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Nurturing Engineering Skills and Talents, a disruptive methodology in Engineering Education

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Abstract

Engineering education is passing through a paradigm shift in teaching millennials. Sage on stage is replaced with facilitator by the side to have an effective teaching learning process. This paper concentrates on the physical, emotional and intellectual quotient (PQ+EQ+IQ) of the students to impart a holistic learning. Nurturing Engineering Skills and Talents (NEST) brings in the concept for which a survey with considerable candidates from various geographic location, gender and family backgrounds are considered. Nurturing Existing Skills and Talents, learners are to be provided with a nurturing, caring and protected environment where their emotional needs are met. Instead of one cap fits all method a highly flexible course system where Inter and Trans Disciplinary (ITD) approach is to be adopted. Skill sets of the learners are to be identified scientifically and to be groomed. NEST also brings in Nurturing Engineering/Enhancing Skills and Talents in the learners. Experiential learning is to be introduced into every course so that any technology that is considered as distraction could be changed to a disruptive one to improve teaching learning process.

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1. Introduction

Globalization has opened up the economy to global players in the industry and service sectors. They have set up manufacturing facilities and service organizations with the state of the art, technologies, and marketing techniques. To keep pace with their developments, the products coming out of technological institutions should be capable of meeting the challenges of the modern industry. They should be up to date in their technical know-how. They need to have the willingness and capability to learn new things, as and when they come across, and have in this era of globalization a deep sense of quality, work ethics and motivation. With the influence of globalization and radical digital technology, the learning methods of the students have disrupted.

2. Literature Survey

Petridis et.al in his research work on emotional intelligence as personality has focussed on the role of EQ in education. [1] He has summarised the effect of traits of emotional intelligence on academic performance and related variable across primary, secondary and tertiary education. He has also shown evidence of lasting advantages for learners and learning centres. Maria Fuchsova, in his studies has highlighted that the augmented reality (AR) is the supplementation of the reality presumed by the user with virtual elements [2]. It also elucidates that the mobile AR technology application allows the work of education more effective. He has concluded that the use of AR has made the learner understanding deeper, motivation greater and creativity stronger. The digital technology seemed to structure cognitive schemes in a way that would be unfamiliar to students of previous decades.

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Cynthia has developed Just in Time Teaching (JITT) as a learning strategy to promote active learning [3]. Gregor et. al, have developed a feedback loop between web-based learning materials and class room. [4] This technology provides structured opportunities for learners to construct new knowledge from prior knowledge. The results of his studies showed an increase in attitudinal and cognitive learning. The success is due to the three factors namely increase in quality and quantity of student interaction, student and teacher interaction and student study outside the class.

According to Novak Education as a service model (EaaS) is proposed in which students get what they need when they need it. [5] YearUP is a Boston based not for profit organisation that provides JIT path way to a professional carrier and under privileged students. This program provides 21 weeks education program in functions like IT, Operations and Finances, Sales and Marketing and customer service with 26 weeks internship at employer partners. The US department of education is well ahead of other universities and colleges in rearranging the potential of JIT in education. Kin Wai [6] has focussed on creative thinking, critical thinking and analysis with 8 Components of learning namely, Competent, Comprehensive, Compulsory, Critical, Creative, Curious, Collaborative and Continuous.

3.NEST Model

NEST disruptive technology is a model which is an emulation of the nest of a crow where the cuckoo bird lays its eggs as a parasite. The crow gives the warmth to the egg of the cuckoo bird and it hatches and is nurtured by the crow. This care is given until the little cuckoo bird grows, learns to fly and is becoming independent. The little cuckoo bird is nurtured and its skills enhance to face its future challenges. In the similar way the students are nurtured and their skills enhanced through the NEST model. Like the baby birds open their mouth for food, a desire and a deep passion is created in this new learning atmosphere to enhance the life skills to face the challenges at the global level and to be independent. Students are not confined to the traditional classrooms. The learning takes place in the natural setup and in a phase that depends on the PQ+IQ+EQ level of the students. They are not forced to learn in the built-in environment set up only and in the fixed timings like in a semester system which is existing in most of the programmes of our present education system. Students are not compartmentalised to a particular discipline but transdisciplinary system of education is encouraged for them to choose.

Therefore, the engineering skills that students today should acquire from technological institutions are not limited merely to the subject knowledge but also to the practical implications with the skillset of applying innovative ideas to resolve the real-world problem. It is a learning strategy where voice of student matters what he/she is going to learn. The curriculum would be student specific and they get to learn what they are willing to learn. In general, there are three aspects of wellbeing of a student. They are Physical Quotient, Emotional Quotient, and Intellectual Quotient. An engineering student must have the above quotients to adapt himself for new paradigm shift of Disruptive learning.

- Effective Teaching Learning Process
- Nurturing Existing Engineering Skills
- Inter and Trans disciplinary approach.
- Imparting Holistic Learning
- Protected environment for emotional needs.
- Experiential learning.

3.1 Physical Quotient

Physical Quotient of a student is how well he is attuned to his wellbeing. How he treats his mind, body and spirit. Sound mind is in a sound/healthy body. It is about being healthy and confident about his appearance When he feels good about his body, he will feel more confident and it reflects in his personality. PQ is any other resource in a biological system and it can be developed and it can be eroded. Lack of PQ leads students to inferiority complex which prevents them from healthy interaction with other students and teachers. It means learning about and identifying symptoms of disease, getting regular medical checkups, and protecting yourself from injuries and harm

3.2 Emotional Quotient

According to Goleman (1998), emotional intelligence is an ability to understand the self-emotion and one applies the talent to make effective decisions in life. With emotional intelligence, an individual is able to contain disappointments, sadness and other negative feelings in a positive manner.



Fig 1: Nest of a crow

3.3 Intellectual quotient

Students get opportunity to learn lots of theoretical concepts, which are not useful in many places. One should be able to understand the arrival of formulae but need not be an expert to solve numerical and practical problems in this era where simulations are capable of doing everything in a much efficient manner. There should be latest technologies and advancements taught in the class rather than same old stuff. Faculties should participate in consultation works in industries where they can get exposure with the current trend and educate student accordingly.

Recent notification from AICTE (All India Council for Technical Education) that “students and staff should be permitted to take off from their regular studies if they are working on start-ups” is a good initiative in line with this disruptive technology. Start-ups and industrial projects should also be taken over by a small group of students as part of their nurturing and enhancing their skills. Professors should also get trained with the latest advancements in technology in order to motivate students.

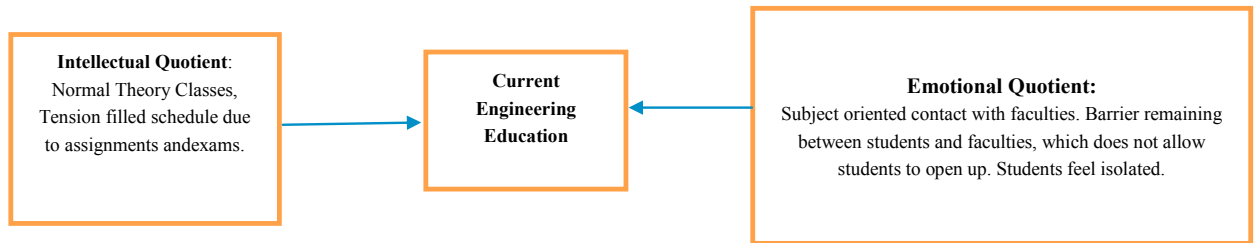


Fig.2: IQ and EQ

3.3 Inter and transdisciplinary:

In this approach the learners are free to choose the courses according to their $PQ+IQ+EQ$ rating. They may choose courses like Augmented Reality, Virtual Reality, Block Chain, Cryptocurrencies, Electrification of Mobility, Energy Storage, Digitalisation, Decentralised energy integration, Nano Technology Application in energy and environment, Micro grid, Drones, IOT and other latest and cutting-edge technologies. All the labs will be provided with research facilities integrated with incubation and tinkering centres. It would be similar to the Just in Time Technology (JiTT) developed years ago for improving the quality.

3.4 Entrepreneurship education

Entrepreneurship education is not the one which can be learnt through classroom activities. It demands out of the box thinking, connections with industries, self-decision-making capabilities, learning and understanding the market, and much more. These should be encouraged by the educational institutes by giving a problem or a direction to start with and let the students explore in a certain period of about a month to do a detailed study to come up with these ideas. They get opportunities to share amongst each-others along with industrial experts in a conference. This can improve connections, as well as help them to gain a lot of skills.

3.5 Real life problem tackling

After graduation there are many of them with no idea on how to solve real world problems and being incapable of such ideology and motivation, they often turn up to be an unsatisfied employee for the days job. Along with the course work if the students get to interact with the industrial problems they will come up with their own solutions. Skill development is ensured if they learn how the problems are tackled in the current scenarios and get equipped to tackle similar problems before they are into such industries.

3.6 Recent trends and development

Machine learning being a trend from past few years, but now is being implemented in industries is a trend, the faculties should also be aware of these advancements and should participate in the industries along with industrial experts and a small group of students to unite and work for the problem.

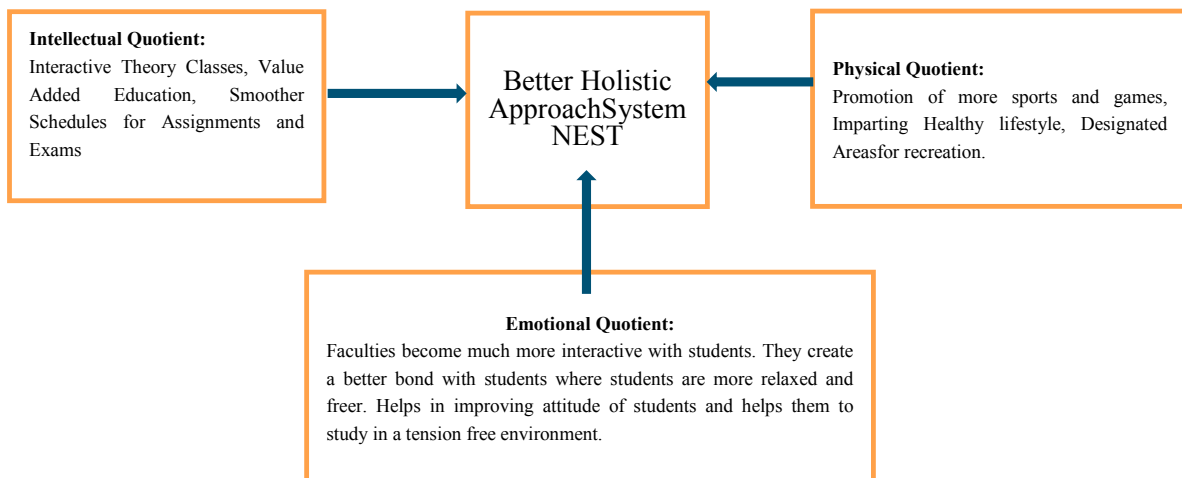


Fig.3: Holistic Approach System

3.7 Research oriented training

Students should be given awareness with the present scenarios along with the advancements which might take place in coming 5 to 10 years at the time when they get to work in industries. So, they can start working from right now for research and development. There should be projects taken over in multi-disciplinary departments for gaining exposure

3.8 Students should get opportunity to share his ideology irrespective to their domain

The students should get an exposure also on other domains apart from what they are getting trained. Thus, every person should be able to teach others in what they are interested at, which makes the students think in wider aspects rather than narrowing it down.

3.9 Decisions should be taken after awareness

After the higher secondary school students get a chance to pick up the department in which they want to pursue for graduation, when many are not aware of what actually will be taught on picking up that choice. Rather after a year of training in college on all the departments, they have to be given a choice for their future.

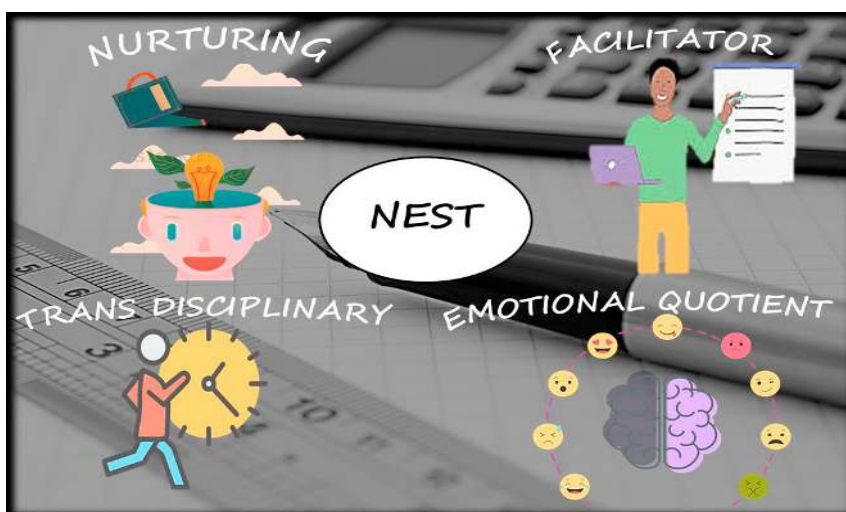


Fig:4 NEST-Nurturing

3.10 Knowledge on economy growth and motivation to work for the country

Every student should also have an idea on how his decisions are going to change the future of the country rather than just following the people who make more

money abroad and settle abroad. Also, economy growth of the country should also be taught. As it's not a one-man's job but every citizen should work for it.

3.11 Migration between colleges for better exposure

Not all institutes in this country are popular for every department. One might have facility which others might not, or one might have exceptional training facilities than the others for a particular course. So, if the students could migrate to other institutes for a set of courses it would give them a great exposure.

4. The existing barriers for the NEST model

4.1 Syllabus

- Traditional method of curriculum development which is done periodically.
- Old editions are prescribed for new syllabus.
- Syllabus committee is not ready to have a break through from the old frame work.
- Flexible curriculum is not an option.

4.2 Teaching Staff

- Faculty members are not trained to update the knowledge in the latest trends.
- Work to rule attitude and systems destroy creativity.
- Solutions to lab experiments are readily available.
- Teaching is focussed mostly towards basic level component of learning.

4.3 Infrastructure / budget.

- Surplus of revenue budget is considered as profit.
- No provision for depreciation
- Very Little provision for capital expenditure.
- Same Lab equipment setups are used for 20-25 years and even more.

4.4 Head of the Institutions

- Interested to run institutions as business centres rather than knowledge centres.
 - All focussed is on advertisements, admissions and placements due to scarcity of candidates joining engineering courses.
 - Less investment and more profit are an accepted norm.
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5. Conclusion:

This paper has highlighted the NEST model of disruptive technology to prepare the students for the evolving challenges globally. The understanding of the barriers of this NEST model helps one to initiate corrections in the learning centres to make it more suitable and attractive for the digital natives. Nurturing the students in preparing them emotionally, physically and intellectually with transdisciplinary approach will go a long way for the preparation for the present and future demands of the society globally

Reference

- [1]. Petrides e.al (208) "Emotional Intelligence as Personality: Measurement and Role of Trait Emotional Intelligence in Educational Contexts" "Emotional Intelligence in Education pp 49-81
- [2]. Maria Fuchsova and LillaKorenova (2019) "Visualisation in Basic Science and Engineering Education of Future Primary School Teachers in Human Biology Education Using Augmented Reality" European Journal of Contemporary Education, 2019, 8(1)
- [3]. Gregor et.al, (2004), "Just-in-Time teaching in biology: creating an active learner classroom using internet" A Journal of life science education 2004 Spring; 3(1): 49–61.
- [4]. Novak (1984) Learning technologies should be designed to increase, and not to reduce, the amount of personal contact between students and faculty on intellectual issues. (<https://jittdl.physics.iupui.edu/jitt/what.html>)
- [5]. Cynthia (Just-in-Time%20Teaching % 20 (JiTT)Center % 20 for %20Teaching%20_Vanderbilt%University
- [6]. Kin Wai (2003) Nurturing All-round Engineering and Product Designers, International Journal of Technology and Design Education 13, 243–254.