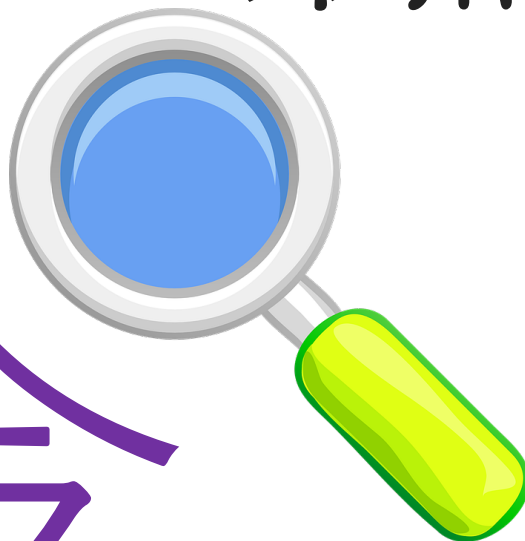


卓越教學論壇2019

卓越課程的發展——
聚焦、深化、持續

聚焦 STEAM

聚焦



概念

行政長官卓越教學獎(科技教育學習領域) 2017-2018 獲獎教學理念

東華三院張明添中學梁偉業老師

STEMaker

科藝創建師



源起



- 特首於2015施政報告提出「教育局會更新及強化科學、科技及數學課程和學習活動，並加強師資培訓，讓中小學生充分發揮創意潛能。」

香港特區政府《2015年施政報告》，2015年1月14日
<http://www.policyaddress.gov.hk/2015/>

香港科技教育學會向教育局提出推展**STEM**的策略建議 --- 科藝創建師 (as in BOLT meeting 31.5.2015)

Making "**STEM** in **Edu**" flourish in HK:
What and How



STEMmaker

STEMaker: thinker and doer in one person

STEMaker

推動STEM教育 發揮創意潛能

概覽



課程發展議會
2015年11月

同年11月教育局文件

模式二正是此建議：

透過專題研習讓學生綜合不同學習
領域的相關學習元素。

2016年校本正式全面引入

- ▶ 2016年9月起重開中三級「設計與科技」課程
- ▶ 全面推行「科藝創建師」教育，並以中一至中三「設計與科技」科為主要實踐科目
- ▶ 跨科組會議共同製訂設計習作
- ▶ 自編校本教材



13-1-2017 跨科組會議



中一至中三級校本教材

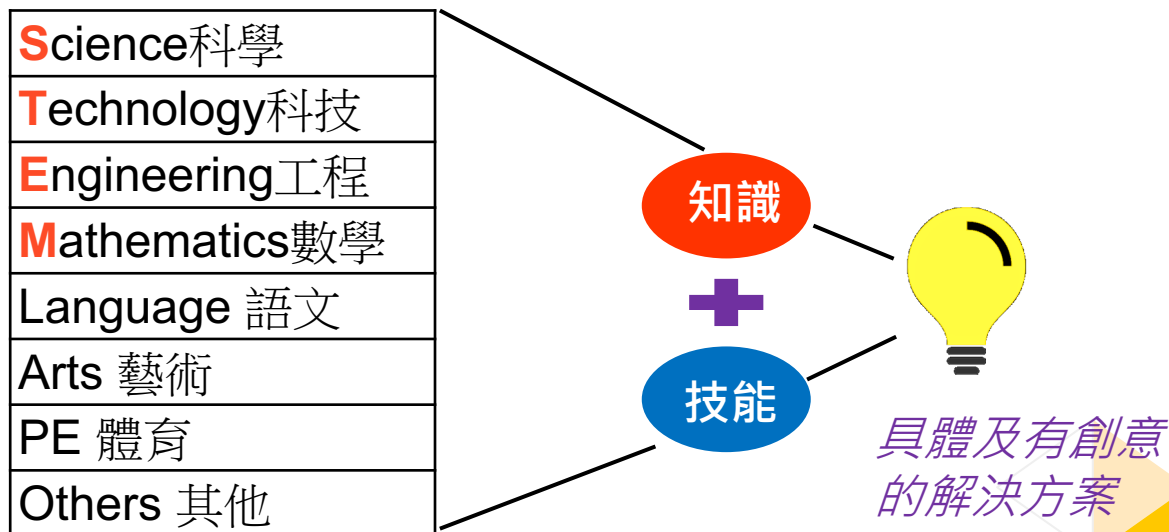


甚麼是「STEM科藝」？

STEM Education => STEM in Edu.

...要讓學生就著日常生活問題，設計和擬定具體及有創意的解決方案，從而增強他們在綜合和應用跨學科知識與技能的能力。

《推動 STEM 教育—發揮創意潛能》概覽 (CDC 2015, 教育局)



STEM並非單單涉及S、T、E、M四個科目

STEM目標

透過解難項目，培育學生科藝素養、人本精神及創業家思維，使年青一代能以綜合和應用跨科目知識和技能，配合工程思維，以科技手段去創新發明，解決現實生活情境問題，培育國家年輕一代成為21世紀的創新創業人才。

聚焦



創新 + 解難



甚麼是 「科藝創建師STEMaker」？

科藝創建師：手腦並用的人 STEMaker: Thinker & Doer in One Person

→ Serves the long term development of HK communities

→ 支持香港長遠發展

STEM
in Edu.



創客文化

Maker
Culture



STEM
aker

科藝創
建師



香港: 將來需要甚麼?

- ▶ 有潛力、高增長產業(施政報告, 2014):
 - ▶ 創新及科技產業
 - ▶ 創意產業
- ▶ S I E 小型創意企業
 - ▶ 成功故事例子 Jeff Chan and Eu-Wen Ding, Frank Wang

小型創意企業

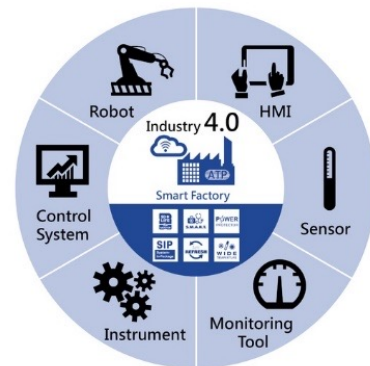
Small
Innovative
Enterprise
(SIE)



香港工業發展新方向!

SIE 小型創意企業

- ▶ 由三數個年輕人因著一個共同發掘出來的創新意念開始
- ▶ 可進行小規模生產(工業4.0時代已臨，產品可化整為零利用平價的設備)或物色合適的生產者
- ▶ 可遙距生產、測試(IoT 物聯網的廣范應用)
- ▶ 利用大資料 (big data) 進行深耕用



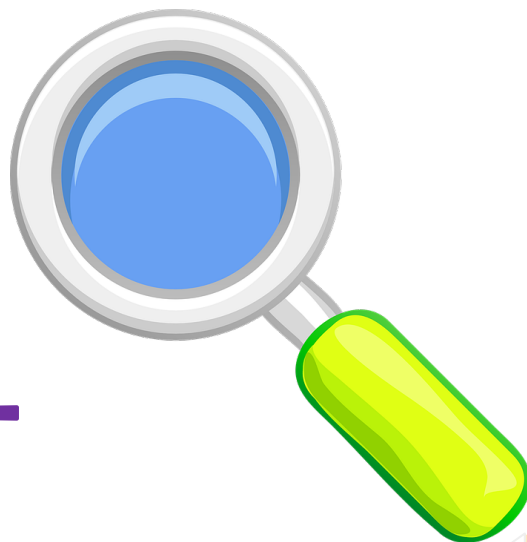
GO

SIE 小型創意企業需要怎樣的人才？

- ▶ 透過網路眾籌集資 (Kickstarter、Indiegogo、

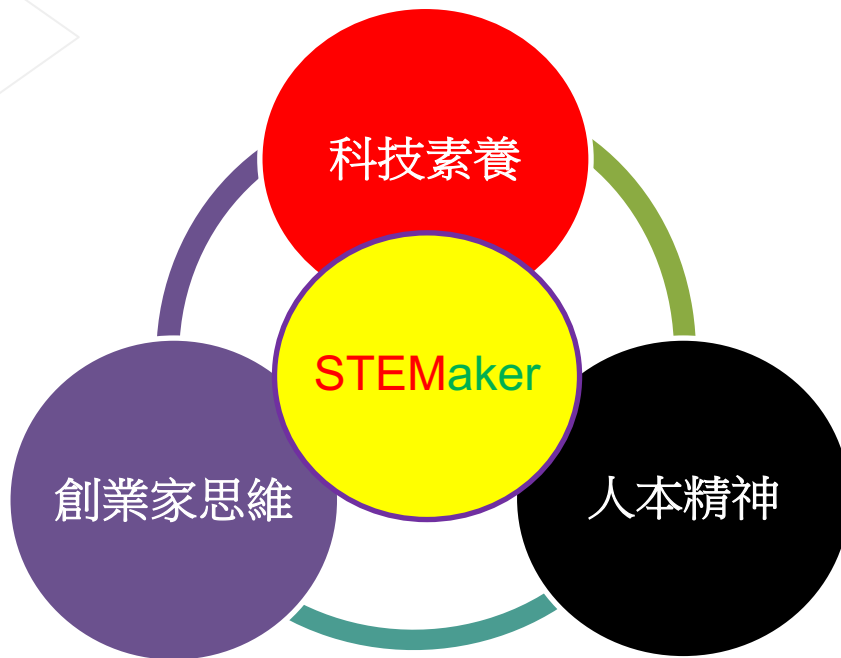
「雙創人才」!

聚焦

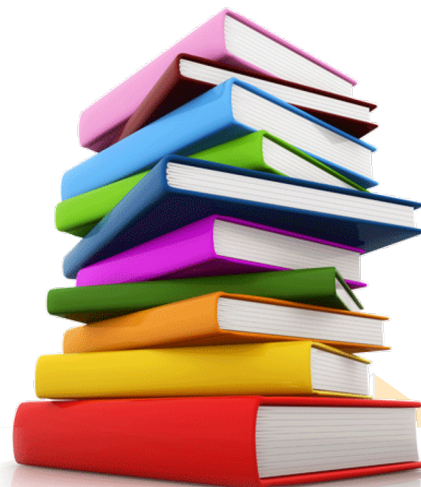


素質

科藝創建師 STEMaker 特質

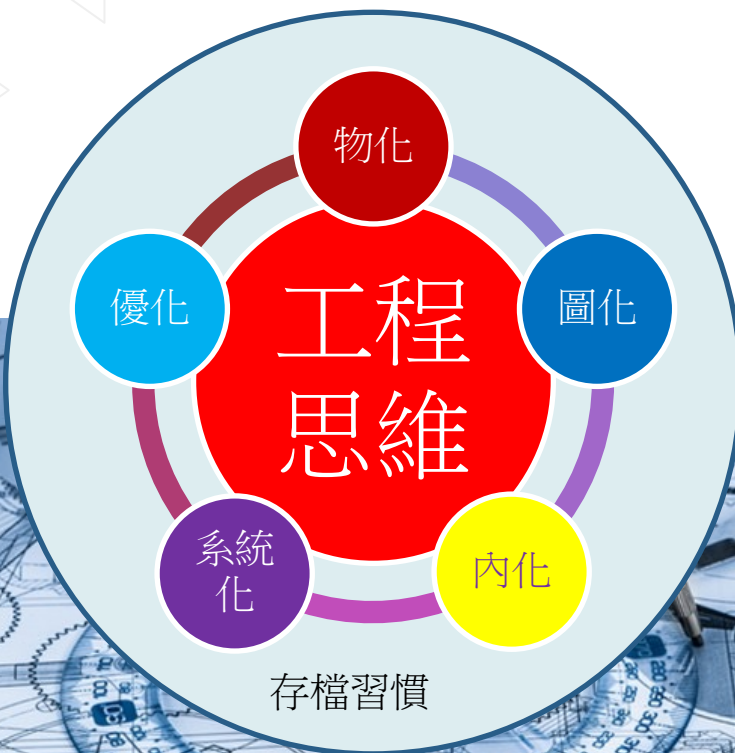


STEM 科藝素養

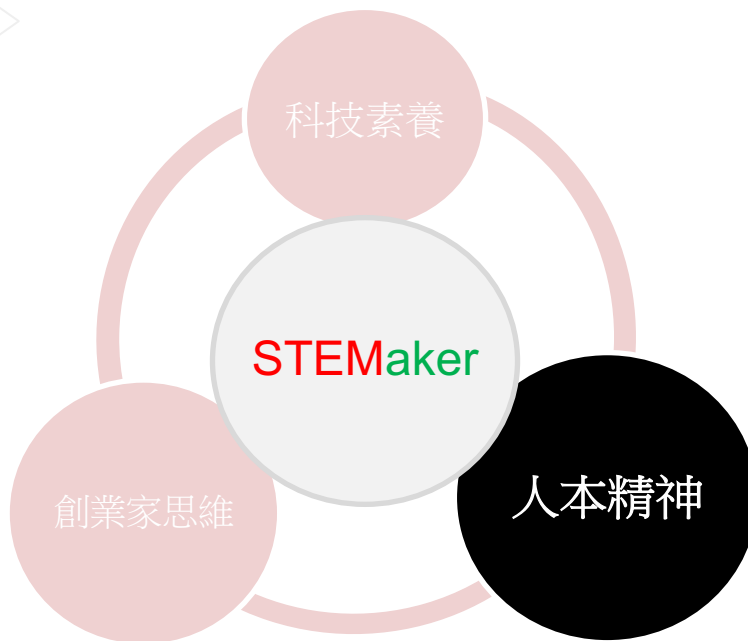


均衡而廣博的科技知識基礎同解難能力

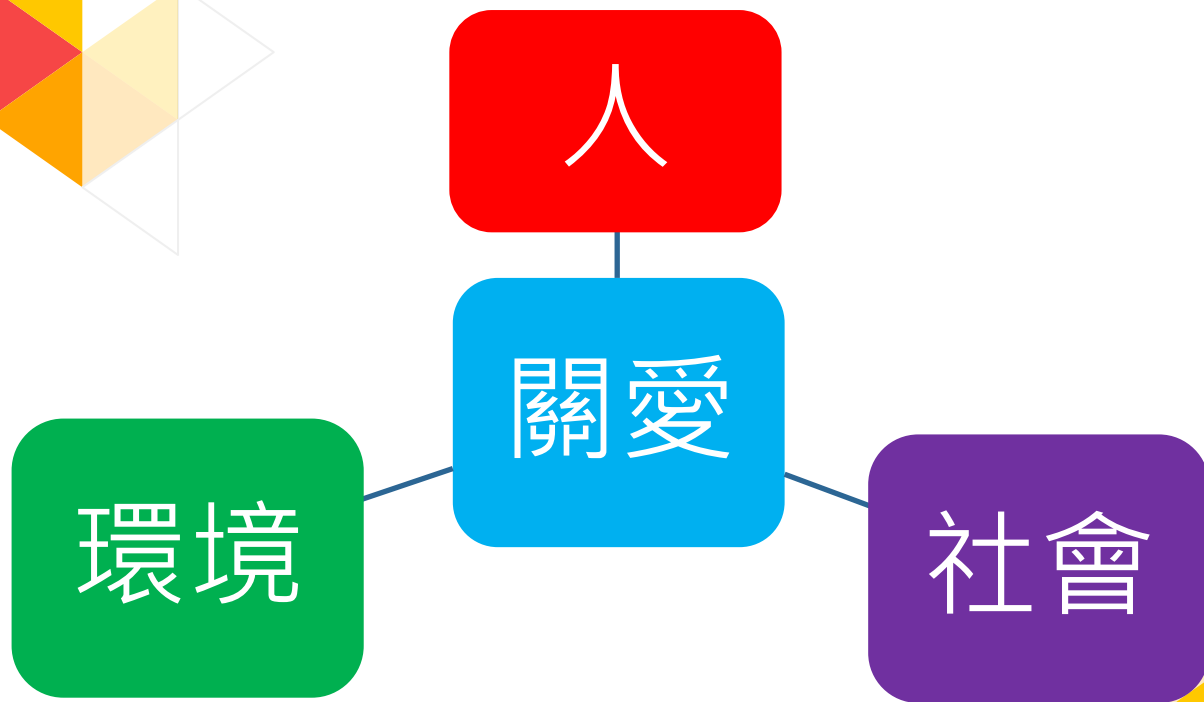
工程思維



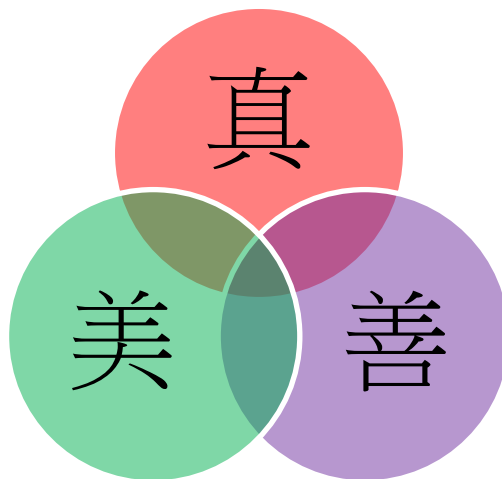
科藝創建師 STEMaker 特質



人本精神

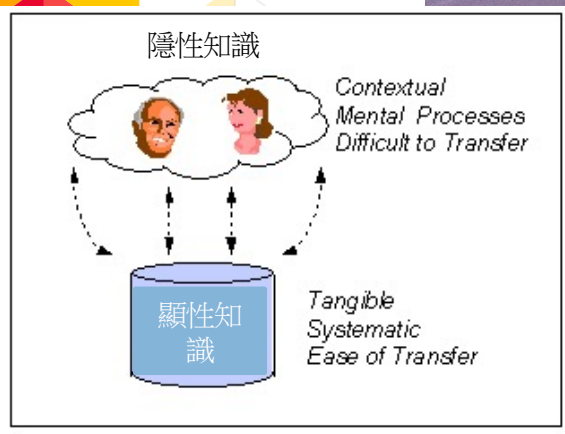


人本精神.../三大追求方向



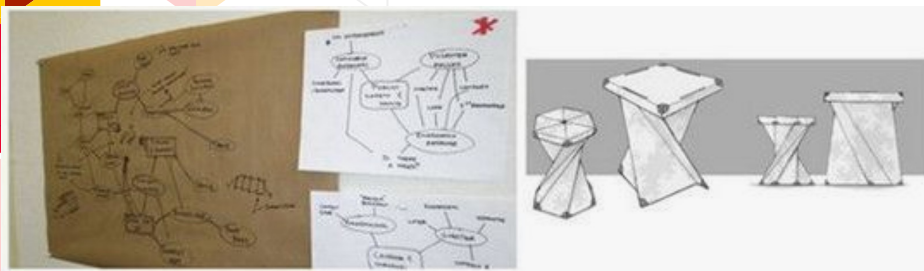
真 - 真確經歷，物化成果

Authentic experience and Tangible outcome



創意更是必需從手做起





- 真實製作出來才知



- 試過方知!



善 - 與人為善，善待環境

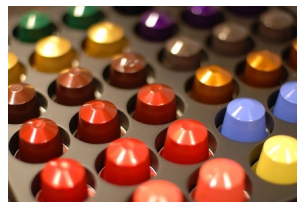
- 對人、對社會、對環境關愛
- 關心尊重他人、環境
- 瞭解使用者與人的關係
- 有責任的使用和創新科技



這科技是否人本？



新咖啡機簡化一切



即用即棄膠囊，
簡化清潔程式



有用的咖啡渣頓變垃圾

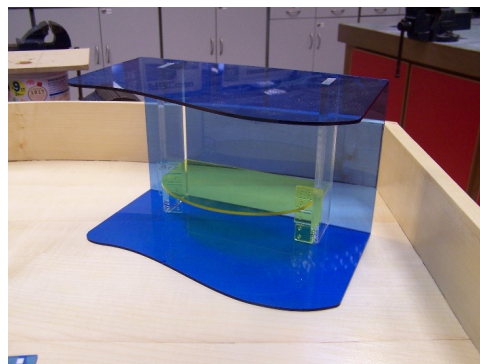
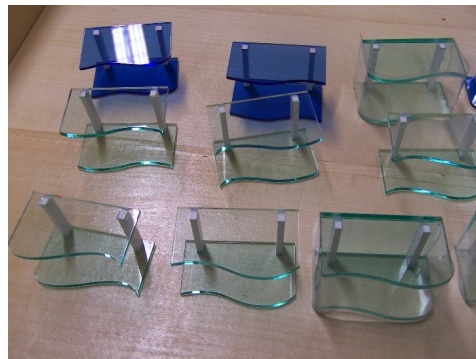
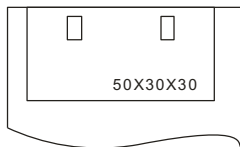
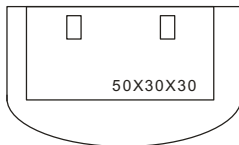
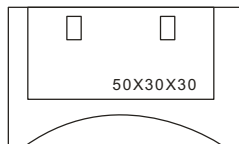
善.../無用之用，方為大用

- ◀ 持續發展設計
 - ◀ 升級再造



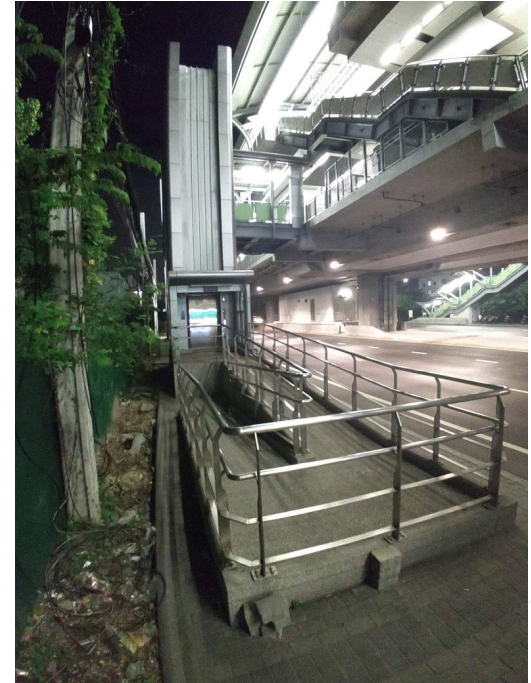
美 - 追求質素，力臻完美

由簡單的意念開始，探尋最美造型。

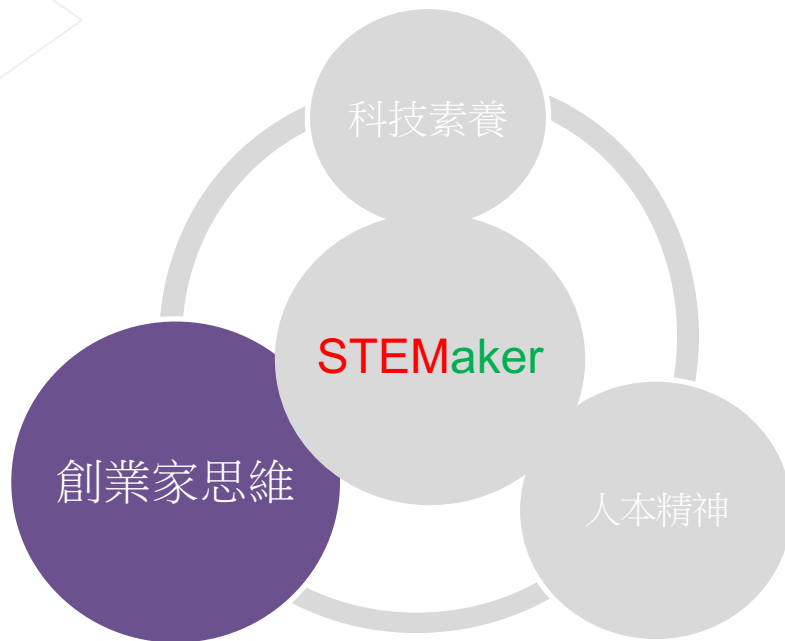


Anthropocentric project design

- ▶ Be kind to human, to environment and to our society



科藝創建師 STEMaker 特質



創業家思維

- 團隊合作teamwork
- 協作collaboration
- 預算 budgeting → BOM
- 計畫 project plan
- 排程 scheduling
- 市場行銷 marketing
- 溝通communication
 - 視覺Visual
 - 口語Oral
 - 文字written

Project Summary Task
task identifying entire project





STEMaker 科藝創建師

The notion of STEMaker is put forward by Hong Kong Technology Education Association (HKTEA) in March 2015 as the essential means to implement STEM Education. Its core exponents are Mr. Kin Kwok Wan, Mr. Alan, Ka Lun Wong, Dr. Charlie, King Wah Ng and Mr Antony, Wai Yip Leung. By addressing the changing economic scene in HK, the notion highlights the endeavour to nourish creative talents who will contribute to the economy development with technological innovations. This is in line with Premier Li Ke-qiang's strategic comment "Mass and grass-roots entrepreneurship" (大眾創業、萬眾創新) on sustainable economic development of China in future.

「STEMaker 科藝創建師」為香港科技教育學會於 2015 年 3 月發表的 STEM 教育策略建議。此建議倡議人主要為溫建國老師、黃家倫老師、伍敬華博士及梁偉業老師。建議主要針對香港特有的營商環境，提出可持續發展的人才培育模式，並同時配合國家「大眾創新、萬眾創業」的國策，親意為香港新一代培育優秀創新人才。

何為 STEMaker 科藝創建師？What is STEMaker?

能動手兼動腦，透過科技實踐過程去解決現實困難，並能創新發明的新一代。STEMakers are "thinker and doer in one person" in our future generation who undertake technological process with tangible outcome to innovate and solve realistic problems.

為何要有 STEMaker 科藝創建師？

配合普世科技發展，由一群 STEMaker 科藝創建師所建立的小型企業團隊，將不停開發新產品，自行通過網路籌募，管理外列生產及行銷推廣，組成小型創意企業 Small Innovative Enterprise (SIE)。此等 SIE 勢必成為香港未來主要的實質經濟體，為香港提供龐大的高科技勞動人力市場，推動香港產業走向高增值、高水平的地步，成為香港未來經濟的其中一支重要支柱。

Given the rapid technological advancement, it is envisioned the future generation will likely be involved in "small innovative enterprises" (SIEs). SIE comprise of several young entrepreneurs that

- focus on the design and development of client-oriented products involving a range of technologies and related sciences and Maths concepts and understandings,
- raise capitals through cloud-funding,
- depend on the collaboration and effective communication among members to operate and flourish,
- are flexible in making timely adjustment to cope with the challenges and fluidity of global market.
-

SIE will become mainstay of the HK production economy and also the drive to emerge into high standard and value-added industries.

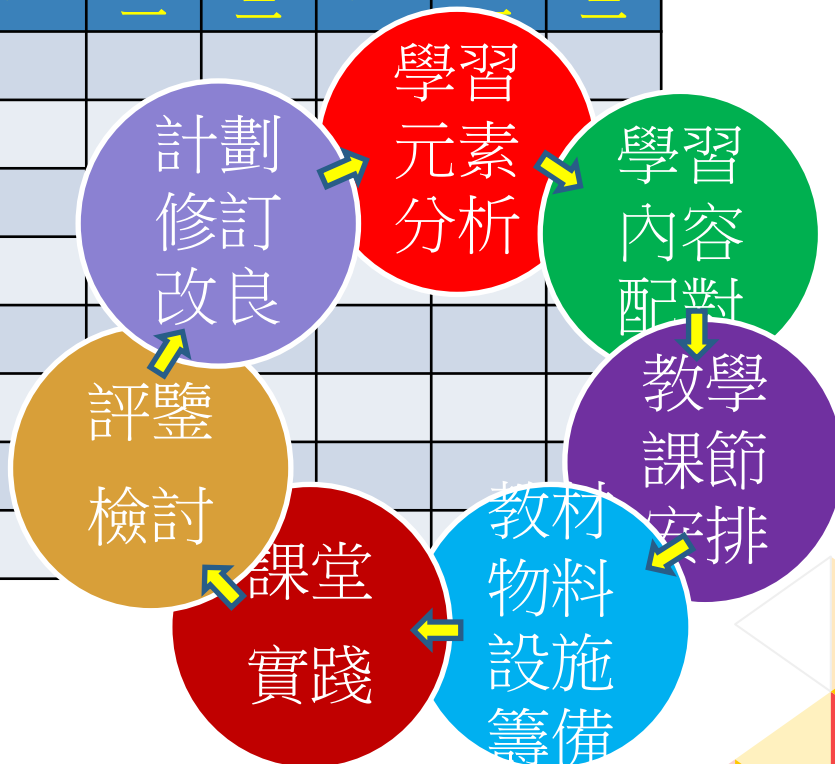
聚焦



課程

科藝創建師習作跨課程安排

學習元素	初一	初二	初三	高一	高二	高三
Science(PCB)						
Technology						
Engineering						
Mathematics						
Language						
Arts						
PE						
Others						



STEMaker

Project

Planning Form

科藝創建師習作規劃表

STEMaker Project Planning Form 科藝創建師集作規劃表

題目	
年級	
難題	
教學情境	
課程實施模式	每週固定課節上課／課程統整單元／一學期專題研習／每學年專題研習月／每學年專題研習周／每學年一次科技日／其他：
所需時間 (課節)	
學習元素	S-科學
	T-科技
	E-工程思維
	M-數學
人本精神	
創業家思維	
對人、社會和環境 的影響	
生涯規劃元素	
備註欄	

©香港科技教育學會

STEMaker Project Planning Form 科藝創建師集作規劃表

題目	
年級	
難題	
教學情境	
課程實施模式	每週固定課節上課／課程統整單元／一學期專題研習／每學年專題研習月／每學年專題研習周／每學年一次科技日／其他：
所需時間 (課節)	

學習元素	S-科學
	T-科技
	E-工程思維
	M-數學
人本精神	
創業家思維	
對人、社會和環境的影響	
生涯規劃元素	
備註欄	

©香港科技教育學會



Project Implementation Plan

習作施行方案

課堂教案											
<table border="1"> <tr> <td>年級</td> <td colspan="2"></td> </tr> <tr> <td>教師</td> <td colspan="2">習作分組性質 ☐ 個人 ☐ 人—組</td> </tr> <tr> <td>習作單元 () 教學週、每週 () 節、每節 () 分鐘</td> <td colspan="2"></td> </tr> </table>			年級			教師	習作分組性質 ☐ 個人 ☐ 人—組		習作單元 () 教學週、每週 () 節、每節 () 分鐘		
年級											
教師	習作分組性質 ☐ 個人 ☐ 人—組										
習作單元 () 教學週、每週 () 節、每節 () 分鐘											
習作目標 完成本習作後，你將可以...	預期完成樣子										
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
習作大綱 設計及製作											
習作要解決之問題											
材料提供	工具設備	預備件									
設計時需要的繪圖技巧											

PROJECT PLAN_BLANK 1

設計技巧		製作技巧	
習作中運用的科技知識			
人本知識		創庫家思維	
習作帶來的影響			
人	社會	環境	
探究及實驗			
教學資源			
建議網址			

PROJECT PLAN_BLANK 2

課堂教案

年級	
教師：	習作分組性質 ☐ 個人 ☐ 人一組
習作需時：()教學週，每週()節，每節 ()分鐘	

習作目標	預期完成樣子
完成本習作後，你將可以... 1. 2. 3. 4. 5. 6. 7. 8.	
習作大綱	
設計及製作_____	

習作要解決之問題

材料提供

工具設備

預製件

設計時需要的繪圖技巧

PROJECT PLAN _BLANK

1

設計技巧			製作技巧
習作中運用的科技知識			
人本精神			創業家思維
習作帶來的影響			
人	社會	環境	

探究及實驗

教學資源

建議網址

PROJECT PLAN _BLANK

2



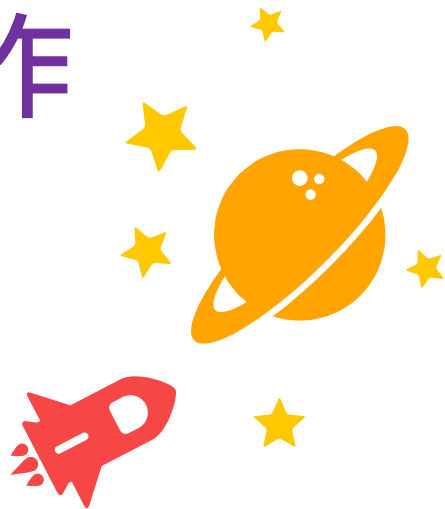
聚焦



習作

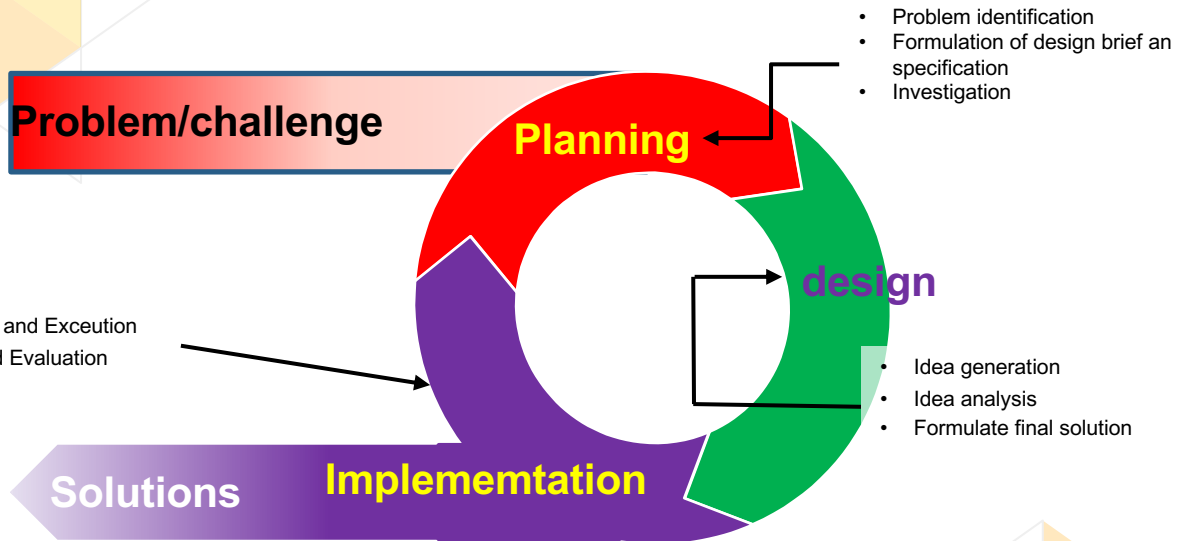
怎樣才算好習作

What is a good project?

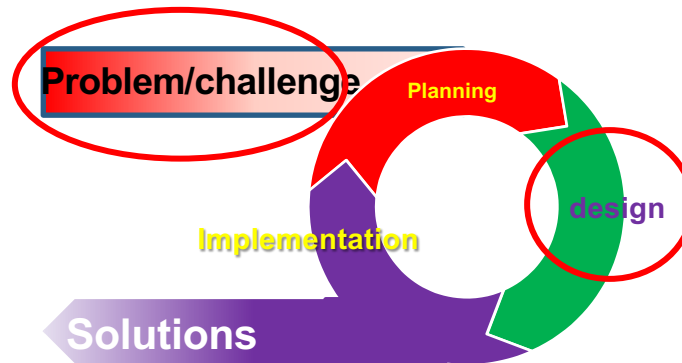


Design Cycle

- design is the process and technique in solving problem.



- ▶ Problem Identification (PI)
- ▶ Idea Generation (IG)



Problem Identification

How to define a problem?

My arm is too short to cut my nails...



Different kinds of Problem

Four types of Problem

Based on the creativity space of the problem:

Title-based Problem
<i>To design and make an egg opener</i>
Task-based Problem
<i>To design and make a device to open an egg with one minute</i>
Problem-based Problem
<i>To design and make a device to open egg as many as possible in shortest time</i>
Theme-based Problem
<i>Fast food shop need to open lots of eggs every morning</i>



Comparison

	Title-based Problem	Task-based Problem	Problem-based Problem	Theme-based Problem
Characteristics	• Every students do the same • Follow simple instruction	• Students need to finish task under certain limitation	• Students need to define the limitations of a problem	• Students need to define the problem
Difficulty				
Creativity	• Mainly on shape and colour	• Could be on mechanic design	• Mainly on idea to solve the problem	• Problem somehow maybe creative
Uncertainty				

8 level of STEM activities

1. Craft skill project



2. Scientific investigation



3. Model making



4. Project using kits



5. Programming project



6. Project on embedded system



7. Problem-based project



8. Career orientated project

1. Craft skill project

- Traditional DT project
- Stress on craft skill
- Long production time
- Need a special room/workshop



2. Scientific investigation

- Coached by science teachers
- Clear aims and objectives
- Effective in training experimental skill of scientific investigation process

DIY 天然環保橘子清潔劑

材料：橘子皮、市售 75%酒精、玻璃罐、噴瓶



e.g. : apply scientific theory to understand the acidity of different fruits, learn the relationship between cleaning effect and acidity, finally cue students to extract eco-cleaning agent from fruits.

3. Model making

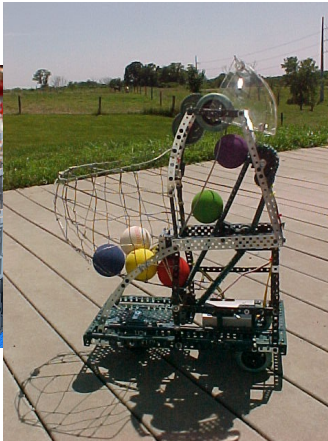
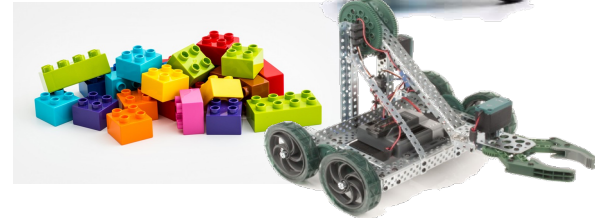
- Using ready made or pre-fabricated model
- Task mainly is assembling
- Fixed procedure and product
- Students may learn how to use different tools and may experience scientific theory involved
- Cultivate basic manual skills
- Quick way to know how to manage tools and fabrication process
- High yield rate
- Full of sense of satisfaction
- Effective means to arouse interest



e.g. solar car model

4. Project using kits

- No fixed product outcome
- More flexible
- Could be problem-based or title-based project
- Common commercial kits are lego 、Fishertechnik 、mBot 、VEX and Metas. Strong satisfaction, easy to start.
- Limitation on material
- Students cannot realize the actual world

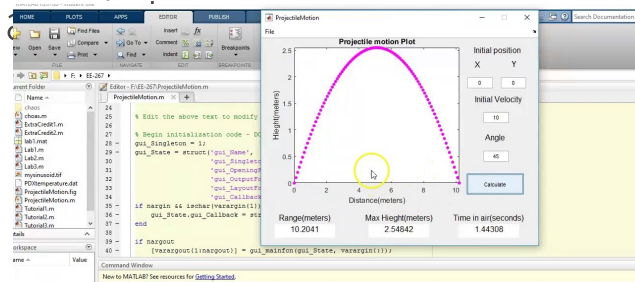


Title-based example :
To design and build a castle with lego

Problem-base example :
To design and make a robot for
assisting tennis playing

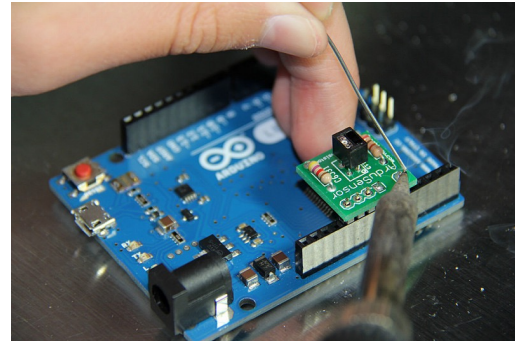
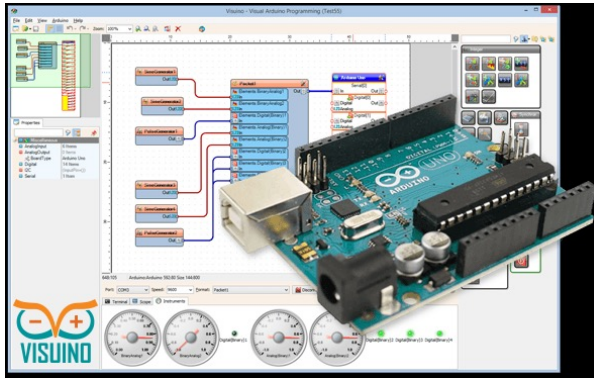
Programming project

- Programming project is the most easiest way to start STEM
- Could make use of topics from science or mathematics, select some problem from them and write a programme to solve it. e.g. simulation programme for calculating projectiles motion of cannon
- Exercises can be done on mobile device, which provide a convenient platform 7 x 24



Project on embedded system

- Open source hardware and software e.g. Arduino
- Coding + electronics



7. Problem-based project

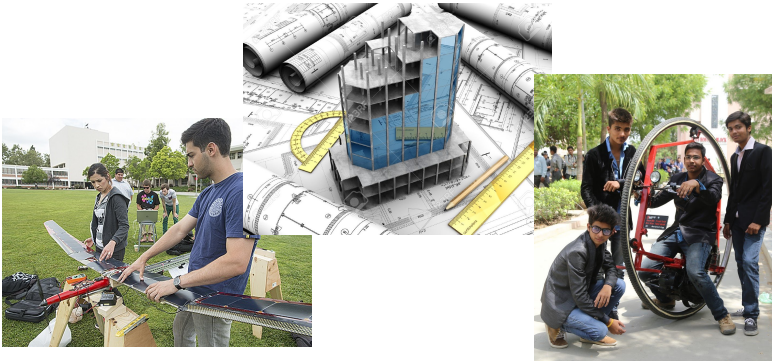
- Difficult to handle
- No clear aims and guidelines
- Students need to analyze the scenario, sorting out the basic problem, consider factors affecting the design and formulate the design specification.
- More problem will be brought out during the process of solving problem, teachers hence to teach something unexpected, i.e. “Learning on Demand”
- Need to handle uncertainty
- Realistic innovation activities



e.g. elderly are found difficult to take bus

8. Career orientated project

- Problem that related to specific career
- As an extension of problem-based project
- Sense of career orientation



	outcome	Hands-on experience	Tools and materials	Process involved
1. Craft skill project	Crafted work piece	Skill practice	Preset	Preset
2. Scientific investigation	Findings	Experimental skill	Preset	Preset
3. Model making	The model	Assembling skill	Preset	Preset
4. Project using kits	Different model	Assembling skill	Preset	Allow limited changes
5. Programming project	Program/apps/ website	Coding skill	Preset	Mainly preset
6. Project on embedded system	Workable model	Coding and wiring skill	Preset	Allow changes on the hardware part
7. Problem-based project	product	Various practical skill	Uncertain	Uncertain
8. Career orientated project	product	Skill related to specific career	Uncertain	Uncertain

How to create creativity?

$$\text{Creativity Space} = \frac{\text{uncertainty} * \text{Resources}}{\text{Limitation}}$$

Similarities

- All have an outcome / product
- All are hands-on activities
- All involve tools and materials
- All undergo process

Project = Product + Process

1. Craft skill project	Put it back in a scenario and define a real problem for that project, make rooms for students to create.
2. Scientific investigation	Should not be a standalone project. However, let's collaborate. Try to adopt appropriate scientific investigation into every project.
3. Model making	Should have it's value on skill training, but please don't said its STEMaker project.
4. Project using kits	It is worth to have it as a strategies on idea generation. Any outcome cannot be a final product. Do you want to have everything make up from lego bricks?
5. Programming project	Should not be a standalone project. However, let's collaborate. Try to adopt appropriate programming skill into projects that appropriate.
6. Project on embedded system	Without a tangible product as vehicle, the outcome is merely a demonstration on some ideas only, but it is worth to employ it in our project if possible.

Checklist for a STEM project

- What is the scenario of the problem?
- What is the problem the project need to be solved?
- Who are the users?
- Will it have a tangible product as outcome?
- Do you really use the product? (e.g. water filter)
- Will the project (including the process and the product) be good to our society, human and our environment?
- Will you buy it? In terms of money, how much you willing to pay for it?



聚焦



創新 + 解難



Thank You

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