Strengthening Self-directed Learning in STEM to Nurture 21ˢᵗ Century Skills

STEM (Science, Technology, Engineering and Mathematics) is defined as a focus for development at all levels of education, and particularly at K-12 levels around the world. In the United States, the National Academy of Science and the National Science Foundation have been leaders in this area, with their Next Generation Science Standards, as well as the resources for teacher professional development and for classroom teaching.

Here in Hong Kong, Professor Nancy Law, Founding Director of the Centre for Information Technology in Education and who is also known internationally for her work as a learning scientist, is leading a team of researchers in a massive two-and-half-year project to facilitate the development of STEM education via Self-directed Learning (SDL) techniques at upper primary and lower secondary levels.

Said Professor Law: "The reason for the strong policy attention is the recognition that STEM Education needs to be strengthened to nurture 21ˢᵗ century skills, and to foster creativity, innovation and entrepreneurship."

While noting that no definitive evidence exists that Hong Kong is falling behind, Professor Law suggests that there are causes for concern. She cites the results from the International Computer and Information Literacy Study, conducted under the umbrella of the International Association for the Evaluation of Student Achievement in 2013 (ICILS 2013), which showed that Hong Kong students' computer and information literacy skills were the lowest among all economically developed countries participating in that study, yet Hong Kong students' level of computer and internet access was among the highest.

The Myth of "Digital Natives"

"The results show that access and frequent use of digital technology for entertainment and personal/social communications are not adequate to ensure that students have the requisite digital competence," said Professor Law. "The Study results also showed that the 'digital natives' assumption – that is, those who grow up with ample access to digital technology are automatically digitally competent – does not hold."

The Hong Kong Jockey Club-funded project aims to bring Hong Kong up to scratch by focusing on STEM education to foster creativity, innovation and entrepreneurship, promoting e-learning and digital competence, nurturing 21ˢᵗ century skills and empowering schools to adopt self-directed learning in STEM.

Leadership Networks Designed to Transform Learning

This project began in March 2019 and will run until August 2021. It involves 18 primary and 14 secondary schools working together with Professor Law's team to set up and develop a Transformative Learning Leadership Network (TLLN) for 21ˢᵗ century schools, an innovation network that will promote transformative SDL in STEM education.

"The TLLN refers both to senior leaders (principal, vice-principals, school-based curriculum
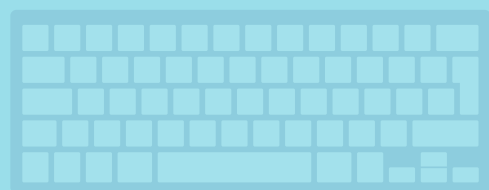
Professor Nancy Law spoke at Jockey Club Self-directed Learning in STEM Programme March 2019 Inception Meeting and Workshop.

development heads and panel heads) and other teachers involved in the project in the participating schools," said Professor Law. "The Network is to foster school level change leadership capacity involving senior and middle management staff to motivate, steer and scale STEM innovations for transformative learning in the school.

"Building leadership capacity is key to ensure, one: deep changes in how learning, teaching and assessment take place on a day-to-day basis; and two: interdisciplinary collaboration among teachers from different STEM disciplines to achieve the goal of providing integrated STEM learning experiences to students."

In providing support for teachers to develop and implement STEM innovations, the project will be inventive on many levels. Explained Professor Law: "At the classroom learning and teaching level, the focus will be on professional development and specially designed technology tools to help teachers design the learning environment (physical, digital and social) and learning experiences (design of learning tasks and interactions) for students.

"At the holistic school strategic change level, it will guide school-based strategic development plans for STEM innovation as a whole-school initiative for sustainable impact – and not simply a couple of teachers for a year or two.

"At the Network level, it will build mentorship capacities by working together with designated mentor schools."

Research Goals and Implications
Design-based implementation research for sustainable and scalable technology-enhanced innovations is Professor Law's core research area, and her focus for the project is to implement, evaluate and refine the TLLN Model for all kinds of technology-enhanced transformative learning for 21st century skills.

In broader terms, this work is already impacting policy in that some of the principles in the project [which evolved from Professor Law's other previously funded projects supported by Research Grants Council (RGC), Education Bureau (EDB) and Quality Education Fund (QEF)] are now influencing the EBD and QEF in their formulation of funding programmes to universities and schools to support curriculum and pedagogical innovations in their school-based professional development support programmes.

Concluded Professor Law: "I hope this project can serve as a fertile ground for generating technological tools, and pedagogical and leadership models that serve to advance and sustain the STEM educational goals beyond the schools already involved."