

# Reforming Engineering Education for Innovation Research and Development to achieve Academic Excellence

<sup>1</sup> Geet Sandhu

<sup>1</sup>Assistant Professor

<sup>1</sup>Amity School of Engineering & Technology

<sup>1</sup>Amity University Haryana, Haryana, India

**Abstract** – Engineering education needs to be tailored to suit the current industry trends. Industry sustainability of learners can be achieved if the present education system is revolutionized from its conventional tutoring mechanism to research and innovation driven academic framework. This shift will make learning application oriented and dynamic. The paper suggests the need to reform engineering education to achieve academic excellence to cater to innovation, cutting-edge research and development. A cross disciplinary academic framework has been suggested in this regard. Some observations on this subject are also discussed.

**IndexTerms** – Cross disciplinary education, academic excellence, Research & Innovation

## I. INTRODUCTION

Engineering education is the mainstay for popularizing Research & Development. The main task is to promote application-oriented and compound engineering and technical human resources to meet needs of financially viable expansion [1]. This requires higher engineering quality learning. It is important to build an environment that develops academic excellence. It fosters students build self esteem, competency, and elasticity and saleable and viable skills through education experience which would uphold them in the global market. The need of the hour is to reinforce research and innovative practices in engineering education. Much of the work has to be done in this regard. Activities like Academic Excellence Workshops [2] help to move away from traditional tutoring to a potential curriculum integration in future, as well as for team participation of students in industry. There is a gradual shift from conventional approach of learning to a more industry oriented learning which has made research study an integral part of the academic framework in engineering education. Culture of continuing academic excellence should be observed at organization level itself. Excellence in engineering education is defined in terms of perspectives of teacher, student, employer, community and professional engineering bodies [3]. Hence all the stakeholders play a key role in restructuring engineering education to make it research and goal driven. A knowledge based society is created only when its educational bodies are devoted to provide higher education rooted to research and innovation. Academic research standards should be prioritized [4]. Reformation of academic structure such that it holds up the research standards and current industry trends is need of the hour.

The paper focuses on the need of reorganization of conventional academic framework to research oriented cross disciplinary academic framework in engineering education. The research paper is divided into five sections. The first section discusses some related work done by other researchers on this subject. The second section presents discussion and observations of the work proposed by other scholars and researchers. It also highlights some of the useful concepts in this regard. Section three suggests an academic framework which is cross disciplinary and blended in nature. Fourth and Fifth section concludes the theme of reforming academic framework for research and innovation in engineering education highlighting scope of future work in this area.

## II. RELATED WORK

Kerns[5] described **Academic Excellence** in terms of intersection of business practices, intellectual contributions and teaching. The author proposes a framework addressing these three spheres of achieving academic excellence in the field of education. The research work undertaken is a reflection of relevance and impact dynamics affecting learner's professional life.

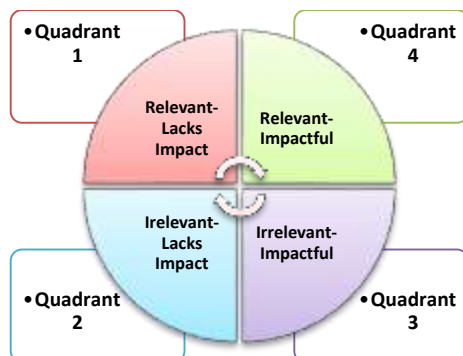


Figure. 1. Relevance-Impact Dynamics [5]

**Relevance** is defined in terms of learner’s perception of usefulness of content and process of imparting educational experience to the real world of work. The author describes **Impact** as the learner’s assessment of application of learning experience in the real world environment. The Relevance-Impact dynamics was divided into four quadrants mainly – Quadrant 1: **Relevant-Lacks Impact** i.e Content & Process is useful but the learner is unable to transfer the framework and tools into practice, Quadrant 2: **Irrelevant-Lacks Impact** where the author talks about lack of applicability of learning into real world and the content and process also bears no relevance, Quadrant 3: **Irrelevant-Impactful** whereby learning experience finds a way to be put into practice but the process is largely irrelevant and transferrable to practical use by the learner’s. Hence according to the author, Academic Excellence can be achieved if the teaching-learning approach reaches Quadrant 4: **Relevant-Impactful** learning experience.

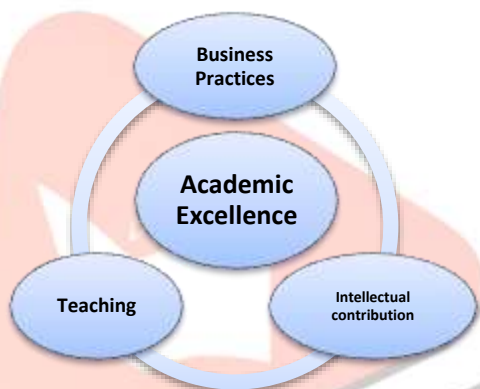


Figure.2. Pillars of Academic Excellence [5]

The author also proposed an integrated framework for enhancing Academic Excellence in terms of Business Practices/Connection, Intellectual contribution and Teaching adopted. The framework aided academicians and business practitioners to align with the above parameters or sphere of influence governing academic excellence.

Liang et.al [6] suggests that Information is not Implementation and further compares the fidelity theory of education with the actual implementation. Conventionally, Fidelity theory following an explicit decision making model. The researchers identified that critical factors such as program content, duration, frequency of delivery and interactive affect the learning outcome of any educational experience and must be well developed. The authors[6] conceptualized and featured the assessment for learning model along with blended learning approach in the form of a ‘Formative Instructional Practices (FIP) professional development (PD) program in various states of U.S.

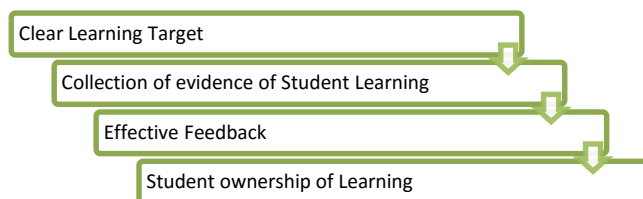


Figure. 3. FIP PD Learning Feedback model [6]

Central to the model was emphasis on clear learning targets, ongoing collection of evidence of student learning, providing effective feedback and fostering the ability of students to take ownership of their learning. The research address a primary goals of identifying programmatic factors that affected fidelity to learning and teacher’s perception on the support provided by educational institutions to ensure fidelity of implementation and not just information in a leaning environment.

Lynch [7] et.al in his work has endorsed a gradual shift from vertical to networked integration as the current industry trend. The problem does not lie in the integration but its virtual aspects of monolithic, hierarchy and centralization. The need of the hour is a

more dynamic approach of network integration in academic excellence. It enables delivering of core competencies supported by value aided competencies.

Smith [8] et.al suggested an integrated IT curriculum model for advancing education which recognizes that significance of changing attitude towards essentials for curriculum modeling besides changing practices in the current innovation driven social, historical and political framework of learning. The authors proposed a MTC model (Managerial, technical and communication skills) for integrated learning which combines hard skills with soft skills, emphasizing quantitative research besides qualitative research and endorsing creative thinking with critical thinking.

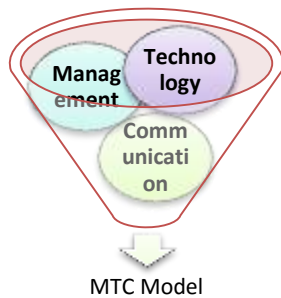


Figure 4. Components of MTC model [8]

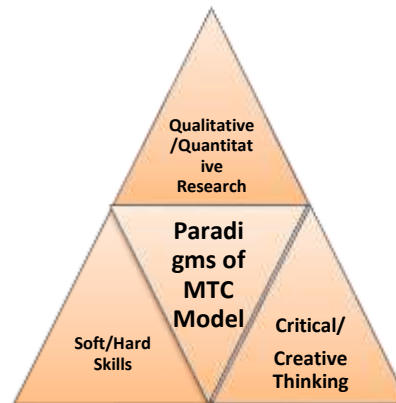


Figure 5. FIP PD Components of MTC model [8]

Endorsing the same Puri et.al [9] in his research work analyzed the impact of student learning by enhancing business education using an integrated curriculum. He devised a COMCORE program that replaced six core courses were replaced with one year integrated program. The author assessed the degree to which students acquired knowledge when content area were integrated, degree of knowledge acquisition across the content areas, the students overall assessments of the integrated curriculum and the readiness to compete with the fellow students trained in traditional courses. The survey reflected very positive results for integrated curriculum than its traditional counterpart.

### III. DISCUSSION AND OBSERVATIONS

Although an integrated framework for academic excellence have been proposed in past and also discussed in the previous section, however it caters to only Business practices/connections, Intellectual contributions and teaching adopted[5]. This framework can serve as a benchmark for collaborative curriculum design for engineering domain as well. It aided academicians align with the above parameters or sphere of business practitioners of influence governing academic excellence. The implication in this framework could be degree of learner's awareness about relevance of the topic being covered in the course curriculum. Another major factor which can be of influence is the faculty member's credibility as a resource for impactful contribution to learning environment. Another matter of concern is that whether a framework like this is able to generate intellectual contributions by the learner's or not. This clearly reflects the need to bridge gap between academicians and business practices and operationalize academic excellence in the learning environment using integrated approach.

Instructional practices used in the learning environment may have many practical implications especially inconsistencies and uneven implementation with respect to Inputs. Instructional models should provide clear understanding of objective of program corresponding to the model to its stakeholders. The instructional model can be underscored practically if it is not supported by the management in terms of funding, and other areas of interest. The FIP PD model [6] discussed in the previous section was perceived irrelevant and needless by the stakeholders involved in the learning environment because of the above shortcomings.

The concept of gradual shift from vertical Integration to Network Integration is noteworthy as projected earlier [7]. This approach if implemented in academic framework can result in academic excellence providing students a holistic perspective of learning. This pushes to rethink and redesign the traditional program structure of Engineering education. The need of the hour is to make engineering education more flexible and result oriented. A more flexible and dynamic model of program curriculum may be designed which promotes cross program education, allowing students study courses cutting across disciplines. This would open grounds to innovations and encourage students to take up demonstrative research. A multidisciplinary approach in today's scenario becomes the best practice to achieve academic excellence.

Amalgamating Managerial (M), Technical(T) and Communication skills (C) is a good practice to enlarge perspective thinking of engineering students encouraging holistic learning. Thorough this type of MTC Model[8], a student can make its space in ever-growing and challenging global marketplace. This concept can be taken one step further by incorporating Research study and Industry connect programs to help foster innovative ideas meeting market trends and expectations.

### IV. SUGGESTED ACADEMIC FRAMEWORK

For reforming engineering, we need to reform the present academic framework. The framework should promote cross disciplinary education such that it opens horizons of students resulting cultivate innovative ideas and bringing into practical implementation. Cross disciplinary education themes around students having flexibility to choose a course across disciplines. For example, a student pursuing Bachelors of Technology in Computer Science Engineering can choose a course other than computer science engineering but maybe a course in Electronics and Communication such as Embedded Systems. So it gives students freedom of designing its

own degree based on its academic and research interest. This flexible framework can certainly make a path for cutting –edge research as now the student have learning of both subjects which can make him open to more ideas and bringing those ideas to practical implementation based on his own interest. Taking the same example once again, through this academic framework a student of Computer science Engineering learning Artificial Intelligence can now implement it using the practical aspects of Embedded systems which he opted from a non-computer science engineering domain

### Objectives

- To make student Industry ready through its broad and application oriented approach
- Strength building in the area of research interest other than core functional area.
- Widening student’s perspective through multi-disciplinary learning environment.

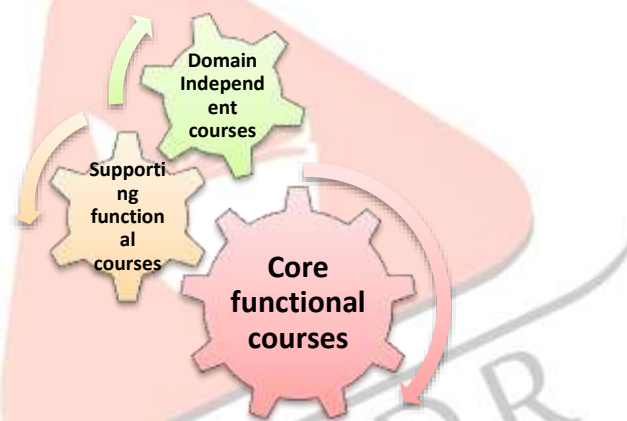
The cross disciplinary education framework has paired vertical and network integration to come up with a more flexible and hybrid approach. The academic framework may be divided into three parts:

- a) Domain Specific / Core Functional Courses
- b) Supporting Functional Courses
- c) Domain Independent Courses

The Core Functional courses are domain specific and mandatory. For example, For Bachelors of Technology in Computer Science Engineering, the core courses are central to its own domain of computer science i.e Operating System, Artificial Intelligence, Network Security etc.

Supporting Functional courses includes those courses which substantiate the core functional courses and helps give a deeper understanding of the subject. This would be choice based but related to key functional area. For example, advance level courses, certifications, projects, industry connect programs etc.

Domain Independent Courses are those courses that are not directly related to the core functional area but opted by the student as per interest. For example, A student of Bachelors of Technology in Computer Science Engineering may opt to learn a particular course such as AUTOCAD of mechanical engineering or architecture. This is also choice based.



**Figure. 6. Cross disciplinary academic framework**

Such type of learning environment will give a holistic perspective to take up demonstrative research and cultivate innovative thinking.

### V. CONCLUSION

To achieve academic excellence in engineering Studies, the education system for learner’s should be capable to provide holistic learning environment. It is important to nurture innovative thinking in students so that they can put these ideas into practice and manifest research into practicality. For this, the present engineering academic framework needs a transformation to traditional theory type learning to research oriented application based learning. To achieve this, a cross discipline approach in terms of providing cross program education has been suggested. This framework would help students to inculcate best practices to motivate students to make intellectual contributions in the area of research and development.

### VI. FUTURE SCOPE

An interdisciplinary approach which also amalgamates business education can be enthused. The model can be extended to other domains besides engineering. Cross program education can be expanded to introduce non engineering subjects aswell. The assessment of the model can be done on the basis of Relevance and Impact to the learner. Practical implementation of the model can be done in future.

### VII. ACKNOWLEDGMENT

I extend my sincere thank you to all students and colleagues who have been helping me thorough in this research work.

**VIII. REFERENCES**

- [1] H.Cai, Y.li, “Notice of Retraction The analysis and research on young teacher’s engineering continuing education in the local engineering colleges,”IEEE-International Conference on Education and Information Technology ,vol.2,17-19<sup>th</sup> September,2010.
- [2] Anderson-Rowland ,Mc Cartney, Reyes, “Academic excellence for minority engineering students,”IEEE- Proceedings of Frontiers in Education Conference,vol.1,1-4<sup>th</sup> November,1995.
- [3] Shanableh, M. Omar , B. Younes ,S. Barakat, “ Perception on effective engineering,”IEEE- Annual Frontiers in Education Conference,vol.3,3-5<sup>th</sup> November,2003.
- [4] L. Szentirmai, L. Radács, “Improvement of academic and research standards of higher engineering education in light of bologna process” , IEEE- International Conference on Emerging eLearning Technologies & Applications,pp 381-387,8-9<sup>th</sup> November,2012.
- [5] Charles D. Kerns, “ Striving for academic excellence in business education: An integrated framework,” The business Renaissance Quarterly: Enhancing the quality of life at work.
- [6] X. Liang,Linda Collins, Sharon Kruse, Lisa Lenhart, “ Information is not implementation: Fidelity to a statewide professional development plan”, Academy of Educational Leadership Journal, Vol. 19, No. 3, 2015.
- [7] Robert Poter Lynch, Ian Somerville, “ The shift from vertical to networked integration, part 1”, NCBI, May,1996.
- [8] Lola B. Smith, C. Steven, Rik Berry, Darla Hunt, “ An integrated IT curriculum model for advancing education in information technologies, learning, and performance”, Information Technology, Learning, and Performance Journal, vol.22,no. 3,2007.
- [9] Yash R. Puri, Brenda Jocums, Saira Latif, “ Enhancing business education using an integrated curriculum: The impact on student learning”, Journal of the Academy of Business Education, Spring 2010.

