Research Assessment Exercise 2020
Impact Case Study

University: The Education University of Hong Kong
Unit of Assessment (UoA): 13 Computer studies/science (incl. information technology)

Title of case study: Improving education through promoting e-Learning and computational thinking

(1) Summary of the impact

Prof KONG Siu-cheung plays a key role in education reforms conducted by Hong Kong government. The reforms set to develop students' competiveness by boosting their skills in e-Learning. He has led the reforms through his two-decade research commitments as a key expert for governmental policy, school practice and teacher development on e-Learning, having system-wide impact. His on-going research in a four-year pilot on computational thinking education (CTE) has benefited 16,500 students and 112 teachers to pioneer the first CTE curriculum in Hong Kong, and influenced 537 local primary school heads and over 4,000 local parents to better understand and perceive CTE in Hong Kong.

(2) Underpinning research

Prof Kong Siu-cheung, Professor in the Department of Mathematics and Information Technology and Director of the Centre for Learning, Teaching and Technology, is recognised globally for his research in the areas of pedagogy in the digital classroom; policy on technology-transformed education; and computational thinking education (CTE). Since 2000, he has led 52 research projects related to these research areas in both international and local contexts.

Prof Kong is a recognized expert in e-Learning pedagogies, notably involving a.) mathematics education and b.) information literacy (IL) and critical thinking through e-Learning. For the former issue, he led a Quality Education Fund (QEF) project on inquiry-based mathematics e-Learning in 15 local primary schools in 2015 to 2017. Four sets of topic-specific e-resources were developed for open access to address the pressing need for e-resources evident to facilitate students' significant enhancement of mathematical concepts and procedural knowledge. For the latter, he completed longitudinal research in 2011 to 2014 on the flipped classroom strategy, supporting 124 secondary school students to enhance IL and critical thinking in Integrated Humanities classrooms across Secondary 1 to 3. This pedagogical innovation was confirmed effective to develop, from a subject-specific perspective, the necessary knowledge and proper attitudes fundamental to IL, and the skills in hypothesis identification, induction, deduction, explanation and evaluation which are fundamental to critical thinking **[R1, R2]**. Territory-wide, this was scaled up through the local IL teacher network, building on this longitudinal school-based experience with empirical evidence.

Prof Kong has since 2004 deployed his research expertise through leading 13 government-sponsored projects that empirically informed policy-planning and supported policy-implementation and policy-evaluation related to e-Learning. These focused on student competency development, teacher professional development, school-based policy planning, curriculum-based resources distribution, and subject-specific pedagogical innovations. Three representative projects since 2007 include the development of school-based planning resources packs (2008) informed by school leaders in 18 primary schools, 20 secondary schools and five special schools; the development of an online depository for subject-specific learning and teaching resources across all 8 Key Learning Areas (2009) informed by online questionnaire surveys with 2,182 teachers across 12 subjects; and the evaluation of the territory-wide Pilot Scheme on e-Learning in Schools (2014) involving 11 selected project cases with 37 participating schools **[R3], [R4]**. In December 2012 to December 2015, Prof Kong convened an internationally collaborative practice-driven research for a pioneer meta-analysis of e-Learning directions for the coming 10 years. **[R5]**.

With the growing focus of e-Learning on empowering students to be creators of IT innovations, since April 2016 Prof Kong has extended his research to computational thinking

education (CTE), which cultivates logical thinking and problem-solving skills. He is leading a four-year project funded by Hong Kong Jockey Club Charities Trust – CoolThink@JC project – in partnership with Massachusetts Institute of Technology (MIT), City University of Hong Kong and SRI International for pioneering CTE in local primary schools. This is the worldwide first for a holistic plan and consistent implementation of CTE, involving curriculum development, teacher development, school implementation and parent education at a city-wide level. The first phase piloted the framework and materials for a CTE curriculum at Primary 4 to 6 in 32 primary schools with 16,500 students. The initial results of the on-going empirical evaluation reveal that students' interest is a determinant for a successful CTE curriculum **[R6]**. Its success has led a further three-year phase.

(3) References to the research

[R1] Kong, S. C. (2014). Developing information literacy and critical thinking skills through domain knowledge learning in digital classrooms: An experience of practicing flipped classroom strategy. *Computers and Education*, *78*, 160-173. (SSCI-listed journal, Impact factor at 2014 is 2.556, Rank 8 among 224 ranked journals in Education & Educational Research, Rank A*; Scopus 70 citations; 11275 downloads/views since uploaded onto the journal website)

[R2] Kong, S. C. (2015). An experience of a three-year study on the development of critical thinking skills in flipped secondary classrooms with pedagogical and technological support. *Computers and Education*, *89*, 16-31. (SSCI-listed journal, Impact factor at 2015 is 2.881, Rank 9 among 231 ranked journals in Education & Educational Research, Rank A*; Scopus 10 citations)

[R3] Kong, S. C. (2018). Parents' perceptions of e-learning in school education: Implications for the partnership between schools and parents. *Technology, Pedagogy and Education, 27*(1), 15-31. (SSCI-listed journal, Impact factor at 2016 is 1.066, Rank 124 among 235 ranked journals in Education & Educational Research, Rank A; Scopus indexed)

[R4] Kong, S. C. (2019). Partnership among schools in e-Learning implementation: Implications on elements for sustainable development. *Educational Technology and Society*, 22(1), 28-43. (Rank A)

[R5] Kong, S. C., Chan, T.-W., Griffin, P., Hoppe, U., Huang, R., Kinshuk, Looi, C. K., Milrad, M., Norris, C., Nussbaum, M., Sharples, M., So, W. M. W., Soloway, E., & Yu, S. (2014). E-learning in school education in the coming 10 years for developing 21st century skills: Critical research issues and policy implications. *Educational Technology and Society*, *17*(1), 70-78. (SSCI-listed journal, Impact factor at 2014 is 1.018, Rank 73 among 224 ranked journals in Education & Educational Research, Rank A; Scopus 23 citations)

[R6] Kong, S.C., Chiu, M.M., Lai, M. (2018). A study of primary school students' interest, collaboration attitude, and programming empowerment in computational thinking education. *Computers and Education*, *127*, 178-189. (SSCI-listed journal, Impact factor at 2017 is 4.538, Rank 4 among 238 ranked journals in Education & Educational Research, Rank A*)

(4) Details of the impact

(i) Impact on education policy

Prof Kong has influenced and improved e-Learning policy in Hong Kong through research commissions, some of which are cited directly in policy documents; and participation in key governmental committees. He has conducted 21 government funded research projects since 2004 covering issues such as: student competency development (e.g. IL Framework for Hong Kong Students in May 2018); teacher professional development (e.g. three-dimension IT Training Framework for teachers since February 2007); school-based policy planning and curriculum-based resources distribution in the standardized platform (e.g. EDB One-stop Portal for Learning & Teaching since May 2012). He led territory-wide evaluations of the Second and Third Strategies on IT in Education, and the second-part evaluation of the territory-wide Pilot Scheme on e-Learning in Schools in 2013 to 2014. The 23-case evaluation gave insights into the school-cluster approach to e-Learning, which informed and was cited in the government's *Fourth Strategy on Information Technology in Education* **[C1, p23]**. Moreover, Prof Kong has contributed advice to and influenced policy-makers as a member of three governmental committees: i). Assessment and Monitoring Sub-

committee of the Quality Education Fund (QEF) (February 2011 to January 2017); ii). Curriculum Development Council (CDC) Committee on Learning Resources and Support Services (September 2011 to June 2017); and iii). CDC-HKEAA Committee on Information and Communication Technology, HKSAR EDB (2015-2019). The government adopted Prof Kong's advice to include artificial intelligence education and prepare supplementary documents on CTE for primary schools. The former Chief Curriculum Development Officer (IT in Education) affirmed Prof Kong's contribution **[C2]**: "The rich outcomes of the projects supervised by Prof Kong have concretely contributed to the planning, implementation and evaluation of local policies on IT in education."

(ii) Impact on teaching and educational practice, and student learning

Impact on directions for e-Learning. Prof Kong convened World Education Research Association (WERA) International Research Network (IRN) *Theory and Practice of Pedagogical Design for Learning in Digital Classrooms* in December 2012 to December 2015. He led IRN for journal publications (e.g. **[R5]**); three panel presentations and four panel sessions in China, Indonesia, Japan and Taiwan in 2013 and 2014; and 10 invited speeches in China, Hong Kong, Japan, Macau, Romania, Singapore, Sweden and Taiwan since 2016. The high citation rate of the IRN article **[R5]** reflects IRN insights have reached educational practitioners and policy-makers in 20 countries/regions in Europe, Asia, Africa, North America and South America. Impacts are made in the areas of e-Learning blueprint; e-Learning practice (subject learning and skills development); e-Learning assessment; e-Learning infrastructure; and e-Learning perception (students and teachers).

Impact on e-Learning in Integrated Humanities subject. Prof Kong was the consultant for Lai King Catholic Secondary School on e-Learning for IL in Integrated Humanities curriculum in June 2011 to August 2014. Besides benefiting 151 students of IL development through subject learning along three years of junior secondary study, Prof Kong's consultancy supported the school's set-up of territory-wide teacher network for IL education in August 2014. The Head of IT of the school reflected the project's longer-term impact had "promoted our school to continuously reflect on the school-based strategies for integrating IL education into everyday curriculum delivery" **[C3]**.

Impact on mathematics e-Learning. Prof Kong led a QEF project on the use of technology for innovating mathematics inquiry from March 2015 to May 2017. The trial teaching benefited 15 primary schools, 50 teachers and 1,810 students. Project materials were opened to all local primary schools via QEF's cloud-based repository **[C4]**. Project insights reached the public via two press conferences and three newspaper articles. The vice-principal of a project school affirmed the project significance for "enhancing the quality of school-based mathematics curriculum development according to the latest trends of e-Learning in school education" **[C5]**. The project e-resources were well-received by mathematics teachers. Prof Kong chaired a post-project seminar, as invited by QEF, for over 150 local teachers who all quested for the meaningful pedagogies in using these open-access e-resources for supporting students' mathematics inquiry. Commissioned by Li Ka Shing Foundation for a 34-month research since March 2018, Prof Kong has extended his impact on mathematical concept development through e-Learning platform "Cornerstone Mathematics". Project kick-off was a summer camp in July 2018, which benefited over 150 students and teachers from six local secondary schools to learn and teach mathematical concepts dynamically and reached audiences of at least a million people, through print, TV and online media coverage **[C6]**.

Impact on computational thinking education. Prof Kong is leading CoolThink@JC project for a large-scale pilot on the first CTE curriculum for Hong Kong primary schools, involving 112 teachers and 16,500 Primary 4 to 6 students from 32 schools in the first phase of the project. The CoolThink@JC Learning Platform has recorded 52,800 student login hours and 1,400 teacher login hours **[C7]**. Over 1,000 participants from 15 jurisdictions (including policy-makers and school practitioners besides academic researchers) engaged in CTE experience-sharing in the International Conference on Computational Thinking Education organized by Prof Kong's team in 2017 to 2019. In parallel with 2018 and 2019 conferences, in each year near 5,000 participants from local primary schools (with parents besides students and teachers) joined a coding fair for CTE outside the campus **[C8-9]**. Wider public and professional awareness and support for CTE has been achieved through

extensive general and specialist media coverage the project and conference have attracted, featuring Prof Kong as the expert voice **[C10-12]**. The project involves a further 30 schools in 2018-19 school year, with the established foundation to guide the next generation to participate in and contribute to the digital world. Mr Cheung Leong, Executive Director of the Hong Kong Jockey Club Charities Trust, affirmed that the project deliverables had exceeded expectations and noted: "Contributions made by Prof Kong established a strong foundation to scale up CT education in Hong Kong's primary schools." Government has taken this forward by releasing a draft supplementary curriculum document on CTE in November 2017 **[C13]**. Mr Cheung also affirmed the project's impact in management education, having been adopted as a case study for the MBA programme of Chicago Booth School of Business, as "a model of strong global and local collaboration".

(5) Sources to corroborate the impact

[C1] The Fourth Strategy on IT in Education in the Global Context, May 2014. Education Bureau, 2014 http://www.edb.gov.hk/attachment/en/edu-system/primary-secondary/applicable-to-primary-secondary/it-in-edu/it-in-edu/Policies/4th_consultation_eng.pdf

[C2] Letter, Mr She Mang, former Chief Curriculum Development Officer (IT in Education)

[C3] Letter, Mr Wong Hoi Chun, School IT Head, Lai King Catholic Secondary School

[C4] "Building a Community of Practice (CoP) for Mathematics Teachers: Using Cognitive Tools and Communication Platforms inside and outside Digital Classrooms for Developing Mathematics Concept of Learners": Cloud-based repository: https://drive.google.com/drive/folders/0BydCkxyouCAqN041TUVkNmJHNkk

[C5] Letter, Ms Chan Pui Shan, Vice-Principal, Jordan Valley St Joseph's Catholic Primary School

[C6] Media coverage: (a) Li Ka Shing Foundation (2018.07.17). EdUHK receives donation from Li Ka Shing Foundation to promote Cornerstone Maths. *Li Ka Shing Foundation Press Release*; (b) Hong Kong Economic Times (2018.07.17). Li Ka Shing Donation $10 Million to EdUHK to Promote the Use of Cornerstone Maths. *Hong Kong Economic Times* (In Chinese); (c) HK01 (2018.07.17). EdUHK Receives Donation from Li Ka Shing Foundation to Promote Cornerstone Maths for Supporting Students to Learn Mathematics Functions. *HK01* (In Chinese); (d) Bastille Post (2018.07.17). EdUHK Receives Donation from Li Ka Shing Foundation to Promote the Use of Cornerstone Maths. *Bastille Post* (In Chinese); (e) Hong Kong Economic Journal (2018.07.18). EdUHK Receives Donation from Li Ka Shing Foundation to Promote Cornerstone Maths. *Hong Kong Economic Journal* (Page A10) (In Chinese); (f) Sky Post (2018.07.18). Li Ka Shing Foundation Donates $10 million EdUHK to Promote Cornerstone Maths. *Sky Post* (Page P06) (In Chinese); (g) Now TV (2018.07.22). EdUHK introduces the e-Learning platform "Cornerstone Maths". *Now TV* (In Chinese); (h) Master Insight (2018.07.25). EdUHK introduces the e-Learning platform "Cornerstone Maths" for promoting junior secondary school students to master core mathematical concepts. *Master Insight* (In Chinese)

[C7] CoolThink@JC Learning Platform https://www.coolthink.hk/en/learningplatform/

[C8] International Conference on Computational Thinking Education. (2018) https://www.eduhk.hk/cte2018/

[C9] International Conference on Computational Thinking Education. (2019) https://www.eduhk.hk/cte2019/

Media coverages [C10-12]

[C10] Commercial Broadcasting Company Radio 881 show "Beautiful Sunday: Coding Education in Primary Schools" in Commercial Broadcasting Company Radio 881 (2016.06.26) [9:00 – 10:00 am],

[C11] RTHK Radio 1 (19.08.2017). Radio show: "Computational Thinking Education"

[C12] "Developing Children's Ability and Attitude of Computational Thinking", EdPost (2017, March), published by Hong Kong Education City

[C13] Letter, Mr Cheung Leong, Executive Director of the Hong Kong Jockey Club Charities Trust