses.

C. Parent's Feedback Survey:

The parent's feedback tried to gauge the satisfaction in the transformation of their wards from a student to a professional. It contained questions which can be related to courses in the curriculum and skill learning in engineering studies and also map few POs and PSOs for attainment measure. The questions were on (1) Preparedness for getting job, (2) Ethics and sense of responsibility towards society (3) Sense of responsibility towards improvement of environment using information technology (4) overall development of Personality and Communication (5) Motivation in pursuing higher studies for better carrier (6) Inclination towards research, innovation and entrepreneurship (7) overall growth considering participation in co-curricular activities and events (8) suggestions for improvement.

D. Student's Feedback Survey

The purpose of the student survey was to get an immediate feedback from the students after they have completed each year of study regarding the suitability and outcome of the courses taken. The purpose here is to make a quick validation of the modified course for any fine tuning instead of waiting for 4 years to see the impact. The design of this form may depend on the program and year of study, as it has parameters regarding curriculum components. The understanding and satisfaction level of the student can be judged progressively by using this type of analysis.

4. Feedback Analysis

We present here the analysis of stake holder's feedback relevant for the design and improvement of curriculum, teaching learning, and evaluation.

A. Analysis of Graduate Survey Feedback for 3 years:

The graduate feedback analysis is summarized in Table 4.1, where the last column provides a qualitative score for the type of course modules in column 2.

Table 4.1: Summary of Graduate Feedback

Sl	Course Type	Comments / Suggestions
1	Programming courses like C, C++, Java, Internet and Web Technologies	Most beneficial and most liked
2	Core courses like Data Structures, Design and Analysis of Algorithms, Computer Organization, Operating Systems, Software engineering and project management	Very useful for job interviews and higher studies such as MTech and MBA
3	Electives like Principles of Soft Computing, Digital Image Processing, Computer Network, Security and Cryptography	Were found useful for R&D type of work
4	Skill based classes on IBM Java & Oracle, NVIDIA CUDA programming, MATLAB, and Cambridge BEC courses for English communication	Provided the best practical experiences, should give more time for all hands-on courses
5	Sessional courses such as Technical Seminar, Minor and Major projects	Extremely good for self-learning. Projects should be on real life problems.
6	Events such as Technical Workshops and Seminars on emerging technologies, events organized by professional societies like CSI, Technical and Cultural functions	Provided teamwork and leadership qualities and are good for self-learning ability

B. Alumni Feedback Analysis

The Alumni feedback analysis is summarized in Table 4.2, where the last column provides a scoring indicating the number of persons giving the similar comment (column 2).

Table 4.2: Summary of Alumni Feedback

Sl	Comments / Suggestions	Score
1	Training on modern tools	High
2	Improvement of laboratory equipment	Medium
3	More practical training	High
4	Training and exposure on latest technology	High
5	Seminars, Workshops on industry oriented topics, using industry resources are beneficial.	Medium

C. Industry Feedback Analysis:

The feedback received from industry leaders has been summarized in Table 4.3, where the last column provides a score indicating the number of persons giving the similar comment (column 2).

Table 4.3: Summary of Industry Feedback

Sl	Comments / Suggestions by industry leaders from Cognizant Technology Solutions, IBM, Infosys Ltd, Oracle, Wipro Ltd. etc	Score
1	Need to be strong in core computer courses.	High
2	Additional skill training provides confidence and helps in interviews	Medium
3	Practical exposure to problem solving is desirable.	High
4	Should be flexible with innovative ideas for real life problems.	Medium
5	Good practice on programming and designing techniques is required	High
6	Strong foundation on Java programming helps to pick up other related concepts and programming languages, packages	High
7	Use of modern tools and methods. Design and development tools such as Rational or other open source tools.	Medium
8	Sound language skills and communication is necessary for placement selection.	High
9	Soft skills such as language and communication, leadership qualities and team work are essential for career growth, should be inculcated as part of curriculum.	High
10	Seminars from industry personnel should be done frequently for the students.	Medium

11	Develop attitude of self-learning and adapting to emerging technological environment. Need to develop interest in learning new technology for taking leadership.	High
12	IT industries give preference to engineers with certifications from industry majors like Oracle, IBM, Microsoft, CISCO, and other product companies.	Medium
13	Faculty members need to be trained on new technology and change the curriculum more frequently, tuning it every 2-3 years as per latest technology trends in the industry	High

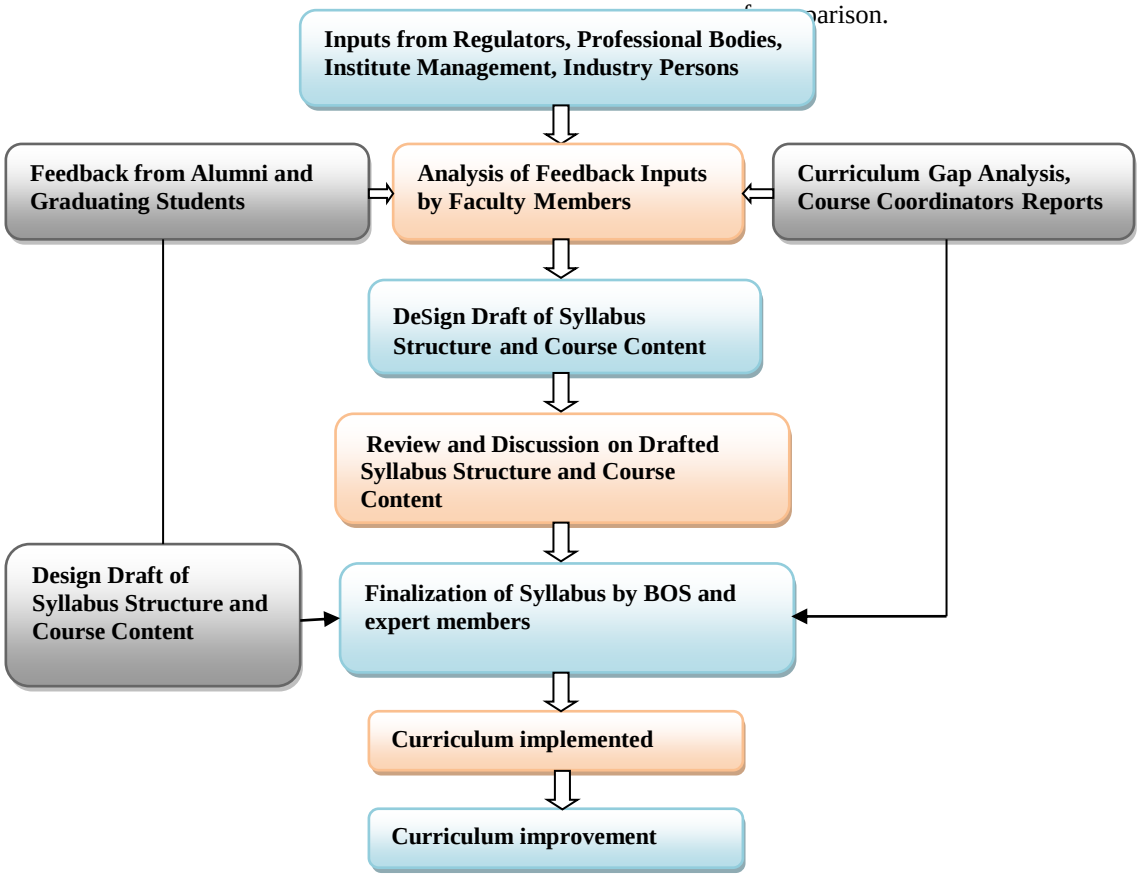

Figure 5.1: Block Diagram of Curriculum Design and Improvement Steps

5. Curriculum Design And Validation

A. Curriculum Design Process

The process steps in the design of curriculum and course contents followed for the IT B.Tech program and proposed in this paper has been depicted in Figure 5.1. It may be noted that the Graduate and Alumni survey analysis may be carried out once in 3 years after collection of sizable data. However, the feedback from existing students, their parents, and the course coordinators is a continuous feedback process for handling minor gap, inconsistency, duplications etc. and fine tuning the curriculum every year. Each revision undergoes consultation with Board of Studies experts and due approval for implementation. The inputs from regulators, management and other professional bodies and associations are based on change to environment and one need to be aware of these changes from time to time.

B. Curriculum Components for I.T Graduate Program

The existing curriculum of BPUT had an overall distribution of credits among course categories; Humanities & Social Science, Basic Science & mathematics, Engineering Science, professional Core, Professional Electives, Free Electives, Seminar, Viva Voce, Industrial Training and Project as given in Figure 5.2 along with similar distribution in the new autonomous syllabus for comparison.

Following were some of the major changes in the new autonomous syllabus based on the feedback and inputs:

(1) In the new syllabus structure the course categories are renamed as Humanities, Mathematics, Engineering Science, Core, Multidisciplinary (MD) and Elective. Course categories added were General Proficiency, Skill and Professional Development Labs (see table 5.1).

(2) In the new curriculum the credits of basic sciences and engineering sciences were reduced and the professional core and electives were increased to accommodate new courses in the Information Technology related domain as per technological change and industry demand.

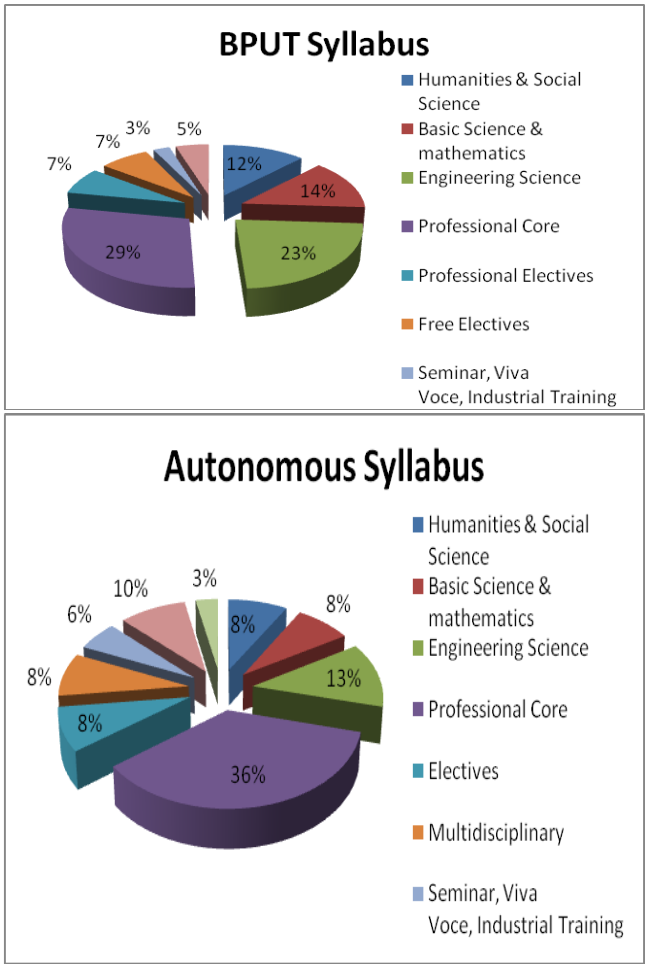

Figure 5.2: Distribution of credits among course categories for existing BPUT and new autonomous syllabus

Table 5.1: Comparison of Credit Distribution

Course Category – BPUT Curriculum	Distribution	Course Category – Autonomous Curriculum	Distribution
Humanities & Social Science	12%	Humanities & Social Science	8%
Basic Science & mathematics	14%	Basic Science & mathematics	8%
Engineering Science	23%	Engineering Science	13%
Professional Core	29%	Professional Core	36%
Professional Electives	7%	Electives	8%
Free Electives	7%	Multidisciplinary	8%
Seminar, Viva Voce, Industrial Training	2%	Seminar, Viva Voce, Industrial Training	6%
Project	5%	Project	9%
		Professional Development	3%

As a result of changes mentioned above, courses on emerging technology and industry orientation such as Cloud Computing, Big Data Analysis, Infrastructure Management, Machine Learning, Pervasive Computing, Android Programming, J2EE were added to existing courses on Data Mining, Mobile Communication, Computer Security, Digital Image Processing, Wireless Sensor Network etc.

Further the institute has now signed MOU with industry majors and set-up industry centric Special labs and Centre of Excellence (COE). As part of the MOU, the institute is able to get corporate faculty with industry experience and certifications to teach full or part of the industry oriented courses, thereby facilitating teaching learning process.

(3) In the earlier syllabus, normal programming courses (C, C++, Java, Web Technology for Internet programming) were available with labs. Only core courses like Data Structures (DS), Design and Analysis of Algorithms (DAA), Operating Systems (OS), Computer Networking, and Computer Organization had corresponding lab.

To increase the practical experience laboratory were added to all theory subjects except mathematics and few electives. Students can now practice Data Mining using R language, Machine Learning using Python, Computational Intelligence using MATLAB, Mobile Communication using Android programming, Cloud computing using VMware Virtualization etc.

(4) Skill or Professional development (SD/PD) courses added were also laboratory based providing additional hand-on experience. These are especially helpful for slow learners with lower cognitive sense, but better hands-on attitude (motor sense).

(5) To inculcate problem solving and design thinking among the students a mini project was added in semesters 1 to 5, and major project phase 1, 2 and 3 was added in semesters 6 to 8. To support project based learning, the students are also encouraged to participate in national level projects, competitions and pursue entrepreneurship ideas. The project-based training helps in better understanding of problem solving in real life.

(6) Tutorials were given for mathematical subjects and Viva Voce was added in each semester with a view to make the fundamentals strong.

(7) Each course is well defined with course objective, pre-requisite, text and reference books, and course outcomes. This helps in creating continuity between courses across the years, mapping the evaluation result with the outcomes, and measuring outcome as per NBA requirements.

(8) Each theory course has 5 sections with a self-study part, which is assessed by the trainer. Self- learning in each course develops the attitude of lifelong learning. Faculty members are encouraged to innovate teaching learning methods. Use of teaching resources from NPTEL, Spoken Tutorial, Industry Webinars, MOOC etc. is used along with trainer developed materials, quizzes, case studies, examples, tutorials and problems for effective learning.

(9) In the evaluation process, the weight given to assignments and class test was increased. The class tests are made MCQ type to make students used to competitive examinations for industry selection. Moreover, assignments provide the student a scope for self- searching, group study and problem solving.

(10) Each lab now has weight given for evaluation of experiments conducted and a test at the end. This increases the student's practice of different type of program development.

(11) To supplement the curriculum, additional skill development for certification program (CISCO, Google, CDAC, IBM etc.) is carried out which helps the fast learners and achievers.

C. Curriculum Validation

The feedback of existing students based on questionnaire was used for validating the effectiveness of the designed curriculum which is effective from the admission batch 2015. The students with admission batch 2014 and prior to 2014 were learning based on the BPUT syllabus. A total of 37 students of admission batches 2013 and 2014 participated in the feedback exercise. Figure 5.3 depicts the satisfaction levels of these 37 students for the 12 parameters in the questionnaire. Figure 5.4 and 5.5 present the satisfaction levels of the admission batches 2015 and 2016 respectively, which were on the new autonomous syllabus. The questionnaire feedback was an optional exercise for the students and a total of 22 students of 2015 and 17 students of 2016 participated. As can be observed frm the figures, these 12 parameters can be related to the attributes of some course module(s) in the curriculum based on which the students are able to provide the feedback. If one compares the feedback graphs, we find that the satisfaction levels has moved from "Good" to "very Good" and "Excellent" after the implementation of the new curriculum.

To validate it further the parent's perception while their wards are studying in the college was sought for the batches of students on the new autonomou syllabus. An online system was used to aquire the data and only 35 parents could send their response. As can be seen in the figure 5.6 the parents perception is centered around "Good" and "Very Good" although their wards have completed only 1 to 2 years in the college. This perception is expected to increase to "Excellent" by the time the students graduate.

6. Conclusion

This paper deals with the complexity and challenges of designing a suitable engineering curriculum keeping in mind the regulatory, management and other stakeholder's requirements. It has been felt that feedback from stakeholders can play a crucial role in improving the syllabus, course contents and teaching learning method. This paper suggests a suitable design of survey and feedback system for collecting the suggestions for use and benefit of course modules along with the parameters required for measuring the PO and PSO outcomes.

The collection, analysis and use of feedback from alumni, graduating students, employers/ industry experts, along with inputs from internal stakeholders and experts from BoS and AC for the B.Tech IT curriculum design under the autonomous system of C.V. Raman College of Engineering, Bhubaneswar has been presented as a case study. Moreover an innovative way of validating the changes to the syllabus has been suggested by conducting feedback survey from the existing students, their parents and faculty in a continuous manner after each year of study for obtaining the satisfaction level, problems and inconsistencies. This will facilitate minor changes for improvement in a continuous manner.

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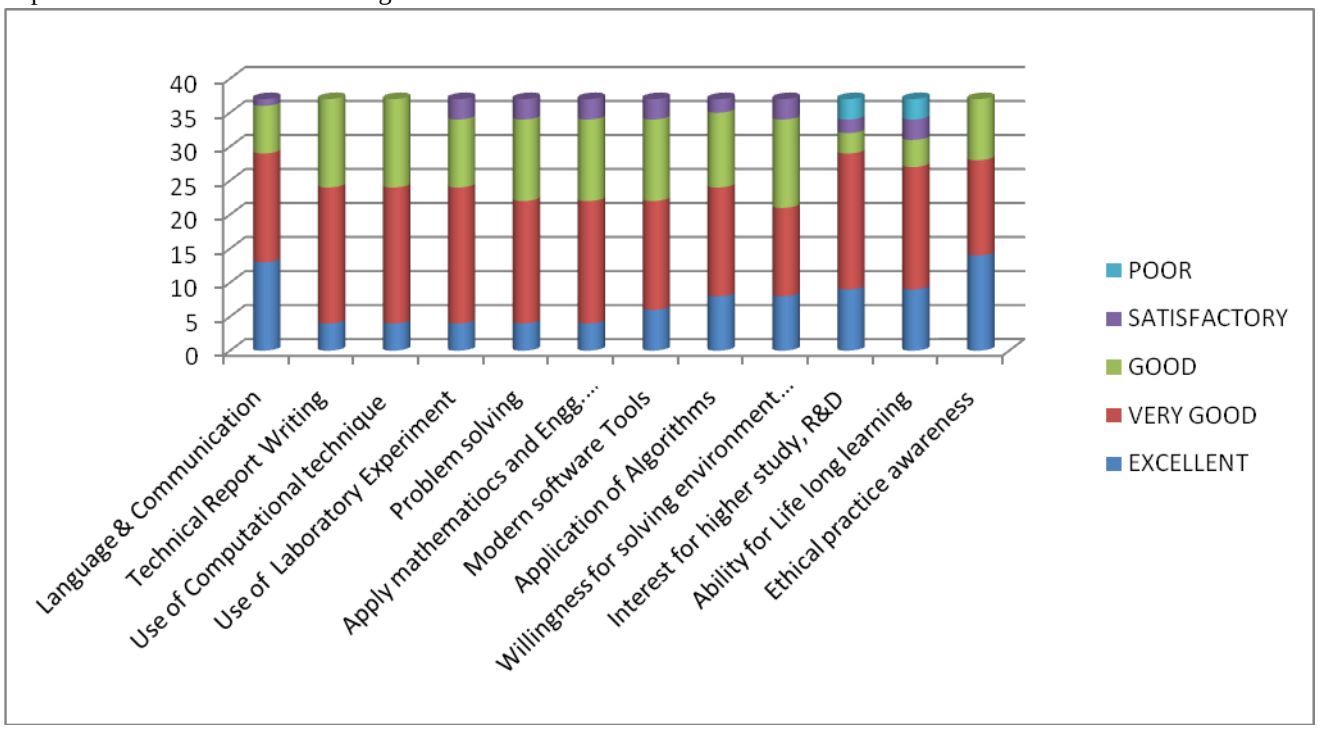


Figure 5.3 Feedback analysis of admission batches 2013 and 2014

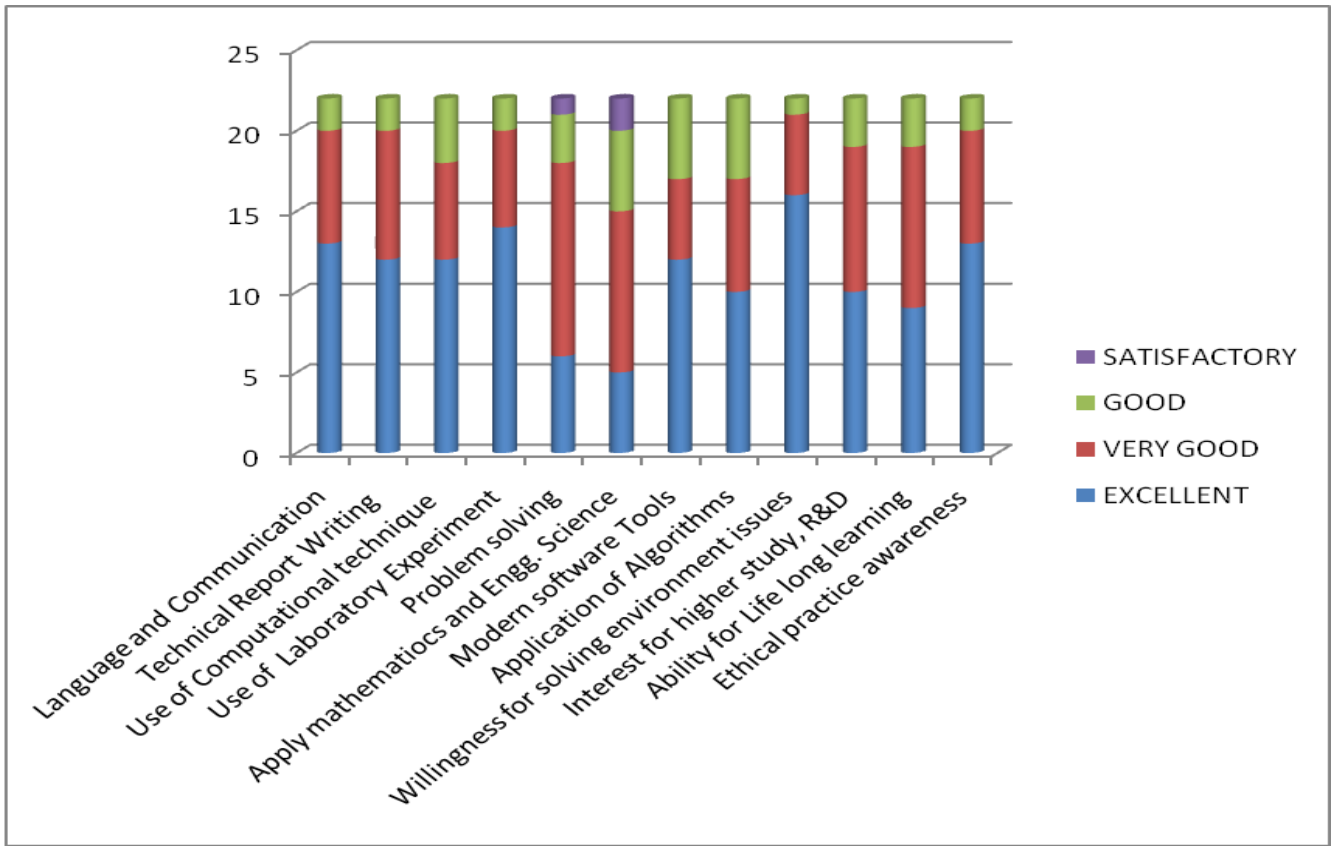
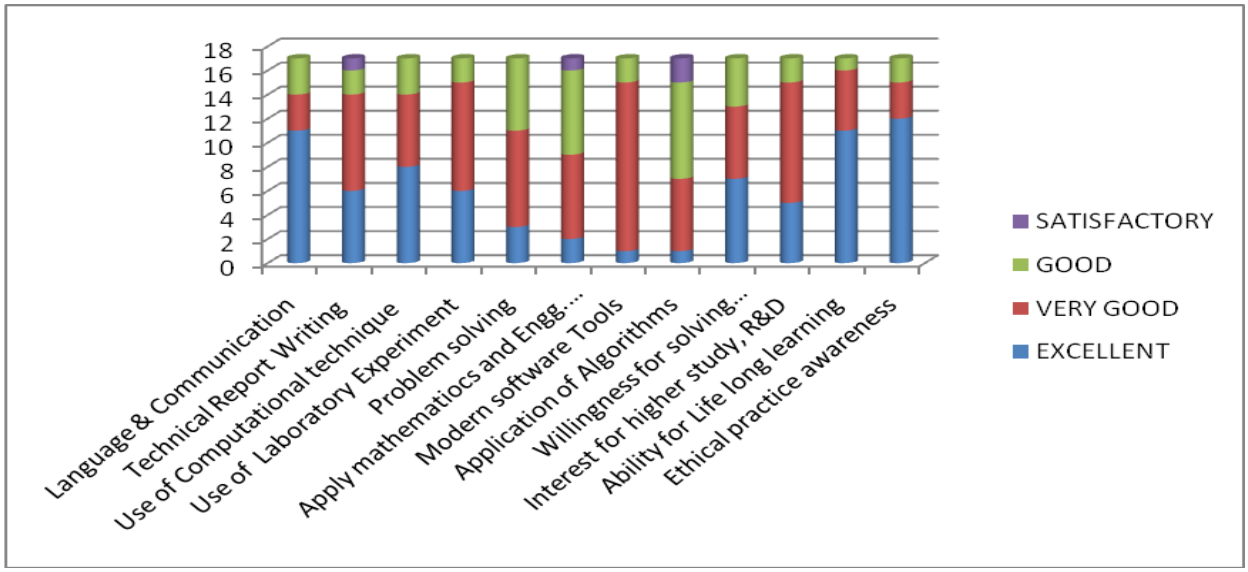


Fig.5.4 Feedback analysis of admission batch-2015



5.5 Feedback Analysis of Admission Batch 2016

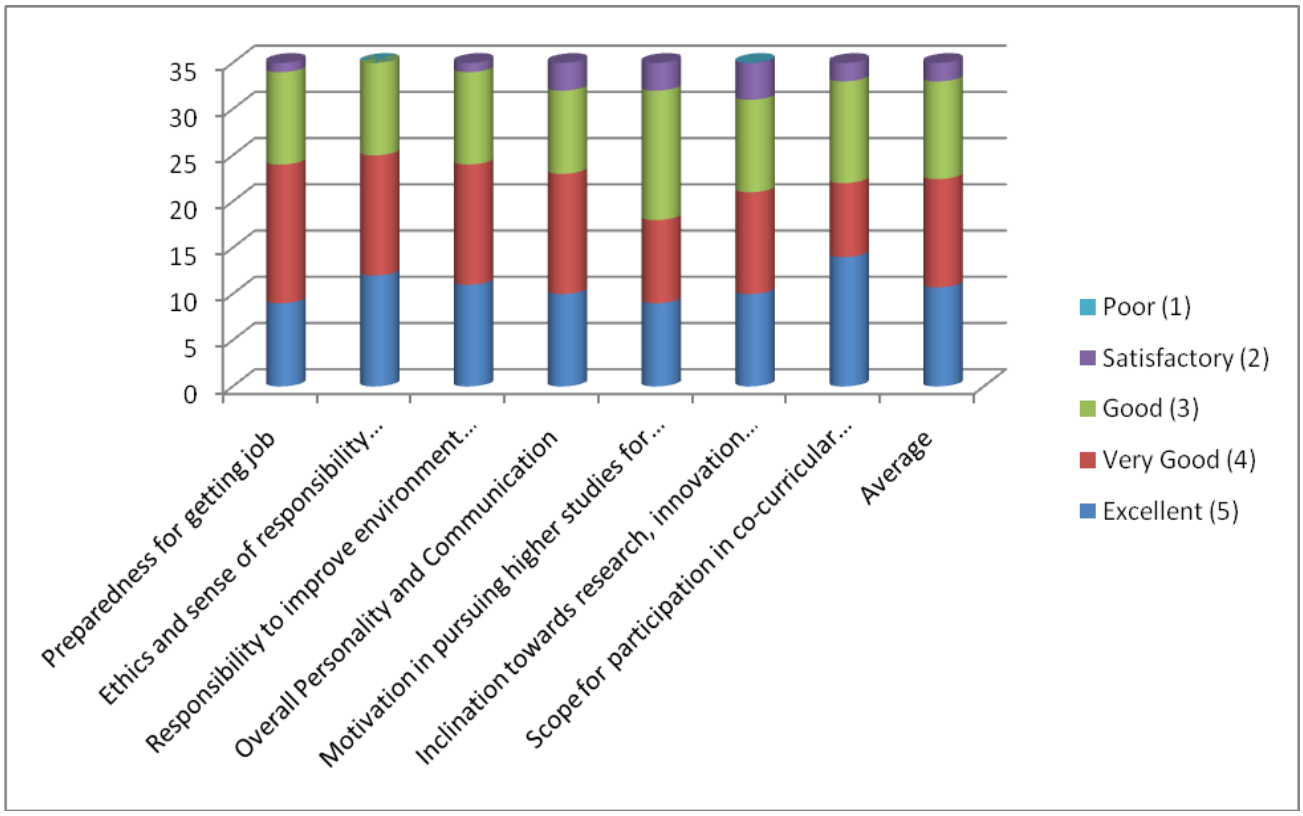


Figure 5.6 Feedback Analyses of Parents