When Schools Meet Artificial Intelligence in Hong Kong

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The continuous development in technology has brought forth a renewed interest in artificial intelligence (AI) and how it has and will continue to transform the way we live, learn, and work. It has become clear that nurturing students' abilities and fostering their interests in AI have become necessary in order to prepare them for the future. This article shares our exploratory effort of bringing the AI learning into Hong Kong education.

HONG KONG'S VISION FOR TECH EDUCATION

In principle, the goal of Hong Kong's education system is to align itself with the global trend of encouraging the development of technological skills. The Chief Executive of Hong Kong government, in a recent policy address, stated that the Greater Bay Area in China offers a great opportunity for the next generation to become entrepreneurs and develop new innovative technology based on AI [2]. The Computer Science Teachers Association (CSTA) standards [3] suggests that the concept of AI could be introduced in Level 3B (Grades 11–12, at ages 16–18). As a major education hub in Asia, how do we integrate AI into K-12 curriculum? Are students able to learn and understand the AI concepts earlier than they are currently presented?

To explore these questions, the Education Bureau in Hong Kong has published multiple curriculum guides for the K-12 to direct the pursuit of this goal. In 2015, the Bureau published a report about the promotion of STEM (Science, Technology, Engineering, Mathematics) education [5]. In 2017, they published an updated curriculum guide [6] for Technology Education (TE) which covers Primary 1 (equivalent to grade 1) to Secondary 6 (equivalent to grade 12). TE now stands as one of the key learning areas with which students are expected to engage. The TE curriculum was developed with the intention of focusing on the improvement of everyday life—how social and economic aspects of one's life could be enhanced by learning the latest technologies. The goal is to provide students with transferable skills through solving real-life problems. At the kindergarten level [4], the Bureau proposed to redesign the learning area "Nature and Living" in a way that helps children acquire an initial understanding of modern technology and its impact on everyday life.

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CURRENT STATE OF AI EDUCATION

Governing bodies and organizations overseas are beginning to see the significance of teaching young people AI. In the United Kingdom, on June 29, 2017, a Select Committee on Artificial Intelligence was appointed by the House of Lords. In a report published by the committee in 2018 [9], it was suggested that regardless of the pace of AI development, it will inevitably impact future generations. Thus, the education system needs to adapt to accommodate these changes and ensure that it is adept in preparing young individuals for life with AI. Most importantly, the education system needs to prepare young people with the necessary skills to enter a potentially unpredictable job market. A report comparing Asian countries' competitiveness and readiness in AI, echoes the same sentiments.

> The next generation of workers and entrepreneurs must be equipped with skills that enable them to work with and manage computers and intelligent systems, solve problems that are non-routine and unpredictable, and learn to understand and interpret more complex data [10].

Initiatives overseas to make AI education at the K-12 level a reality have already begun. However, these examples are very few and far between. The Computer Science Teachers Association (CSTA) and the Association for the Advancement of Artificial Intelligence (AAAI) have formed a joint working group responsible for creating national guidelines for teaching AI at the K-12 level. Although these have not yet been published, the joint working group has already established a foundation on which AI guidelines will be grounded through their "5 big ideas" which they believe students learning AI at the K-12 level should know [11]. In Australia, the *Scientists-in-Schools* program has launched a multi-year pilot AI course to students at the K-6 range and have already identified key insights in how AI should be taught at this level [8].

A CASE IN HONG KONG OUT-OF-SCHOOL AI PROGRAM

That being said, schools can look toward collaborating with service providers from the private sector to identify the best means of implementation in a classroom environment. For instance, HKT (Hong Kong Telecommunications Limited) Education section, in collaboration with Koding Kingdom, has launched STEM programs that aim to promote the teaching and learning of AI fundamentals to students throughout the region. These programs include in-person training, teaching tools, and lesson plans [1]. By teaching these courses to lower and upper secondary school students, instructors at Koding Kingdom have gained insights into the most effective teaching tools and pedagogy for the learning of AI fundamentals that have worked best for them at various age groups in Hong Kong. We will share some cases to exemplify the initiative.

The initial AI curriculum of Koding Kingdom focuses on the basic concepts of computer vision and AI being delivered through out-of-school workshops. With new machine learning services being made increasingly available by companies such as Google, IBM, and Microsoft, tools like 'machinelearningforkids.com,' 'Cognimates,' and 'Azure Machine Learning Studio' offered students the opportunity to receive hands-on, first-hand experiences through the creation of machine learning models and AI enabled solutions (e.g., chatbot, image classifier, sentiment analysis systems, AI used in games) with the assistance of graphical or syntax programming interfaces in the future.

In the workshops, for example, students are taught the process of building a machine learning model by going through the data collection process, data organization and labeling, training the model to accurately recognize/predict labels, and finally building an implementation to publish and consume the model (See Figure 1). They are also encouraged to spend time discussing the ethics and broader implications pertaining to the increasing influence of AI in everyday life, including, for example, personalized content recommendation and self-driving cars.

In addition, students are given several projects to do during the course, one of the simplest to train a machine learning model to recognize compliments and insults by typing examples of kind statements and mean statements. Finally, they are asked to create a platform in Scratch to implement the model and build a character that reacts to messages based on sentiment (see Figure 2). The project is completed within an hour and students are asked to work in pairs from a class size of 20 students.

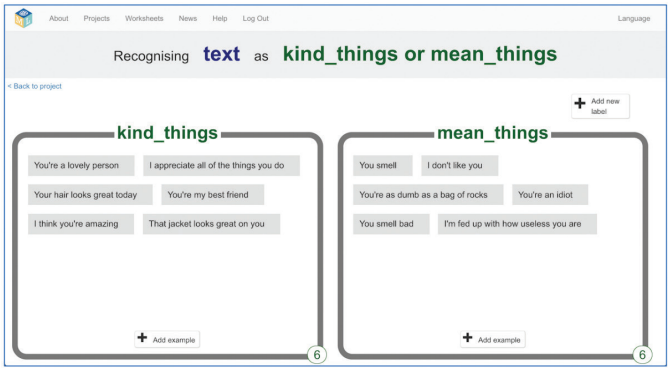

Figure 1: Students creating the database of kind statements and mean.

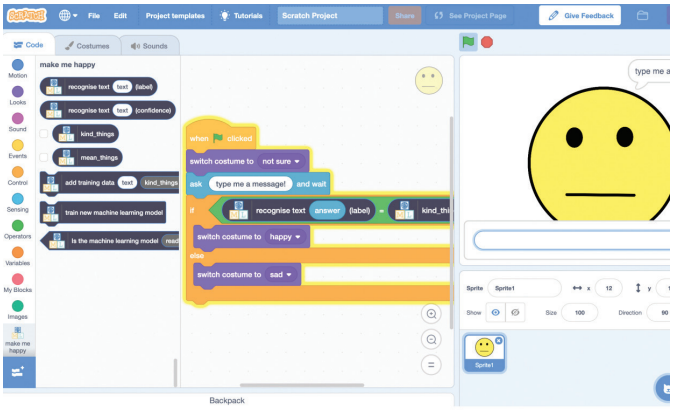

Figure 2: The creation of the scratch platform to use the model created by the student to detect emotions.

Another interesting project is training a machine learning model to recognize pictures of cars or cups (see Figure 3). They then use this to make a project in Scratch that sorts a pile of photos into groups (see Figure 4). The objective of the exercise is to understand how computers can be trained to recognize pictures and the importance of variety in training machine learning systems. Students are asked to work in groups of four for this project, as collecting more images would result in a more accurate model being created and students also learn how to divide work equally and work as teams. The task is also completed within an hour with some extensions to the project achieved by some groups as well.

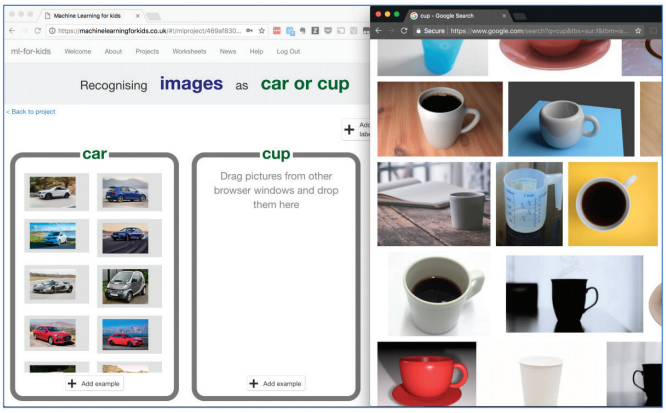

Figure 3: Students collecting pictures of different types of cups and cars to feed into their model.

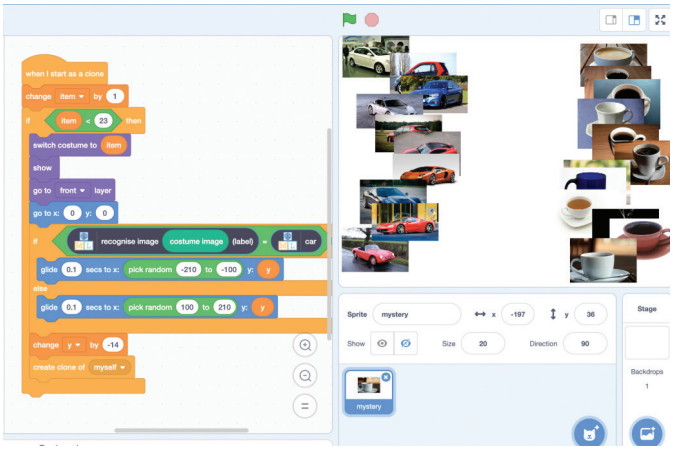

Figure 4: Students building a platform to sort new images never before seen by the model and watching it sort them into groups

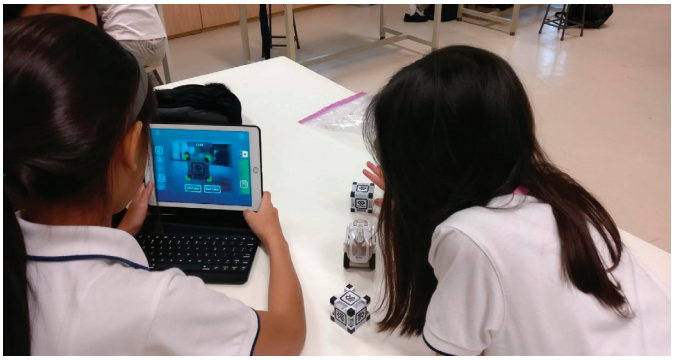

Figure 5: Introduction to AI and Computer Vision using Cozmo for a primary school in Hong Kong

ONE STEP FORWARD IN K-12 AI EDUCATION

The initial AI program has been introduced to several international and local secondary schools in Hong Kong, as part of the extra-curricular activity and 'discovery week' for international schools (where students engage in learning beyond the formal curriculum). Students are generally intrigued in using AI technologies shown to them. However, the instructors did note that the progress of some younger students was inhibited by their foundation in mathematics. Additionally, instructors also posit that due to the general disconnect between their regular school curriculum and the course, several students in the schools struggled to realize the importance of understanding AI in a deeper level.

One of the major difficulties in the advocacy work in AI education for young people is establishing the precise demographic to introduce the subject. Students even in primary schools have shown significant interest in the projects they were undertaking. For example, primary students were introduced to the concept of computer vision in AI application using Cozmo to develop their interest, but they are limited to AI learning due to their conceptual knowledge and practical skills, such as limited development of computational thinking and programming. While many of the concepts and inner mechanisms of AI systems were originally too complex for kids, they could quickly understand how a computer learned as an action that is represented by a game, a story or a character based on our observation and experience interacting with these young students.

In the process of implementation, the aforementioned insights from our collaborative experience are just some factors that need to be keyed in, and the experience of conducting private lessons provide invaluable information in what and how AI should be taught to young people. Delivering similar workshops in the classroom environment requires different requirements and preparation (e.g., hardware, software, teachers' preparation, curriculum design both breadth and depth). Extensive training needs to be provided to those who will teach AI content, and they need to work closely with education specialists in the field—this is especially the case since materials and curriculum for the subject are not readily available across all age groups. Most significantly, it becomes necessary to also identify how AI will fit within the existing TE curriculum in Hong Kong, and whether it is able to prepare students to engage with AI education in the future. Regardless, additional funding will pave a way in which the TE curriculum marks a step in the right direction and may potentially fulfill its vision of truly educating its young people in the latest technologies.

We will soon be launching the first AI education research project in Hong Kong, which will enable us to investigate how to prepare students in developing their computational thinking for AI applications. We want to learn to what extent students can understand concepts and techniques for AI applications. Also, when students explore the AI applications and practice their skills, can students develop awareness on some ethical implications behind the use of AI in our society? We believe AI education can be realized when researchers, educators, teach-

ers, policy makers, and the industrial practitioners collaborate together locally and globally for the curriculum development and practices. Despite the colossal work that needs to be done, this effort potentially signals a bright future for our students in Hong Kong. ❖

References

1. Bushell-Embling, D. HKT Education launches AI learning programs. *Computer World HK* (December 13, 2018); https://www.cw.com.hk/it-leadership/hkt-education-launches-ai-learning-programs. Accessed 2019 Mar 11.
2. Chief Executive's 2018 Policy Address; https://www.policyaddress.gov.hk/2018/eng/policy_ch08.html. Accessed 2019 Mar 14.
3. CSTA K-12 Computer Science Standards; https://www.csteachers.org/page/standards. Accessed 2019 Mar 14.
4. Curriculum Development Council. Kindergarten Education Curriculum Guide: Joyful Learning through Play, Balanced Development All the Way. *Education Bureau of Hong Kong* (2017); https://www.edb.gov.hk/attachment/en/curriculum-development/major-level-of-edu/preprimary/ENG_KGECG_2017.pdf. Accessed 2019 Feb 3.
5. Curriculum Development Council. Promotion of STEM Education: Unleashing Potential in Innovation. *Education Bureau of Hong Kong* (2015); https://www.edb.gov.hk/attachment/en/curriculum-development/renewal/Brief%20on%20STEM%20(Overview)_eng_20151105.pdf. Accessed 2019 Feb 1.
6. Curriculum Development Council. Technology Education: Key Learning Area Curriculum Guide (Primary 1-Secondary 6). *Education Bureau of Hong Kong* (2017); https://www.edb.gov.hk/attachment/en/curriculum-development/kla/technology-edu/curriculum-doc/TE_KLACG_Eng_5_Dec_2017_r2.pdf. Accessed 2019 Feb 26.
7. Government of the Hong Kong Special Administrative Region's Budget Speech for 2019-2020; https://www.budget.gov.hk/2019/eng/budget14.html. Accessed 2019 Mar 11.
8. Heinze, C., Haase, J. and Higgins, H. An Action Research Report from Multi-Year Approach to Teaching Artificial Intelligence at the K-6 level. In *Twenty-Fourth AAAI Conference on Artificial Intelligence*; https://www.aaai.org/ocs/index.php/EAAI/EAAI10/paper/viewPaper/1746. Accessed 2019 Mar 6. Association for the Advancement of Artificial Intelligence ©2010.
9. House of Lords of the UK Parliament, AI in the UK: ready, willing and able? (2018); https://publications.parliament.uk/pa/ld201719/ldselect/ldai/100/100.pdf. Accessed 2019 Mar 14.
10. Pau, J., Baker, J. and Houston N. Artificial Intelligence in Asia: Preparedness and Resilience. *Asia Business Council* (September, 2017); http://www.asiabusinesscouncil.org/docs/AI_briefing.pdf. Accessed 2019 Feb 8.
11. Touretzky, D., Gardner-McCune et al. Envisioning AI for K-12: What should every child know about AI? *Proceedings of the Thirty-Third AAAI Conference on Artificial Intelligence*; DOI: https://doi.org/10.1609/aaai.v33i01.33019795 .

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DOI: 10.1145/3369739