Why Engineering Should Start at School Level

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There has been a lot of hue and cry over the declining interest in Science, Technology, Engineering and Mathematics (STEM) in Malaysia. In reality, this is not only a domestic problem but a global battle too, one that is caused by education trends, shifts in youth mindset and incomes generated based on different professions.

Reversing the trend will take time but immediate plans and actions are necessary. Building young people's engagement in STEM goes beyond the confines of the classroom or school. Education systems alone cannot overcome the pervading cultural norm that it is acceptable to be "bad at Maths" or "not a numbers person".

Mathematics is a fundamental core requirement for engineering. Many people ask why there is an E in STEM when S (Sciences) and M (Mathematics) already cover the basic requirements for engineering. Practical skills are where E (Engineering) works best. Global research shows that building STEM capacity across the population is critical to support innovation and productivity, regardless of occupation or industry (1).

Engineering is and will always be one of the fastest-growing and most rewarding careers in the world. Opportunities for young engineers are plentiful and, as we move towards greater technology advancements, their services will definitely be needed to integrate technology and applications. To earn the rewards of being an engineer, however, one must put in place some essential early building blocks, starting with school.

There should be a focus on action that will lift foundation skills in STEM learning areas, development of mathematical, scientific and technological literacy as well as the promotion of the development of 21st Century skills in problem solving, critical analysis and creative thinking. The importance of focusing on STEM in the early years should be given due recognition and this focus must be maintained throughout the school years.

Taking engineering as a core element, a good start would be to introduce a subject titled "Engineering Science" for example. This is where engineering can be taught via Problem Based Learning (PBL), starting with critical analysis of root causes, leading to research on solutions and finally, coming up with the best methods for solution implementation. The present secondary school system may not be ready for such an introduction, which is why we need to derive the content and way the subject can be rolled out.

At school level, the most fundamental questions are what "engineering" means, how it differs from technology and how it relates to Science and Mathematics curricula. Researchers have come to several important conclusions, one of which is that the dominant

STEM subjects, such as Science and Mathematics, are usually taught in "silos", that is, as separate, independent subjects. Engineering may provide a catalyst for integrating STEM education and making it more relevant to everyday experiences for students (2). This experience can only come from practical work.

Table 1: STEM's Engineering Integration

Subject Matter Title	Science Integration Topic	Engineering Integration Field	Technology Applied
Catching the Wind: Designing Windmills	Wind and Weather	Mechanical	Wind Turbines
Water, Water Everywhere: Designing Water Filters	Water	Chemical/ Environmental	Pumping & Filtration Systems
Sounds like Fun: Listening & Analysing Animal Sounds	Sound	Acoustical	Analogue/Digital Analysers
Roll & Roll: Designing the most challenging rollercoaster	Structure	Civil & Structural	Building block/ Models/Steel Pipes/Bending Machines
The Best of Bugs: Designing Hand Pollinators	Insects & Plants	Agricultural	Gauges/Soil testing Kits/CBRs
An Alarming Idea: Designing Alarm Circuits	Electricity	Electrical	Circuit Boards, Wires, Electronic Components, Arduino
Marvellous Machines: Making Work Easier	Simple Machines	Industrial	AC or DC Motors – Stepper/ Induction

There is a difference between Technical and Vocational Education and Training (TVET) and STEM. Vocational learning is tuned towards producing future hands-on technical experts while STEM is inclined towards creators and innovators. The engineering science model will work if it is embedded with content covering the basic elements of engineering. A sample is shown in Table 1.

STEM is all about integration and, if well-coordinated, it can be fun. Now with engineering as a core element that ensures practice as shown in Table 1, the fun will come in touching, creating, forming, assembling, testing and innovating while taking up challenges.

These activities are what learning should be about. Learning will be further enhanced if the activities are done as a team, with the exchange of ideas and debates on how best to do tackle problems. This learning method leads to the true development of engineers from a very young age.

One possible method is to enlist the aid of university engineering students (as part of their community service or internship) to participate in these teaching deliveries at secondary school level. This will be a win-win situation, one that allows ex-students of a particular school to spread the awareness of STEM and Engineering in their own communities. ■

Photos are courtesy of Asia Pacific University of Technology & Innovation (APU)

REFERENCES

[1] PricewaterhouseCoopers (PWC), *A Smart Move: future-proofing Australia's workforce by growing skills in STEM* (2015).

[2] Charles M. Vest, *Putting the 'E' in STEM Education*, National Academy of Engineering, The Bridge – Linking Engineering and the Society (2015)