Roles of Technology Education in Promoting STEM Education
科技教育在推動 STEM 教育中扮演的角色

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Outline

- About the speaker
- Overview of the Hong Kong School Curriculum
- TE Teaching & Learning
- STEM Education
- Learning & Teaching Cycles
- Key Considerations
- Conclusion

About the speaker

2002 : Facilitator for "Learning to learn" (using PBL)

2005 : Applied PBL to teach "Electronic Product Design (EPD)" for one programme

Pilot run (2017) and full deploy. (2018) of the EPD to all EE prog.

2018: 2nd spin off with students

1995

2003 : First Peer tutoring scheme in EE and then CSE

2004 : TDG project – using PBL to teach "Modern Power Electronics"

2005 – 2010 – Associate Dean (Student activities)

2015: 1st spin off with students

2016: Assistant Head (Student Activities)

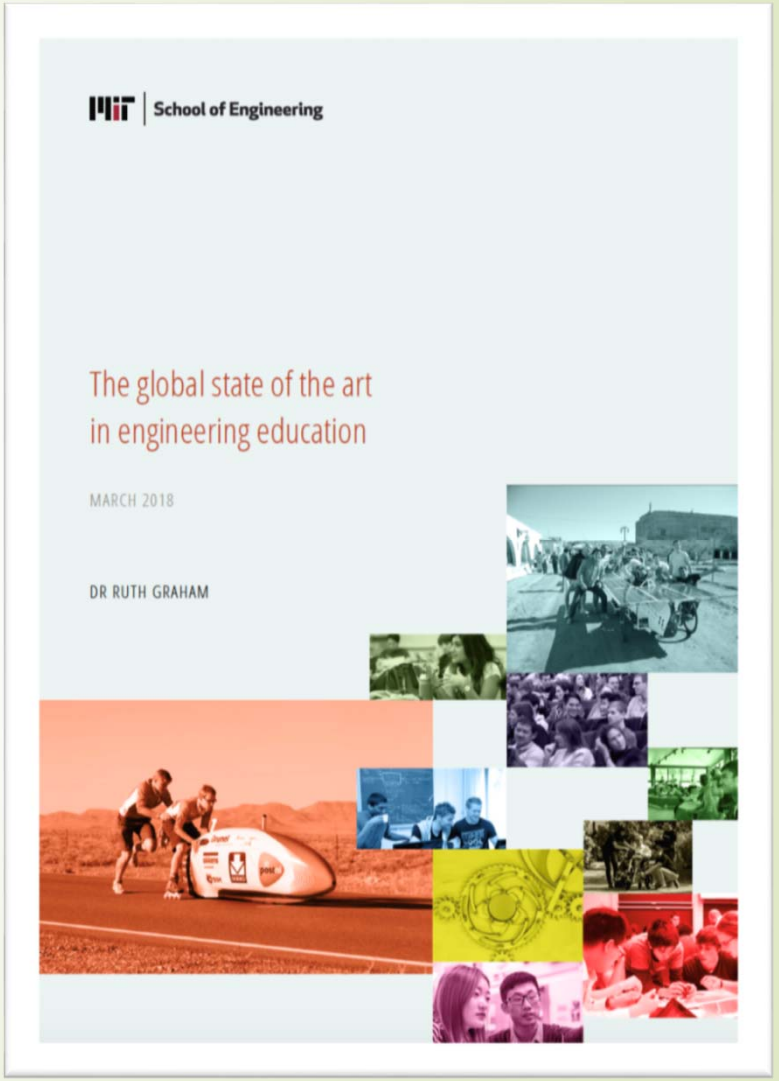
Summer programme for Secondary students

https://www.youtube.com/watch?v=xbKW5XpIhtE&t=18s

What is the future direction for the engineering education sector?

In the longer term, some of the world's leading engineering programs would increasingly deliver student-centered learning to large student cohorts through a blend of off-campus personalized online learning and on-campus hands-on experiential learning:

"This is the future of the field, where you put the student at the center and use the resources to facilitate team projects and authentic experiences, and then put the taught curriculum online."



Overview of the Hong Kong School Curriculum

Mission

Technology Education (TE) is the study of the purposeful application of knowledge (such as Information and Communication Technology, Materials & Structures, Operations & Manufacturing, Strategies & Management, Systems & Control and Technology & Living), skills and experiences in using resources to create or add value to products and systems to meet human needs.

TE aims at preparing students to be valuable human capital amidst the rapidly emerging technologies. It enables students to

- develop technological capability, understanding and awareness
- critically appraise the impacts of technology on the individual, family, society and environment
- become competent and confident members of the world of technology and the society at large.

Teaching & Learning

The TE curriculum is designed to match students' interests and intellectual development at different key stages:

- Key Stages 1 and 2: Awareness and Exploration
- Key Stage 3: Exploration, Experiencing and Familiarisation
- Key Stage 4 and beyond: Exploring Orientation for Life-long Learning and Specialisation

The learning and teaching of TE is

- purposeful
- progressive and iterative in nature
- involving the coordination of the mind (problem-solving) and hands (hands-on experiences)

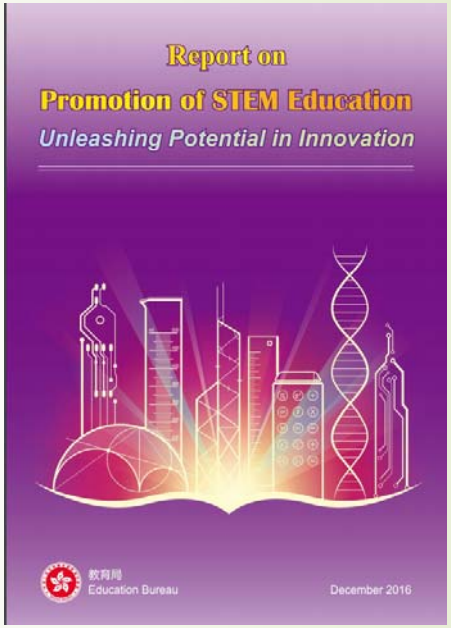
STEM Education - Innovation

Preamble

To better prepare our students for the rapid economic, scientific and technological developments ahead, STEM education is being promoted as a key emphasis in the ongoing renewal of the school curriculum that is essential for their lifelong learning and whole-person development.

The promotion of STEM education was first proposed in the 2015 Policy Address and further supported in the 2016 Policy Address. Apart from cultivating students' interest in Science, Technology and Mathematics, and developing among them a solid knowledge base, we aim to strengthen students' ability to integrate and apply knowledge and skills across different STEM disciplines, and to nurture their **creativity, collaboration and problem solving skills**, as well as to foster their **innovation and entrepreneurial spirit** as required in the 21st century. Through the promotion of STEM education in schools, we aim to nurture a versatile pool of talents with different sets and levels of skills to enhance the competitiveness of Hong Kong.

We have been promoting STEM education among schools in a holistic and coherent manner, with strategies that embrace **renewing the curricula of the Science, Technology and Mathematics Education KLAs, enriching the learning activities for students, providing learning and teaching resources, enhancing professional development of schools and teachers, strengthening partnerships with community stakeholders and maintaining professional communities**, as well as **conducting reviews and disseminating good practices**.



Just only for Science, Technology, Engineering, and Mathematics ?

STEM education – Teaching & Learning

https://store.makeblock.com/mbot-v1-1-stem-educational-robot-kit

https://www.theedadvocate.org/how-to-use-artificial-education-in-the-classroom/

https://directnational.com.au/products/stem-products-2/

http://pakistanparenting.com/tag/stem-education/

Products

https://www.ciu10.org/site/Default.aspx?PageType=19&DomainID=0

https://www.thebigbangfair.co.uk/gsk-uk-young-scientist-and-uk-young-engineer-of-the-year-announced/

http://secorstrategies.com/stem-education/

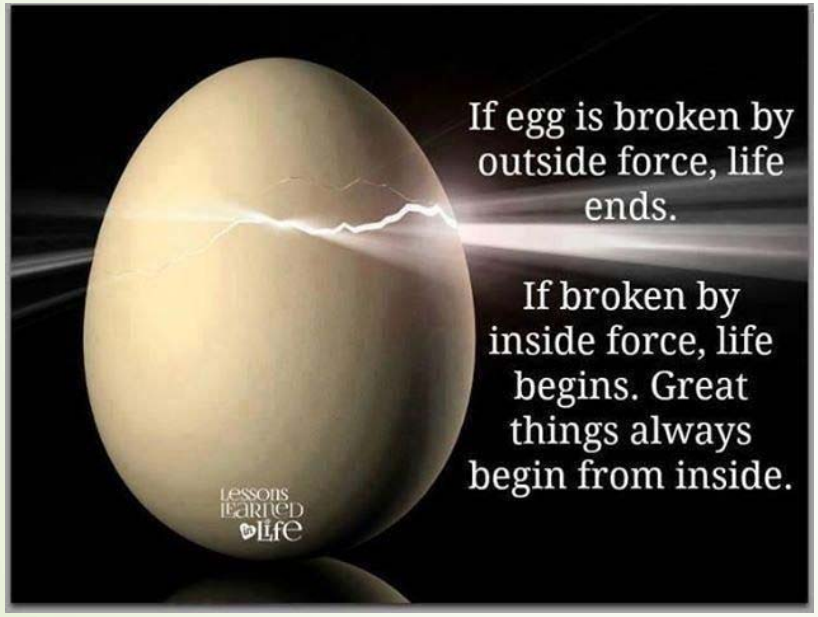
STEM for excellent students only?

Establish a good learning environment, no matter in-class or out-of-classroom activities, for all students to learn.

Observations

- Science and Engineering disciplines have experienced rapid growth due to confluence of various areas.
- It is essential to get students know to grasp the relationships among various disciplines. Students seem to lack the ability or motivation to go beyond factual knowledge to a deeper understanding of the course contents.
- We have received feedback from industry that a great number of university graduates do not meet their expectations and requirements, are lack of soft skills, and are not performing well at workplace.
- We have to train up students with multi-dimensional and multi-disciplinary strength.

Simple way to test motivation

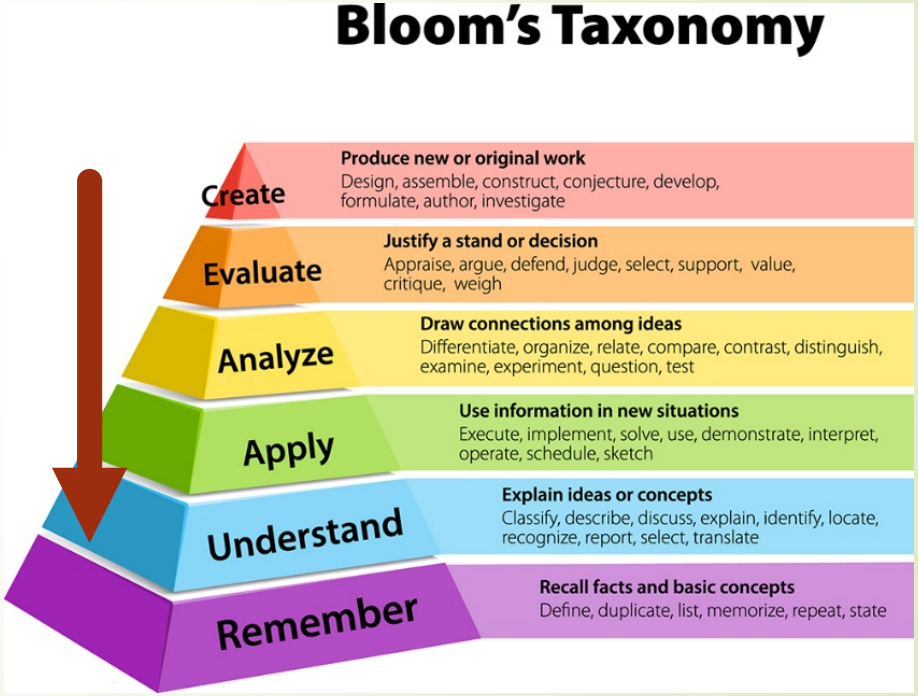


https://krishnacalling.wordpress.com/2015/07/14/great-things-always-begin-from-our-inside/

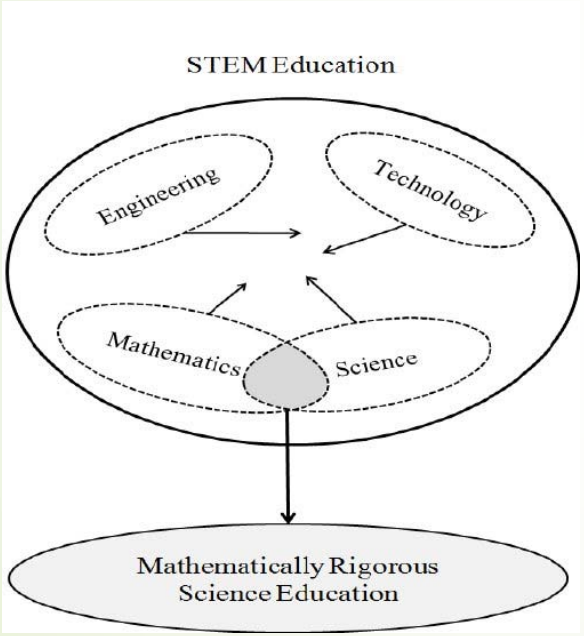
https://www.goqwickly.com/attendance/

From “Idea” to “Theory”

Create a learning environment where the real world context comes first and the theory second to promote the student's grasp of the phenomenon, concept or event.



STEM Education



https://www.researchgate.net/publication/260517903_Introducing_STEM_Education_Implications_for_Educating_Our_Teachers_For_the_Age_of_Innovation/figures?lo=1

- Learners explore open-ended real world problems as the starting point of learning
- Learners engage in self-directed learning, including planning, implementing and evaluating their overall learning process
- Learners work cooperatively in small groups to support each other to achieve the learning outcomes
- Teachers assume the role of facilitators and co-learners
- Learning outcomes emphasize not only content knowledge but also process skills and learning attitudes

Teaching and learning cycles

- Exploration
- Preparation
- Sharing
- Reflection
- Refinement
- Peer support or tutoring
- External support

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- Explore the case problem. Create hypotheses. Identify critical issues. Elaborate. [Tool: Mind map]
- Try to solve the problem with what the students currently know [Reflection + problem solving + awareness, competency, innovation]
- Identify what the students do not know [Reflection + problem solving + awareness]
- Set learning goals* and objectives* and allocate resources and identify tasks for each member in a student group.

*related to S, T, E, M, + …

Teaching and learning cycles

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- Put together information collected
- Decide if more information should be collected [critical thinking]
- Realize the case [familiarization, hands on experience, innovation]
- Prepare for the sharing meeting

Teaching and learning cycles

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- Share the new knowledge, the problem solution, and the effectiveness of the process used with other groups [self-confidence, critical thinking, impact, specialization, innovation]
- Get feedback from peers and tutor [entrepreneurship]

Teaching and learning cycles

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- Perform self and small group assessment [reflection, life-long learning]
- Put together the final draft of the case report [presentation, critical thinking, language, computer literacy, language, entrepreneurship]

Teaching and learning cycles

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- Reflection
- Refinement
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- External support

- Invite students, who have completed the course, to design teaching materials, cases [reflection, life-long learning]
- Invite those students to support in-class activities [community service, life-long learning]

Teaching and learning cycles

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- Refinement
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- External support

- Invite senior students to provide junior students with support of out-of-classroom tutoring services [community service, life-long learning]

Teaching and learning cycles

- Exploration
- Preparation
- Sharing
- Reflection
- Refinement
- Peer support or tutoring
- External support

- Get support from universities, industry [impact, specialization, entrepreneurship]

Key issues

- Design a case with STEM elements included [Designing a robot may not be ...]
- Design teaching materials for students to record learning activities, explore the case, and do reflection
- Motivate students to explore cases
- Encourage students to share and contribute

Conclusion

Taking the right approach to motivate students to learn science, technology, engineering and mathematics can help prepare students for the world that awaits

Excellence Through Passion and Innovation