



香港教育大學

The Education University
of Hong Kong

What are the challenges of STEM education in Hong Kong?

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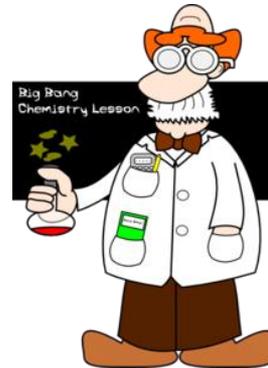
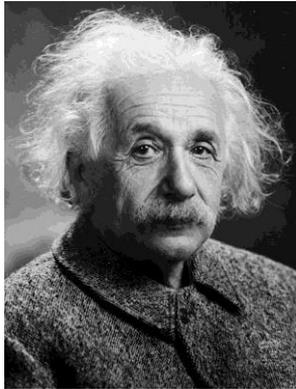
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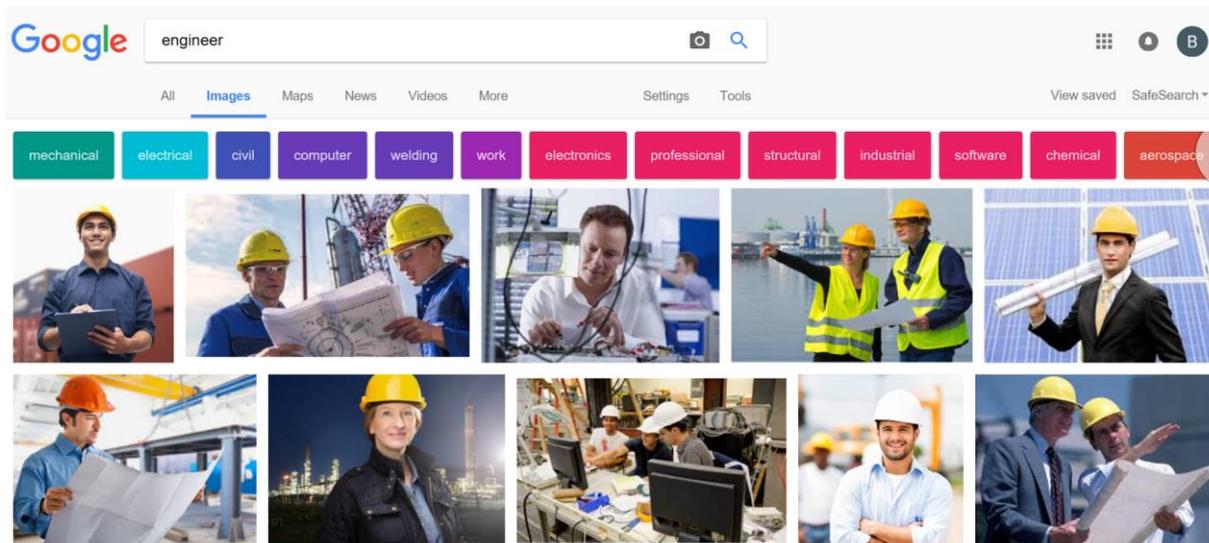
科學與環境學系
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What Scientists and Engineers look like?

- What **Scientists** look like?

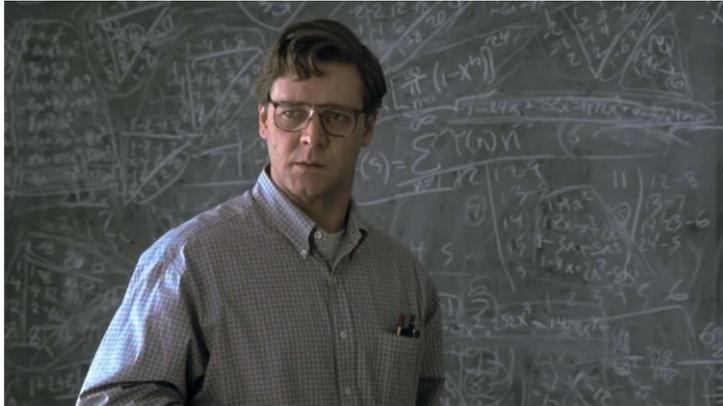


- What **Engineers** look like?



What Mathematicians look like?

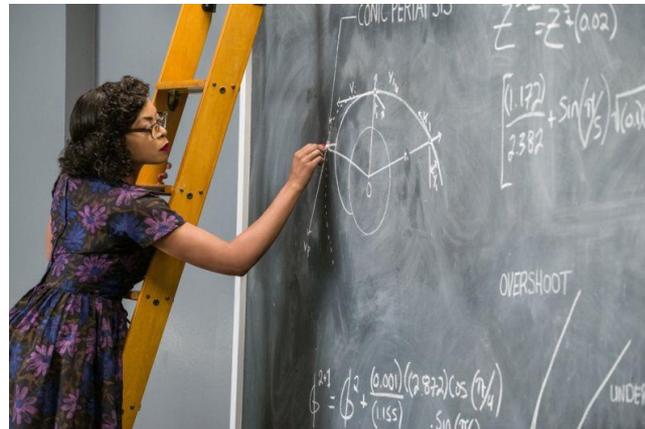
- What **Mathematicians** look like?



A beautiful mind (2001) –
Russell Crowe as **John Nash**



The Imitation Game (2014) –
Benedict Cumberbatch as **Alan Turing**



Hidden figures (2016) –
T. P. Henson as **K. G. Johnson**

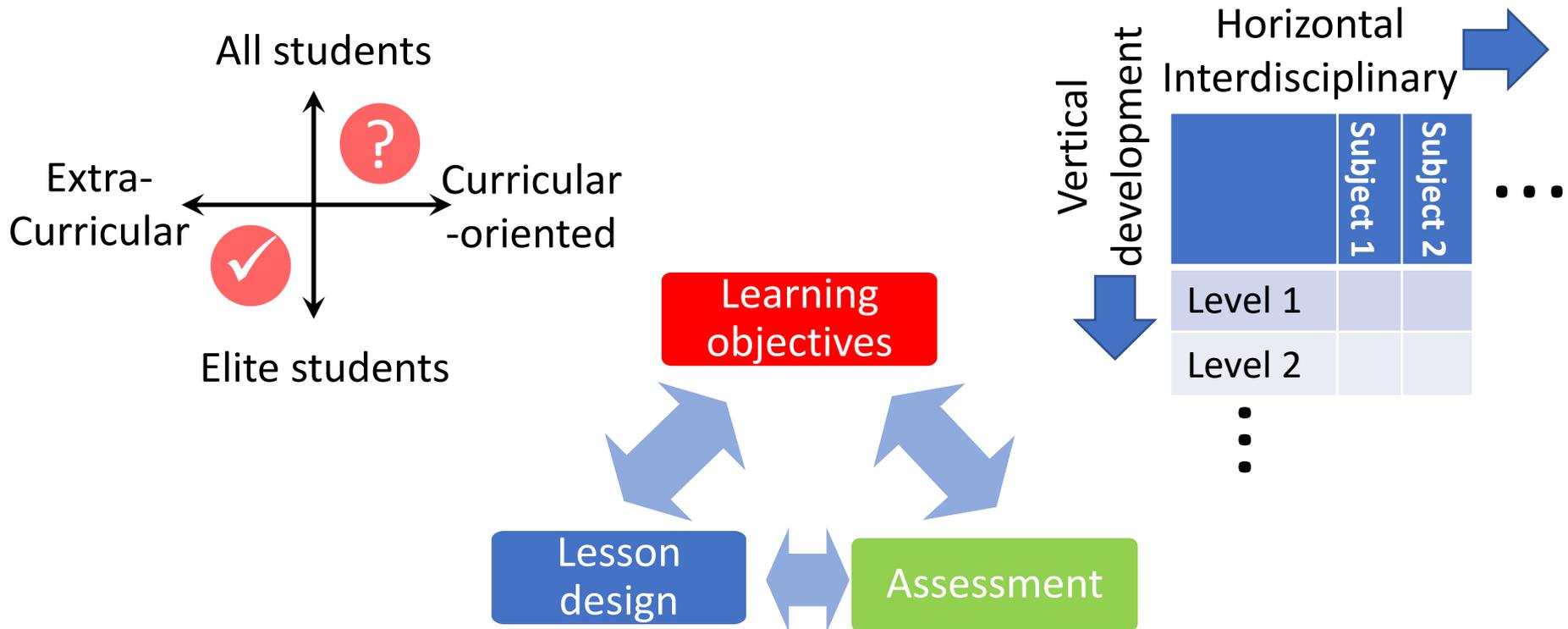
Origin of STEM education?



- **STEM** is the abbreviation of the following disciplines:
 1. Science
 2. Technology
 3. Engineering
 4. Mathematics
- **STEM education** is initiated by **the National Science Foundations (NSF) of US in the 90s** as SMET, but SMET is similar to SMUT, NSF changed SMET to STEM in 2003
- STEM education aims to provide students with opportunities to **integrate** the knowledge in STEM disciplines, and **apply** and convert these knowledge into creative innovations

Challenges in STEM education

- STEM education has developed in Hong Kong for several years, **many schools have well developed in terms of STEM hardware and lesson design**
- Nevertheless, primary and secondary schools are still facing **many challenges in STEM education...**





Challenges in
objectives?

Why STEM education? Learning objectives?

- Global atmosphere?
- Policy driven?
- Cultivate STEM elites for Hong Kong?

Enable students ...

- gain interest in STEM subjects?
- consolidate knowledge in STEM subjects?
- increase STEM literacy (adapt to future STEM world)?
- apply knowledge (instead of only learning knowledge)?
- understand how STEM careers work?
- integrate knowledge from different disciplines?
- understand the interface between subjects?
- understand engineering/technology?
- Improve problem-solving skills?
- cultivate 21st century skills (e.g. creativity, collaboration skills, etc.)?
- get into universities/good secondary schools?





Challenges in practices?

Integrate STEM with formal curricula?

- Subjects usually involved in STEM education:

Primary schools:

- General studies, Mathematics, Computer Studies

Secondary schools:

- Science (or IS), Mathematics, Information and Computer Studies

Less common subjects but are also involved:

- Art , Music , Languages, Ethnics (values education)

Challenges

- How to integrate STEM into subject curricula?
- Limited lesson time?
- Timetabling? (match components from different disciplines)
- Team-teaching/team-building
- The role of mathematics?
- Subject-based or project-based?



How to do assessment in STEM??

- **Should** we assess?
- **What** to assess?
- **When/where** to assess?
- **Who** to assess?
- **How** to assess?
- How to collect **evidence** for assessments?



Challenges in holistic planning?



creativity

communicate

efficiency

plan

investment

Vertical progression?

- STEM is not considered an independent subject in Hong Kong and there is **NO official curriculum** to follow
- The **holistic planning on STEM education** in local schools has to be **school-based**

Potential directions for vertical progression:

- learning objectives?
- level of knowledge and technology involved?
- multidisciplinary?
- application of engineering design cycle (EDP)?
- level of problem solving?
- 21st century skill?
- strengthening of life and values educational elements?



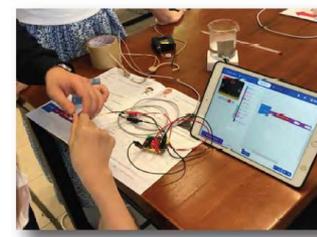
How to achieve?

Some examples of progression in STEM curriculum/lesson designs

	S	T	E	M
Remember (記憶)				
Understand (理解)	6. 說明科學探究原理 25. 說明科學原理	13. 說明個別工具工用 29. 說明個別科技工用	26. 說明設計循環中的步驟	22. 說明數學原理
Apply (應用)	11. 應用科學原理 15. 應用科學探究原理 20. 應用公平測試	2. 應用網絡搜尋資訊 12. 應用工具 14. 應用科技 27. 應用資訊科技記錄實驗或成品製作流程 30. 應用編程	1. 繪畫設計圖 18. 應用設計循環	3. 測量數據 7. 以數據劃製圖表 16. 應用數學原理 31. 應用邏輯思維
Analyze (分析)	10. 分析實驗誤差		17. 分析產品優缺、比較產品優異	5. 分析數據
Evaluate (評鑑)	28. 評估測試結果		8. 改良產品	
Create (創造)	4. 設計實驗測試產品 19. 設計科學實驗 23. 發現科學原理		21. 設計產品 24. 製作產品	9. 發現數學原理



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Progression in problem-solving?

	Inquiry level	Question	Procedure	Solution
1	Confirmation inquiry Students confirm a principle through an activity when the results are known in advance	✓	✓	✓
2	Structured inquiry Students investigate a teacher-presented question through a prescribed procedure	✓	✓	
3	Guided inquiry Students investigate a teacher-presented question using student designed/ selected procedures	✓		
4	Open/true inquiry Students investigate questions that are student formulated through student designed/selected procedures			

4 levels of inquiry-based learning
(Banchi and Bell 2008)

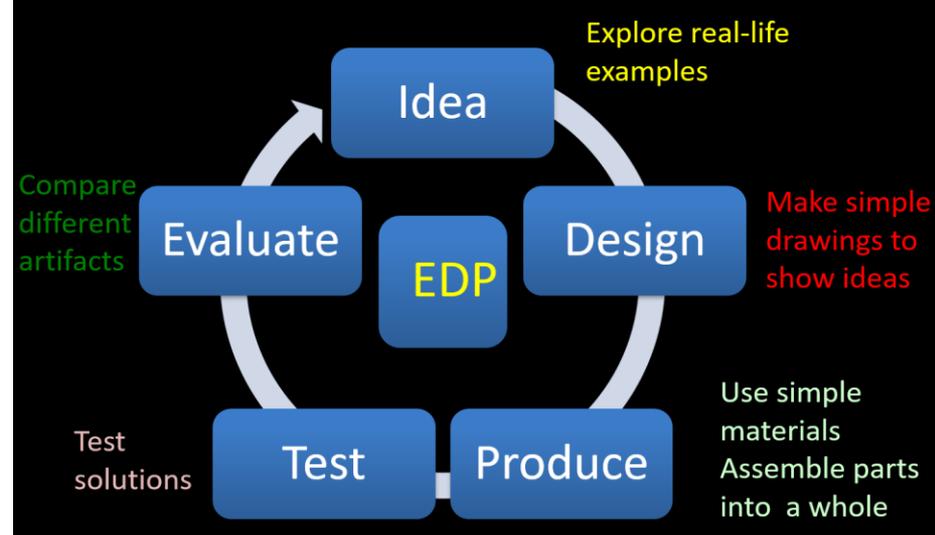


4 proposed levels for problem-solving

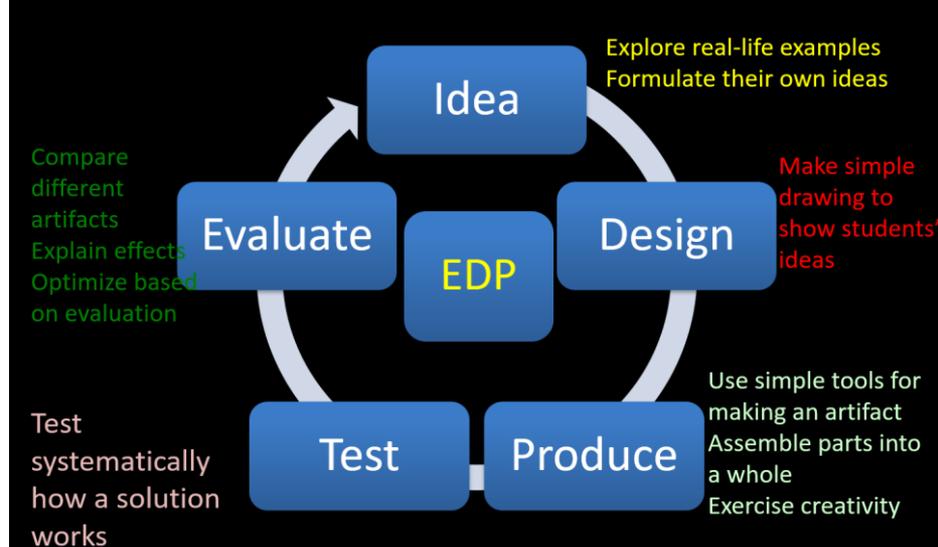
	Level of problem-solving	Problem	Solution/ Plan	Result/ Improvement
1	Confirmation problem-solving Students confirm the known improvement to a prescribed problem via a known solution	✓	✓	✓
2	Structured problem-solving Students examine the improvement resulted by a solution to a problem both presented by teachers	✓	✓	
3	Guided problem-solving Students solve a teacher-presented problem by planning their own solutions	✓		
4	Open/true problem-solving Students formulate their own problems <u>in a given</u> situation and solve them with their own solutions			

Engineering Design Cycle (EDP)

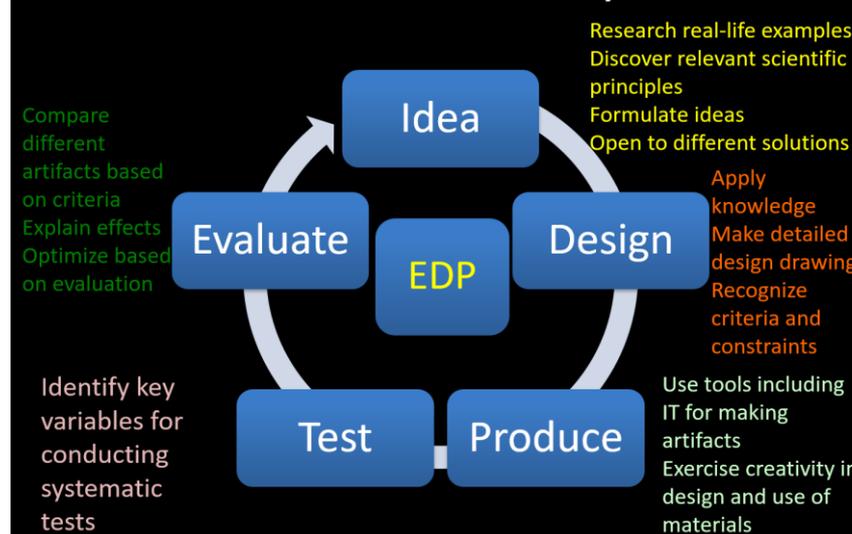
Lower Primary (EDP)



Upper Primary



Junior Secondary



More in-depth stages of the EDP

Reference:
Dr LEE Yeung Chung

A 3D rendered maze with dark grey walls and a light grey floor. A small, dark grey, stylized human figure stands in a narrow path, looking towards the viewer. The maze is complex, with many dead ends and paths. The lighting is dramatic, with strong shadows and highlights, creating a sense of depth and complexity.

Other challenges?

Any other challenges?

- **Difference in understanding, vision, mission and passion for STEM education** among colleagues and different level of school management
- **Resources** (man-power like STEM teachers, TA, technicians, equipment like computer room or tablets for coding, examples of STEM modules, etc.)
- **Professional development training** for teachers
- **Students' interests**
- Perceptions of STEM by **parents**



Summary

- Although we have started STEM education for several years and are good at design STEM lessons/activities, there are still **challenges ahead** in terms of

1. **Objectives**
2. **Practices**
3. **Holistic planning**

Let's work together



- We look forward to work with all of you to find good solutions for the above challenges 😊