

How Universities can help Secondary/Primary schools in STEM – HK as example

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 - HK participation: kids @ust +....

STEM in HK

- *Before 2015, science and mathematics education have been going downhill continuously in HK*
 - General knowledge and language skill are emphasized in university admission criteria
 - Decreasing number of secondary school students taking science and mathematics in HKDSE
- *CE Policy address 2015: STEM will be a focus of government effort ⇒ Joint effort of Gov, NGO, Commerce, Charity organizations, etc. in promoting STEM since 2016*

STEM in HK

- *EDB support to schools: one-off funding to ALL schools on build STEM projects (HK\$200K/100K for Sec/Pri schools) for 2016/17.*
- *Special Project funds from EDB and/or other charity organization on STEM projects (e.g. Jockey Club project on coding/computational thinking + many more)*
- ⇒ *Huge expansion in STEM-related activities since 2016*
 - over 1000 STEM activities from over 100 providers in Yr. 2016; (Croucher Foundation Survey
 - http://www.croucher.org.hk/wp-content/uploads/2017/02/CF_STEM_study2015-16.pdf)
 - Many STEM conferences/festivals/..... in HK,.....

STEM as commercial opportunity

- *HK Learning and Teaching Expo 2016 (Dec)*
<http://ltexpo.com.hk/show/exhibitor-list/>

Google “STEM” in HK

- *About this result • 17 Best ideas about Stem Projects on Pinterest | Stem activities, What ...*
- <https://www.pinterest.com/explore/stem-projects/Similar>
- Find and save ideas about Stem projects on Pinterest, the world's catalog of ideas. | See more about Stem activities, What is stem and Flood barrier hub.
- *36 Resources for STEM Project-Based Learning Activities*
- <https://globaldigitalcitizen.org/36-stem-project-based-learning-activitiesCached>
- Jul 22, 2016 - We've compiled a list of terrific STEM project-based learning activities that can be tailored to meet your students' needs. Our list breaks down the learning activities by subject: Science, Technology, Engineering, and Math.
- *50+ Genius STEM Activities for Kids - The Stem Laboratory*
- thestemlaboratory.com/stem-activities-for-kids/Cached

STEM in HK

- **Commercialized STEM**
 - Quality control
 - No long-term plan for EDB and majority of schools
 - Lack of understanding and support by parents
- **Lack of coordination between Gov/Edu/Hi-Tech sectors**
 - *The collaboration of the three sectors were emphasized by almost all foreign speakers in STEM conferences*
 - *(STEM is composed of many areas; which area should HK invests in?)*
 - *(Notice universities were largely left out in the process)*

STEM in HK

- **HK Gov/EDB**
 - Successful first step: raise awareness of STEM via giving resources; How to proceed further? (Long Term Plan?)
 - How/whether to involve universities and Hi-Tech Industry?
 - How to educate general public (parents)? (public understanding/support is essential)
 - China factor



STEM to scientists worldwide

- **The essence of STEM**
 - STEM signifies the coming of a new era where technology will affect human lives in an un-precedential way. It is more than a particular technology or invention.
 - Everyone has to learn to understand this new era (STEM for all)
 - Some may learn to become STEM practitioners (working on one particular STEM field)
- **First Step in STEM education (for everyone)**
 - The Language of STEM - Learn to Think Like a Scientist/Mathematician (TLS)
 - Learn some important findings in science (in order to understand technology)

STEM to scientists worldwide

- **A TLS consortium is now under formation (led by D. Pines at Santa Fe Institute) with Scientists from**
 - USA, China, Taiwan, Hong Kong, France, Denmark,
 - Also: Nobel Prize Laureate, (retired) President of AAAS, President of APS, etc.
 - The first worldwide meeting/Summit for seed members will held at July 8-12 2017 at Aspen, USA.
- **First Goal of TLS**
 - To propose new curriculum, set(s) of new teaching material + new teaching methodology for junior secondary + senior primary schools
 - Test run the primary TLS materials in HK

STEM to scientists worldwide

- **First Goal of TLS**
 - To propose new curriculum, set(s) of new teaching material + new teaching methodology for junior secondary + senior primary schools
 - Step one: consolidating existing materials
 - Step two: introduce new (or up-to-date) learning tools (gamification, Citizen Science project, etc.) where appropriate
 - Step three: initial products
 - Primary schools: hands-on activities (not mind-off)
 - Secondary Schools: MOOC type course
 - Step four: more sets of materials
 - HK will be involved in the project
 - Invitation for Macau to participate (test-run in schools?)

Examples

- **UIUC show (Mat A. Selen)**
 - <http://web.hep.uiuc.edu/home/mats/whysguy.html>
- **LAMAP (France)**
 - <http://www.fondation-lamap.org/en/international>
- **Global trend: Citizen Science and gamification**
- https://en.wikipedia.org/wiki/List_of_citizen_science_projects
- <https://www.scienceathome.org/games/quantum-moves/game>

TLS methodology

- **Scientific approach as a habit (primary level)**
 - Be curious
 - Carry out hands-on experiments, observations, and analysis
 - Use probes to make measurements
 - Look for patterns
 - Search for connections
 - Learn to collaborate and communicate through participation in group work
- **Understanding Scientific thinking (primary/junior secondary levels)**
 - Be skeptical
 - Record results and analyse data
 - Check for consistency
 - Recognize that there can be more than one solution to a problem

TLS methodology

- **Understanding Scientific thinking (primary/junior secondary levels)**
 - Be skeptical
 - Record results and analyse data
 - Check for consistency
 - Recognize that there can be more than one solution to a problem
- **Scientific Methodology (junior secondary level)**
 - Know how to get science-based facts and observations from the web
 - Set goals and plan
 - Search and explore
 - Understand systematic and statistical errors
 - Explore synergies
 - Devise scenarios and logical alternatives
 - Appreciate that a negative result, done the right way, is a productive accomplishment, and a positive result done the wrong way, is an exercise and opportunity to reflect on the path to realizing greater skills.

TLS –Big Ideas in Science

Published by Science Education Program, IAP

www.interacademies.net/publications/26703.aspx

- **For Primary Schools**
 - Objects can affect other objects at a distance
 - Energy; Conservation of energy
 - Chemical Reactions and connections
 - Making Stuff
 - Our solar system is a very small part of one of billions of galaxies in the Universe
 - The diversity of organisms, living and extinct, is the result of evolution
 - etc

HKUST's contribution

- **Primary school program (kids@ust) (since 2000)**
 - To provide enrichment activities for Hong Kong primary students
 - Composed of games, daily examples and hands-on experiments
 - Activities jointly designed by HKUST professors and undergraduates



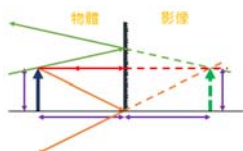
Kids@UST Workshop

Duration:	3 hours (Half-day)
Venue:	HKUST
Subject:	Mathematics and Integrated Science
Target Participants:	P.3 – P.6 students (aged 8-13)
Students enrolled per year:	Around 1500 primary school kids
No. of Workshops per year:	6+ rounds/ year
Workshop Instructors:	HKUST Undergraduate Students

Science Workshop Topics

Physics

- Optics
- Mechanics
- Pressure
- Density
- Surface Tension
- Aeronautics
- Electricity and Magnetism
- Sound
- Energy
- Center of Mass



Science Workshop Topics

Chemistry

- Acid Base Chemistry – Neutralization
- Reaction kinetics
- Forensic Science
- Static Electricity
- Earth Science



Mathematics Workshop Topics

Life Science

- o Sensory System in Human Body
- o Environmental Science
- o Dissolution and Osmosis Waves
- o Plant Biology and Ecology
- o Food Science
- o Human physiology



Mathematics Workshop Topics

Mathematics

- o Algebra
- o Game Theory
- o Cryptology
- o Geometry
- o Coordinates
- o Topology
- o Logic
- o History of Mathematics
- o Probability
- o Combinatorics



HKUST's contribution

- *Goal: Can this form of program be introduced to other places?*
- *(video)*
- *Thank you very much for your attention!*