An Integrated Technical Communication Program

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Abstract— **The Graduate Attributes defined for Outcome based Education (OBE) require a graduate student to learn the prescribed curriculum through active participation, explore the vast content and get oneself updated with the current technologies in addition to the prescribed curriculum. The state government has introduced various schemes enabling wider access to engineering education. The variety includes students from various socio economic backgrounds, students who have studied in vernacular language media, students who are not proficient in English, students who are interested but lack the required mathematical skills and aptitude, students who are uninterested but have been forced by their families, and students who do not think language is an important tool they need for learning. This diversity makes OBE a challenging task. Defining course outcomes, and mapping them to the Graduate Attributes as defined in the accreditation criteria can be done with some efforts by the teachers. But achievement of these outcomes is dependent equally on the learner's skills and attitude. One of the most important factors is the language as this helps the learners in better understanding of the subject and improves their access to good books, e-learning material and online resources. This paper presents specifically the need for a language development program for undergraduate engineering students to enable OBE. Finishing Schools and English language training are only coaching students to face the interviews, but English must be taught as a vehicle for learning the depth in the discipline. We studied the development of English for Specific Purposes (ESP), English for Speakers of Other Languages (ESOL) and similar work in other non-English speaking countries to devise an Integrated Technical Communication program to build English competency and meet the Graduate Attributes. Outcomes are defined for each semester so that by the time graduation they are able to communicate professionally.**

Keywords: Language Development; communication skills; outcome based education; Diversity; Inclusivity

I. INTRODUCTION

The *Graduate Attributes* defined for OBE require a graduate student to learn the prescribed curriculum through active participation, explore the vast electronic and non electronic content and get oneself updated with the current technologies in addition to the prescribed curriculum. *Graduate Attributes* defined by ABET [14] and NBA [15] insist on higher order thinking skills as outcomes.

The learner plays a key role in this process of achieving *Graduate Attributes*. Learner's interest, motivation to learn, understanding capability, communication, all these attributes of the learner contribute in achieving OBE. One of the most important factors affecting the understanding levels of the learner is the language. Strong language skills help the learner in better understanding of the subject and also improve the learner's access to the available resources (e-learning material, online resources, and any other sources of learning material).

Learning and then using the language to understand technical content, communicate ideas effectively, present technical content both orally and in written form, all these form the basis for an engineer to reach the global standards needed.

A survey on Employability and Skill Set of Newly Graduated Engineers in India [2] presents that skill shortage remains one of the major constraints to continued growth of the Indian economy. The National Skill Development Corporation of India in its survey [17] also states that there is a huge short supply of skilled personnel, as most of the graduates are not able to meet the standards.

This paper presents the language development programs in a college affiliated to a state university. In this case, the designing of the curriculum and end semester assessments are done by the affiliating university.

Section II discusses about the inclusivity and diversity initiatives in India and describes the diversity in the learners group. Teaching English not just as an employability factor but its importance in achieving *Graduate Attributes* is presented in Section III. Previous work on language development programs for engineering education is covered in section IV. Section V describes the current scenario of student intake at the institute and their capabilities. Our approach for engineering communication skills is presented in section VI. Section VII presents the implementation process to be followed by the technical faculty. Concluding discussion is presented in section VIII.

II. INCLUSIVITY AND DIVERSITY

Opening up of higher education to a wider range of the society by providing inclusivity based on various socio-economic factors and even gender, has created a huge diversity in the engineering education sector in India. According to Wikipedia page on Engineering Education, in total more than 5000 universities and colleges offer engineering courses in India.

Admission process into Engineering courses specifically in our state has various provisions and reservations and hence the diversity in the incoming students.

The variety includes students from various socio economic backgrounds, students who have studied in vernacular language mediums, students who are not proficient in English, students who show interest to learn, students who are interested but lack the required mathematical skills and aptitude, students who are uninterested but have been forced by their families, and students who do not think language is an important tool they need for learning.

This diversity resulted in a varied group which consists of students with various levels of capabilities, both in understanding and also in communication. With this kind of inclusivity and diversity, achieving *Graduate Attributes* is certainly a challenge.

III.   ROLE OF ENGLISH IN GRADUATE ATTRIBUTES

English Language Teaching (ELT) received lot of attention with the development of science and technology and emergence of English speaking countries as leaders in these areas. Owing to the internationalization of education, English has gained prominence as the communicating language in most of the countries.

ELT branched into several specialized needs, a significant one being English for Speakers of Other Languages (ESOL). ESOL specifically addresses the difficulties of students who have learned a non-English language first. Learners of English make mistakes of syntax, pronunciation and vocabulary due to the influence of the non-English language they have learnt first. Universities and Industries look for qualifying scores in standardized tests for ESOL in their applications from non-English speaking countries. The large scale globalization of education and a huge migration for employment and the cross cultural work teams, contributed to these requirements [5]. India jumped onto this wagon with opening of its own economy in 1991.

Hutchinson and Waters [7] define English for Special Purposes (ESP) as an approach rather than a product – meaning that ESP does not involve a particular kind of language, teaching material or methodology. The basic question of ESP is: Why does this learner need to learn a foreign language? The purpose of learning English became the core. ESP is traditionally divided into EAP (English for academic purposes) and EOP (English for occupational purposes). The positive effect of ESP programs on the students' achievement in English has been studied in [9].

English for Specific Purpose (ESP) is more an interdisciplinary approach and needs support from domain specialists as well as linguists [10]. The focus in ESP is on learning the usage of English for specific professional scenarios [7]. This is the approach needed to be adopted for teaching English in engineering curricula.

In our case, the *Graduate Attributes (GA)* [14] prescribed by NBA[15] provide a basis for these scenarios.

- GA**(10)**: Communicate effectively **on complex engineering activities** with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

This is a direct requirement. But other attributes indirectly refer to a high level of proficiency in professional English

- **GA(1):** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization (branch) to the solution of **complex engineering problems.**
- **GA(2):** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **GA(12):** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Our basic challenge is that achievement of GA(1) and GA(2) assumes proficiency in English, which is not valid for students coming from diverse backgrounds. When a large number of engineering graduates were not found to be ‚employable', one of the reasons the NASSCOM [16] attributed to this was poor communication and soft skills. Unfortunately, this report gave birth to a number of ‚trainers' who focused attention on teaching English for cracking the selection process (interview skills, group discussions and resume writing) rather than on building the core competency of the graduate.

However, we are not alone in these challenges. Concerted efforts have been done elsewhere in building a truly integrated ESP curriculum [8,9,10,12,13].

Student diversity is not the only challenge in this situation. Faculty needs to be competent in both their discipline and English and be open to ‚team teaching', for effective delivery of this curriculum. Since the faculty's competence in English is also limited, they are unable to pay attention to this aspect in their teaching.

Our institute is trying to achieve OBE by concentrating on this basic foundation of the language component and technical communication in the process of preparing better engineers.

IV. EXISTING WORK

We briefly mention here on work elsewhere on professional communication skills. [13] and [1] discuss the importance of English as a communicating language and the difficulties faced by the people of non English speaking nations. Marc J. Riemer [10] investigates into the development of English and communication skills and proposes a research scheme for implementation. Dorthy Missingham [5] does a comparative study of various studies conducted on the role and importance of communicative competence in engineering education. R.Manseur, et al [8] discuss about embedding communication skills in the curriculum by changing the assessment methods in order to meet the ABET criteria of *Graduate Attributes* involving communication skills. Their study was confined to two branches of engineering. Leitch [9] examined the possible inclusion of communication instruction in the assessment process. Another work [12] discusses different types of soft skills, Work Integrated Learning practice at their department and how the mentors can contribute to imparting of soft skills to students and proposes teaching and mentorship styles required the in various stages of student Work Integrated Learning.

V. CURRENT SCENARIO

This paper studies the Integrated Technical Communication (ITC) program in Nalla Malla Reddy Engineering College which is affiliated to JNTU Hyderabad.

It has been observed that about 40% of the students in each class are from non English medium schools, or have a very weak foundation in English language.

The current curriculum includes a basic English language course in the first year, with a lab for communication skills concentrating basically on the speaking and writing skills of the student. This course is followed by an Advanced English communication skills lab in the third year where the student gets trained in group discussions, just a minute sessions, and interview skills.

In spite of taking up these courses, the students are found to be lacking in communication skills when tested. The courses in English language are treated as merely courses without applying the content to other engineering subjects. The students' focus at this stage is usually getting a job and not to start learning language from the beginning (say learning grammar). They expect quick fix solutions such as - a one week course which after attending one becomes proficient in communication skills and gets a job!

The college has a good national newspaper subscription for each student and the student writes a reflective report on this activity at the end of the year. As a matter of routine, letters written by the students for various requests are also checked and returned to students for corrections.

VI. ENGINEERING COMMUNICATION SKILLS: OUR APPROACH

We have devised a fully *Integrated Technical Communication* (ITC) program in addition to the English courses which are part of the regular curriculum. The purpose of this ITC is to enable students to integrate Listening, Speaking, Reading and Writing (LSRW) in technical subjects and to also build specific skills like writing analytical reports, understanding technical manuals, researching and compiling information.

The outcomes from each year's ITC curriculum are listed in the Fig 1. The teacher's manual for the ITC has been prepared giving guidelines to the activities and resources. We briefly outline the gist of the pedagogy and content of each year.

eBridge (employability bridge) is a related event that is conducted fortnightly to train students on these skills. There are four parts in eBridge: Group Discussion, Debate, 2-minute elevator pitch and Case Study Presentation, all on contemporary technical topics. Sample videos and instructions help students prepare to participate. Faculty and students also have a rubric for assessment of each event.

The language development program for each level of students starting from the first year of engineering to the final year of engineering is described in this section. The language development program combined with a mechanism to be implemented by the technical faculty constitutes the *Integrated Technical Communication* Program.

A. First Year

In the first year, students have a lively activity on the usage of different types of dictionaries and thesaurus. They also have a few sessions on relative clauses, subordinate clauses and parallelism, which enable them to write technical instructions and analytical reports. This is also followed by activities where students follow instructions from a technical manual to do a task; they write instructions for a task they performed and they compare these writings with each other.

Summaries and note taking are practiced with selected videos, and these notes are compared with peers. We are making sure that English is put in the context of their technical learning and that there is a lot of paired and team work.

Along with these classes, students are encouraged in their departments to use good text books and make summaries instead of depending on model solutions to questions. They also make vocabulary charts for the technical terms they learn.

B. Second Year

By the end of the first year, students will be ready to do a little more advanced writing and reading. Having acquired tools for

comprehension, they must now practice analytical thinking – moving up the Bloom's [4] ladder. They are taught mind mapping and other graphic organizers to arrange their understanding in the form of cause-effect, compare-contrast and whole-part. They are also equipped with skills to design and conduct experiments with the help of pre-lab activities to think of alternate ways of learning the concept.

They are now expected to start writing summaries from multiple sources of information and are taught the concepts of conciseness and coherence.

A fortnightly event **eBridge** is conducted for students to practice and to showcase these skills to their peers. At this point, students are able to participate in debates and group discussions on technical topics.

C. Third Year

By this time, students have developed a taste for their technical stream and can now be exposed to creative thinking. They are assigned an invention and asked to write a short report on the invention and the inventor and how it was invented. They are also asked to find their career options and make a short presentation on what they would choose based on their specific strengths and interests.

This year, they can participate in 2-minute elevator pitch and case study presentation in the **eBridge** event.

D. Fourth Year

This is the final year of the program, and students must be prepared to write their project dissertation and also to face interviews for jobs. Those who want to pursue master's programs must be able to write their statement of purpose. We train them on resume writing and conduct mock interviews.

From the technical perspective, they are coached to write a technical paper, design handouts for a 30 minute team presentation, and reflect on various team activities that are performed.

VII. THE ROLE OF TECHNICAL FACULTY IN IMPLEMENATTION OF THE PROGRAM

The faculty of the English department are able to give inputs on the language aspect and they do activities that involve general topics. However, the whole purpose of this program is to give technical communication skills. For this to happen, we have prepared a plan for the technical faculty. In our college, a mentor is attached to about 15 students for the entire duration of the program. A class is also allotted in the time-table for mentoring, where the mentor is expected to mentor the student. This time is available for a mentor to specifically concentrate on his/her 15 students (mentees).

It has been decided to use this slot to transfer skills learnt in English classes to the technical domain. Every other week,
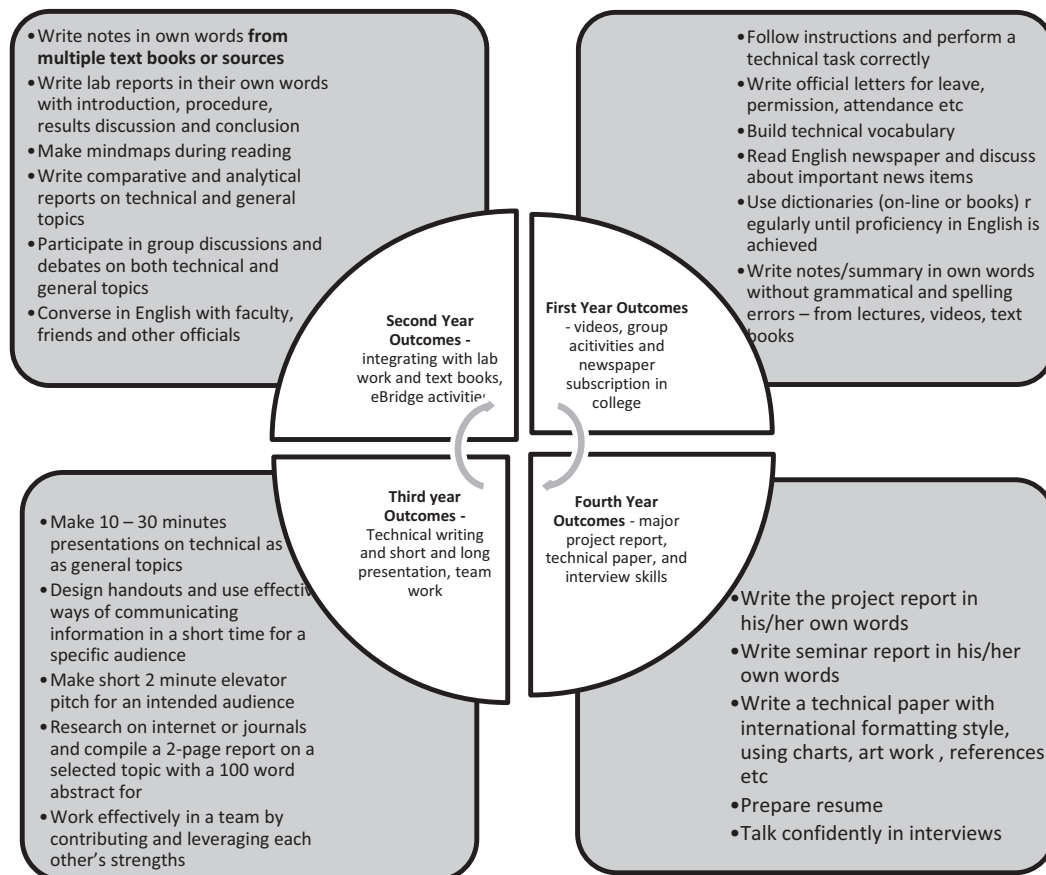

- Write notes in own words **from multiple text books or sources**
- Write lab reports in their own words with introduction, procedure, results discussion and conclusion
- Make mindmaps during reading
- Write comparative and analytical reports on technical and general topics
- Participate in group discussions and debates on both technical and general topics
- Converse in English with faculty, friends and other officials

Second Year Outcomes - integrating with lab work and text books, eBridge activities

- Follow instructions and perform a technical task correctly
- Write official letters for leave, permission, attendance etc
- Build technical vocabulary
- Read English newspaper and discuss about important news items
- Use dictionaries (on-line or books) r egularly until proficiency in English is achieved
- Write notes/summary in own words without grammatical and spelling errors – from lectures, videos, text books

First Year Outcomes - videos, group acitivities and newspaper subscription in college

Third year Outcomes - Technical writing and short and long presentation, team work

- Make 10 – 30 minutes presentations on technical as as general topics
- Design handouts and use effecti ways of communicating information in a short time for a specific audience
- Make short 2 minute elevator pitch for an intended audience
- Research on internet or journals and compile a 2-page report on a selected topic with a 100 word abstract for
- Work effectively in a team by contributing and leveraging each other's strengths

Fourth Year Outcomes - major project report, technical paper, and interview skills

- Write the project report in his/her own words
- Write seminar report in his/her own words
- Write a technical paper with international formatting style, using charts, art work , references etc
- Prepare resume
- Talk confidently in interviews

Fig 1: Outcomes from Integrated Technical Communication (ITC) Program

students are also provided with a „library' hour so that required reading of the technical material can be done.

These mentoring sessions start with a SWOT analysis by the students, followed by goal setting and implementation plan. The students are also asked to survey career options and skills needed and identify their career choices.

Students are given tasks such as the following:
- Pick your favorite book from library and write a paragraph about what the book is about and why you like that book.
- Explore and identify some sample data sets for analysis - Prepare one data analytics report
- Write Reflective Reports on
  a. Activities during this course (ITC program and Library)
  b. Learning in other courses
- Take newspaper articles and make mind maps
- Prepare Vocabulary Cards for all the new technical content learnt this semester (Vocabulary Card consists of a word along with the meaning, usage, application, pictures, etc. in their own words)
- Students in groups of 5 write summary of a topic from any textbook or magazine (which the student is supposed to get to the class or the faculty may provide them with), and compare with group members.

Mentors facilitate these sessions, and enable the students to use their language skills learnt during the language development classes. The reports written by the students are corrected by the mentors who are technical faculty, and are finally documented in the learning portfolios of the students.

These activities serve to set the context for the ITC and also see value in the mentoring classes.

VIII. CONCLUSIONS AND DISCUSSION

We have commenced this program this academic year by training faculty and giving them the agenda. We are in the process of collecting assessment and feedback data. Preliminary informal feedback shows that students have found the mentoring classes useful.

The eBridge event was started as a pilot in Jan 2014 only for CSE/IT students but based on a very positive response from students it is extended to all branches and all years. This event is also managed by students with the help of a faculty coordinator. These activities are helping students to open up and we have observed that students now need to be taught how to prepare for discussions, debates and seminars. They don't have the depth required for sustaining a discussion. These

insights are shared with the students through discussions and online forums.

Setting up of a monitoring process to check if all the students are participating in these sessions and whether the mentors are effectively executing the program is the next thing to be done.

In this paper, we have discussed about the importance of language development in engineering education and have proposed a comprehensive program to improve language skills and hence meet the Graduate Attributes defined by NBA.

This proposal was designed specifically for an affiliated college in India, where the standards of incoming students are diverse. With a diverse group of input, incorporating the language development component into most of the regular activities of the student seems to have shown an improvement in the overall employability levels of the graduates. This program can be used in any college in India since the student demography is similar.

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