





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



STEMaker

STEMaker: thinker and doer in one person

科藝創建師



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。



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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




中一至中三級校本教材

13-1-2017 跨科組會議

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甚麼是「STEM科藝」？

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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)

S cience科學
T echnology科技
E ngineering工程
M athematics數學
Language 語文
Arts 藝術
PE 體育
Others 其他

知識

+

技能



具體及有創意的解決方案

STEM並非單單涉及S、T、E、M四個科目

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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。

STEMaker 2019/3/1 科藝創建師 教師

科藝創建師

聚焦



創新 + 解難

STEMaker 12

科藝創建師

甚麼是「科藝創建師STEMaker」？

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科藝創建師

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 = STEMaker 科藝創建師

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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)



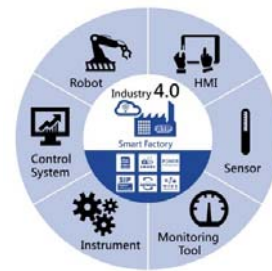
香港工業發展新方向!

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S I E 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 物聯網的廣泛應用)
- ▶ 利用大資料 (big data) 進行深耕用者需



K **GO**

S I E 小型創意企業需要怎樣的人才?

Indiegogo、FlyingV)

「雙創人才」!

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聚焦



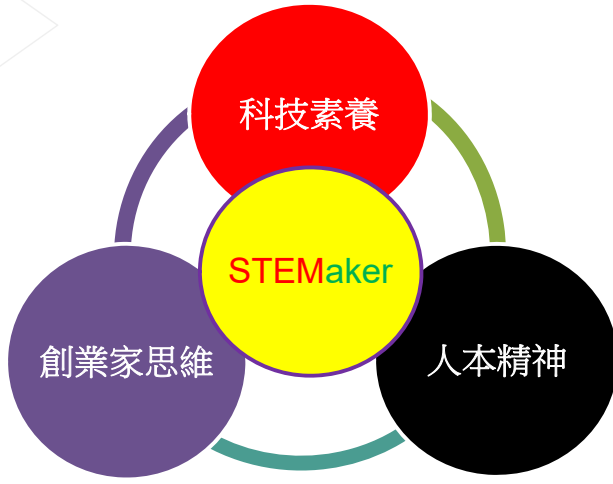
素質

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科藝創建師 STEMaker 特質



科技素養

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創業家思維

人本精神

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STEM 科藝素養

均衡而廣博的科技知識基礎同解難能力

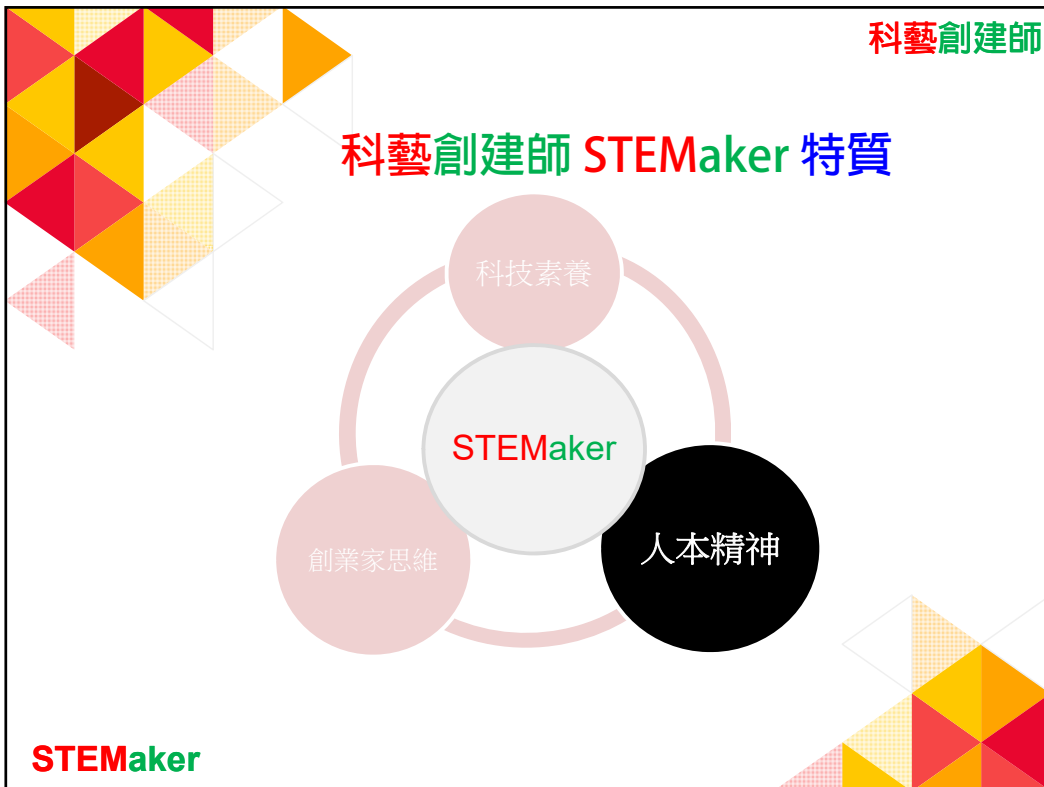
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工程思維

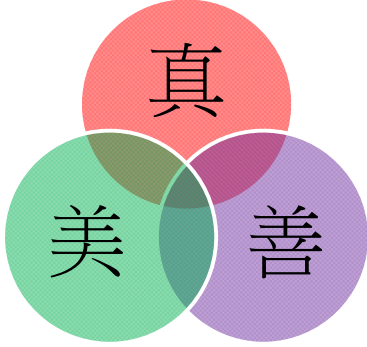
存檔習慣

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人本精神.../三大追求方向



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真 - 真確經歷，物化成果
Authentic experience and Tangible outcome



創意更是必需從手做起

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- 真實製作出來才知
- 試過方知!

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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

沖咖啡入門手冊

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

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善.../無用之用，方為大用

- ◀ 持續發展設計
 - ◀ 升級再造

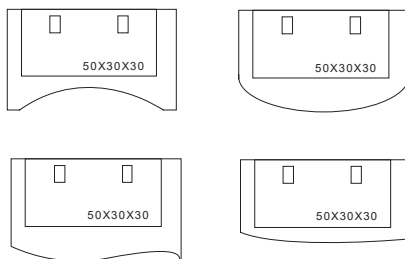


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美 - 追求質素，力臻完美

由簡單的意念開始，探尋最美造型。



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Anthropocentric project design

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



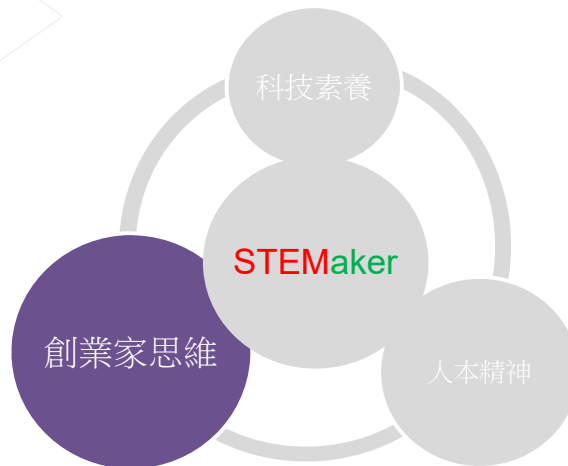
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教師

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科藝創建師 STEMaker 特質



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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 market
- ▶ 溝通 communication
 - ▶ 視覺 Visual
 - ▶ 口語 Oral
 - ▶ 文字 written



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、伍啟華博士及黃偉棠老師。建議主要針對香港特有的經濟環境，提出可持續發展的人才培育模式，並同時配合國家「大眾創業、萬眾創新」的願景，願意為香港新一代培育優秀創科人才。

何為STEMaker 科藝創建師? What is STEMaker?

能夠手兼數職，透過科技實踐過程去解決現實困難，並能創研發明的一代。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?

配合香港科技發展，由一群STEMaker 科藝創建師所建立的小型企業團隊，將不得開發創產品，自行透過網路籌資，管理創科生產及行銷業務，組成小型創科企業 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技術勞動人力市場，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.

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聚焦

課程

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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						

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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	
創業者思維	
個人、社會和環境的影響	
生涯規劃元素	
備註欄	

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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)	

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科藝創建師集作計劃 教師培訓
 2019/3/1

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	

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Project Implementation Plan 習作施行方案

課堂教案

年級	
教師：	習作分組性質 <input type="checkbox"/> 個人 <input type="checkbox"/> 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	

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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




科藝創建師培育計劃
2019/3/1

教師培訓
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設計技巧		製作技巧	
習作中運用的科技知識			
人本精神		創業者思維	
習作帶來的影響			
人	社會	環境	



科藝創建師培育計劃
2019/3/1

教師培訓
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探究及實驗
教學資源
建議網址

PROJECT PLAN _BLANK 2

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聚焦



習作

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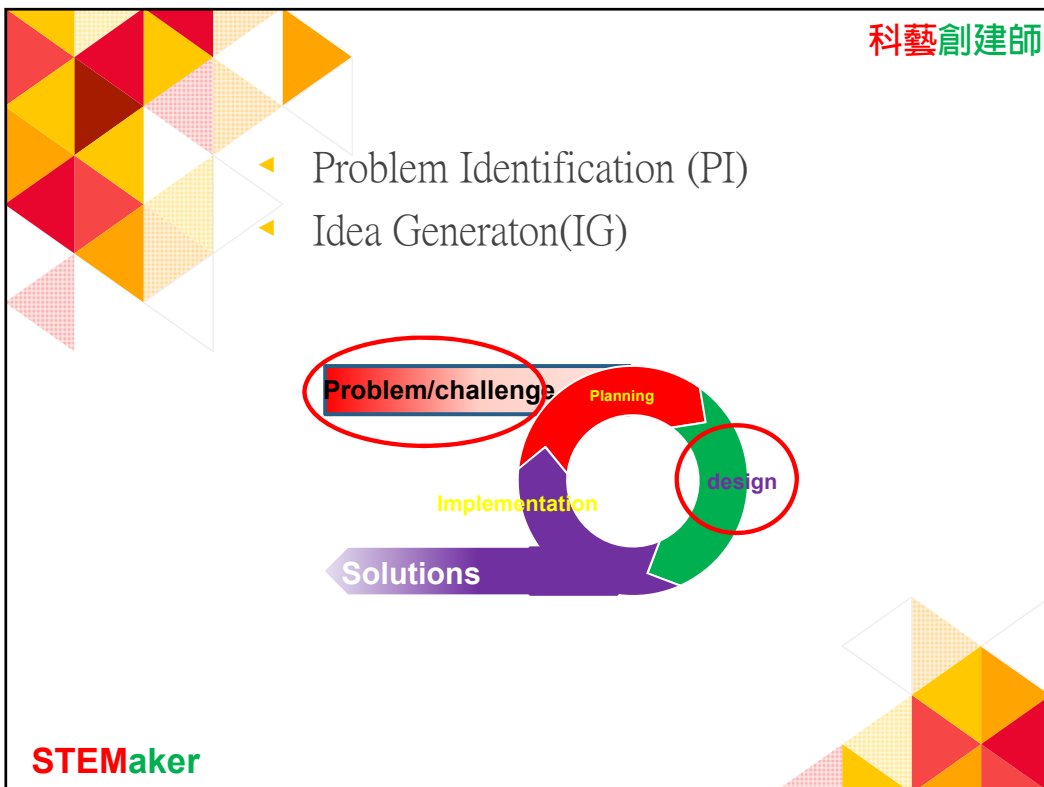
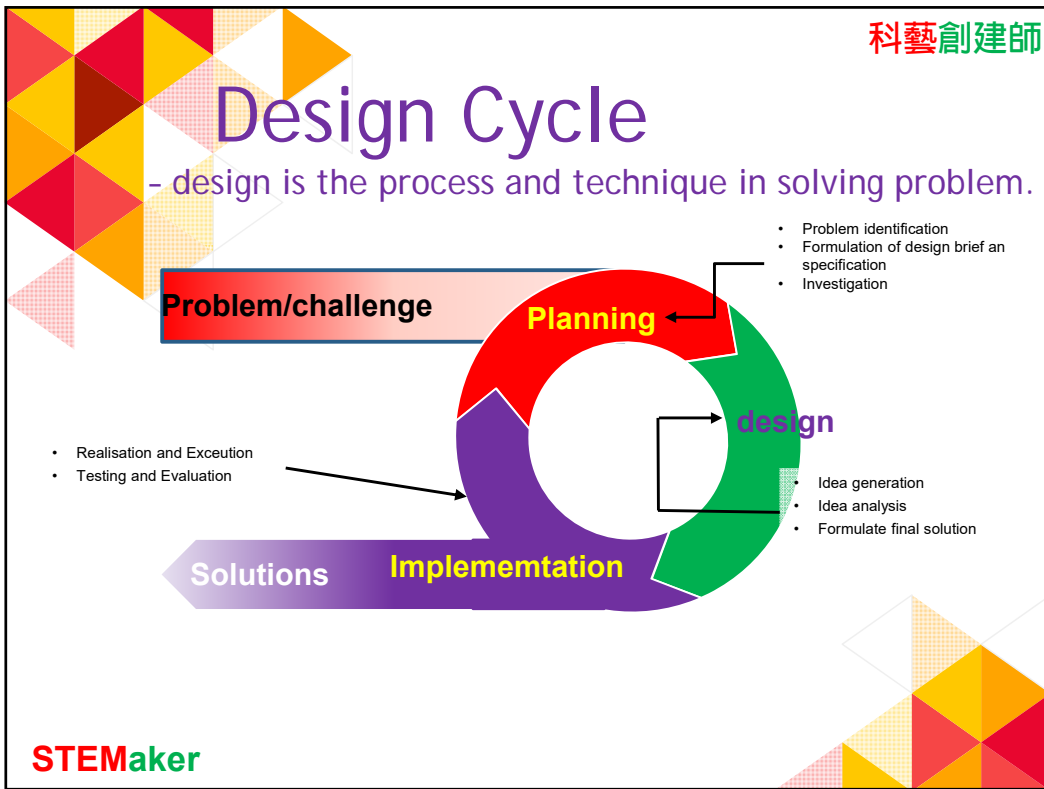
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怎樣才算好習作

What is a good project?



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Problem Indentification

How to define a problem?

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



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The slide features a decorative geometric pattern of triangles in red, yellow, and white on the left side. The text 'Problem Indentification' is in a large purple font. Below it, a question 'How to define a problem?' is followed by a thought bubble containing a cartoon character with a very short arm, struggling to cut his nails. The character is wearing a blue and white striped shirt and an orange hard hat. The 'STEMaker' logo is in the bottom left corner.

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Different kinds of Problem

科藝創建師培訓 教師培
訓工作坊 2019/3/1

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The slide features the same decorative geometric pattern of triangles on the left side. The title 'Different kinds of Problem' is in a large black font. In the bottom right corner, there is a small text box containing the text '科藝創建師培訓 教師培 訓工作坊 2019/3/1'. The 'STEMaker' logo is in the bottom left corner.

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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>



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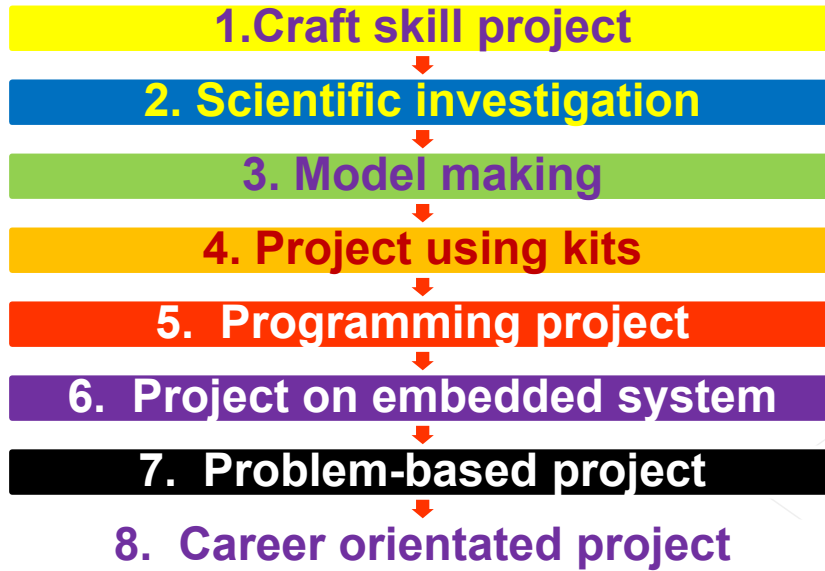
Comparison

	Title-based Problem	Task-based Problem	Problem-based Problem	Theme-based Problem
Characteristics	<ul style="list-style-type: none"> • Every students do the same • Follow simple instruction 	<ul style="list-style-type: none"> • Students need to finish task under certain limitation 	<ul style="list-style-type: none"> • Students need to define the limitations of a problem 	<ul style="list-style-type: none"> • Students need to define the problem
Difficulty				
Creativity	<ul style="list-style-type: none"> • Mainly on shape and colour 	<ul style="list-style-type: none"> • Could be on mechanic design 	<ul style="list-style-type: none"> • Mainly on idea to solve the problem 	<ul style="list-style-type: none"> • Problem somehow maybe creative
Uncertainty				

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8 level of STEM activities



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1. Craft skill project

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

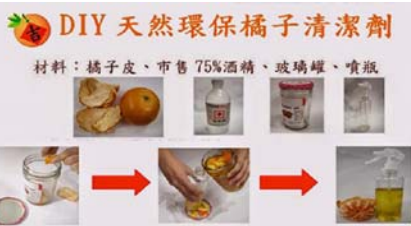


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2. Scientific investigation

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



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.

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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



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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

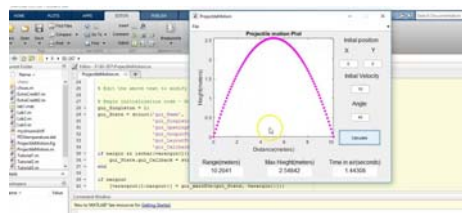


Title-based example :
To design and build a castle with lego

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

Programming project

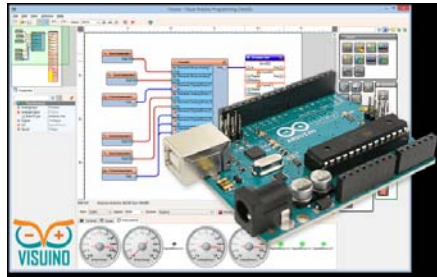
- Programming project is the most easiest way to start STEM
- Could make use of topics from science or mathematics, select some problem from them and write a program to solve it. e.g. simulation program for calculating projectiles motion of cannon
- Exercises can be done on mobile device, which provide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



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Project on embedded system

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



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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

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8. Career orientated project

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




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e.g. architecture, logistics, vehicle, environment, ...

	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

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How to create creativity?

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

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Similarities

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

Project = Product + Process

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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.

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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?

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聚焦

創新 + 解難

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The cover features a magnifying glass with a green handle and a blue lens, positioned over the text. The background is decorated with a pattern of colorful triangles in shades of red, yellow, and orange, some with halftone patterns.

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Thank You

antony@hktea.org

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The back cover features a pattern of colorful triangles in shades of red, yellow, and orange, some with halftone patterns, arranged in a vertical column on the right side.