Integrating STEM into K-12 Schools

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Three points from us

1. **Basic Education years are important foundation years to prepare for the future**

2. **STEM is integrated into K-12 schooling because of certain labour and citizenship goals**

3. **Integrating STEM into school level education requires creative ways which do not detract from main curriculum**

1. Basic Education years are important foundation years to prepare for the future

- Basic education (Primary and Lower Secondary) and Upper Secondary years form the subsequent technical abilities, leanings, and "habits of mind" (problem solving, life related skills, necessary to effectively operate in society, etc.
- Important years to form values associated with caring for the environment
- *Integrating STEM into school level education provides an approach to improve this foundation AND also prime students for careers in science, engineering and technology*

2. STEM is integrated into K-12 schooling because of certain labour and citizenship goals

- Meeting the need for S&M linked jobs arising from Economic transformation, e.g. Singapore's phases (Labour intensive, Industrialisation, Knowledge-driven, Innovation-driven)
- Preparing students who are Future-Ready with "21st Century Competencies" (Critical thinking, Complex problem-solving, collaboration, communication, etc.)
- Preparing responsible citizens to make informed decisions with science and Technology Literacy, and to cope with Disruptive Technologies in everyday modern life

3. Integrating STEM into school level education requires creative ways which do not detract from main curriculum

- E.g. Singapore: Promote STEM education through funding STEM Inc. in Science Centre, STEM Applied Learning Programmes in schools; two STEM-focused schools, and ground-up efforts from schools and teachers in offering STEM co-curricular activities, competitions and research projects.
- E.g. Singapore: Private service providers offer education camps with outdoor or indoor maker activities outside classroom time

- Other countries
  - Application (problem-based) projects
  - New Generation Schools (Cambodia)
  - Building additional skills --ICT, communication, entrepreneurship (Philippines)
  - Third party to encourage STEM (Viet nam)
  - Authentic learning using local context (Viet nam)
  - Training to integrate ICT into solving local problems (India, Uzbekistan)

❑ Enablers

- Authentic and meaningful STEM curriculum (Curriculum developers have to work with industries to develop curriculum with real-world problems)
- Make resources required for STEM education available (for example 3D printers, coding softwares etc)
- Availability of high quality 'just-in-time' teacher professional development courses by universities and teacher education institutes (courses can include designing STEM activities, implementing STEM activities and evaluating STEM learning)
- Formation of STEM teaching teams with members of different disciplines.
- Organise national STEM symposiums or meeting to share best practices in STEM education

AIMING STEM AT STUDENTS

- Getting students interested in careers in science, technology and engineering
- Grounding students in the processes and attitudes of mind associated with science and mathematics, and engineering and technology
- Inculcating ability to take an integrative, interdisciplinary approach to problem-solving
- Helping acquire (21st C) Competencies and Character qualities
- Becoming employable citizens

Provoking Questions

- What is meant by the acronym "STEM" (Science, Technology, Engineering, Mathematics)?
  - A "Catch-all" term?,
  - A suggestive "Integrative" term?, or
  - a descriptive term for a desired 21CC-Heuristic approach?
- Why is STEM assuming more importance?
- What future needs of education are we meeting?
- Does STEM require disruptive transformations to the Science & Mathematics curriculum?