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Analysis of the Connection of United Nations Sustainable Development Goals with the Hong Kong High School Technology Curriculum

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Abstract: United Nations Sustainable Development Goals (SDGs) Target 4.7 stated that by 2030, all learners should acquire the knowledge and skills needed to promote sustainable development. However, only scattered studies outline how SDG knowledge has been taught and assessed in public K12 curricula. This study uses a machine learning approach to identify SDG topics in five technology-related subjects in the Hong Kong Diploma of Secondary Education curriculum. A public training dataset from OSDG and descriptions of subjects were used for the classification. Results of module-/subject-/curriculum-level analysis were used to illustrate the adopted approach's functions.

Keywords: Sustainable Development Goals, classification, curriculum analysis, K12

1. Introduction

In 2015, United Nations established 17 sustainable development goals (SDGs) on sustainable economic growth and social development (United Nations General Assembly, 2015). Target 4.7 stated that by 2030, all learners should acquire the knowledge and skills needed to promote sustainable development. Strategies are needed for the advancement of the SDG education. Hurd and Ormsby (2020) studied how teachers in four US K12 schools taught SDGs in the lesson level. Meanwhile, Zguir, Dubis and Koc (2021) illustrated how governments in countries designed K12 sustainability education at the policy level. However, only scattered studies outline how SDGs have been taught and assessed in the regional or national public K12 curricula. In other words, no mechanisms or protocols have been proposed to analyze how much SDG knowledge have K12 students learned in the curriculum. Measuring the proportion of students who have studied SDGs or sustainability topics during their K12 learning is not easy. For example, Gallwey (2016) discussed challenges in holistically measuring how SDGs have been taught. Furthermore, the curriculum analysis could be challenging to match SDGs with public curricula in practice. Subject teachers also may have difficulties holistically understanding all 17 SDGs. The main purpose of this study is to identify the connection of the SDG education with the general public high school (K10 – K12) technology curriculum in Hong Kong. The research question is: How can topics in high school technology subjects be classified through machine learning according to SDGs? Through the finding of the investigation, government policymakers and school administrators can be more informed about developing high school technology curricula considering SDGs. With better integration of SDGs into the technology curriculum, students are more prepared to adopt technologies to benefit community and the environment by 2030.

2. Research Method

This study analyzes the contents of SDGs in five technology-related subjects provided by high schools (K10 – K12) in Hong Kong. These scope of these subjects are defined in the curriculum of the Hong

Kong Diploma of Secondary Education (HKDSE) by the Hong Kong Examinations and Assessment Authority (HKEAA). The following five technology-related subjects have been analyzed in this study: i) design and applied technology (DAT), ii) health management and social care (HMSC), iii) information and communication technology (ICT), iv) technology and living (TL), and v) Business, Accounting and Financial Studies (BAFS). Every subject has multiple major modules, and the estimated lesson time for each subject is around 250 hours. Subject content is manually extracted from PDF documents located on the HKEAA website. Module introduction, "topics to be learned", and "descriptions of the module" are used to describe the subject. Every subject has its own instruction style, therefore, they do not share an aligned structure of the syllabus.

Meanwhile, our training dataset comes from the OSDG Community dataset (OSDG, 2021). The dataset is mainly based on reports and policy documents from United Nations. These documents are publicly available and often already have SDG labels associated with them. The OSDG community decomposed these documents into records. In 2021, there were around 32000 records of text comprised of 3 to 6 sentences. More than 1000 community volunteers then validated the records on the relevance to originally tagged SDGs. The dataset only includes SDGs between 1- 15 because SDGs 16 and 17 are overarching goals that might pop up in almost all kinds of texts.

The classification procedure that has been used to analyze a university's general education curriculum (Lei et al. 2022) has been used for analyzing DSE technology curriculum. In the machine learning process, frequency-inverse document frequency (TF-IDF) is used in the feature extraction. A multinomial logistic regression algorithm is used for the classification. Relative SDG relevance scores across SDGs 1 to 15 can be obtained for every module of subjects. If the relative relevance score of an SDG is larger than 0.09 (an arbitrary threshold), that SDG will be claimed to be taught in that module.

3. Results

3.1 Module Level Analysis

Figure 1 shows the classified SDGs of two modules in two subjects. Based on Fig. 1 (Left), the module "Entrepreneurship and Enterprise" in the DAT mainly focuses on economic-related SDGs, including SDGs 8 (Decent Work and Economic Growth), 9 (Industry, Innovation and Infrastructure) and 12 (Responsible Consumption and Production). As shown in Fig. 1 (Right), the module "Nutrition, Diet and Health Concerns" in DT mainly focuses on SDGs 2 (Zero hunger) and 3 (Good health and well-being). Generally, in most modules, only one major SDG can be classified. We believe with studying these modules, students can have a better understanding of topics of the classified SDGs.

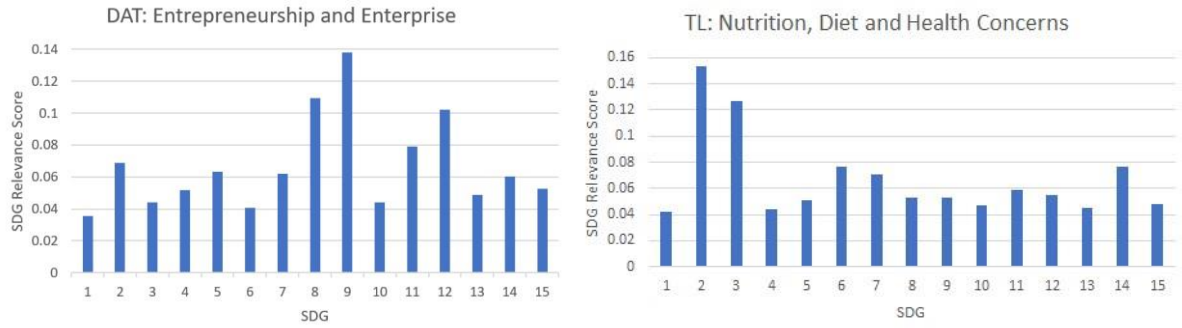

Figure 1. Relative SDG relevance scores in two modules in DAT (Left) and TL (Right).

3.2 Subject / Curriculum Level Analysis

Table 1 shows how SDGs have been taught in the DSE technology curriculum. Results indicated that each subject has its own focus. For example, BAFS and ICT strongly focuses on SDGs 8 and 9, respectively. Every module in HMSC is related to SDG 3. Their focus can also be observed directly via their module title. In TL, seven modules strongly focuses on SDG 2 since these modules mainly focus on nutrition and cooking. Meanwhile, discussions of another seven modules in TL are on textiles and clothing. Therefore, discussions of these modules covers a variety of SDGs. Meanwhile, DAT

covers a spectrum of SDGs, indicating the subject is about applying technologies to resolve various sustainability issues in the community.

Compared to curricula in universities (Lei et al. 2022), the K12 DSE curriculum is found to be less focused on SDG 9. This may be because the high school curriculum focuses more on the foundations of subjects; universities concentrate more on teaching cutting-edge and frontier topics. Topics in SDGs 10 (Reduced inequalities) and 13 (Climate action) are also not yet well discussed in the DSE technology curriculum. We believe these topics are mainly discussed in the "Citizenship and Social Development" DSE curriculum and partially in the humanities and geography DSE curricula.

Table 1. *Number of SDGs Classified in Subject Modules (#: Number of Modules in the Subject): (a) Total number of SDGs Classified, and (b) Proportion (Rounded) of SDGs Classified*

(a)

SDG #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	#
DAT		2		4			1	1	19		2	8		3	1	27
HMSC	1	1	22	1	4	1		1	1						1	22
ICT			3						7							7
TL		7	4		2		1	1	2			4			1	14
BAFS				1	1		2	5	3		1	3		2		11

SDG #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
DAT		5%		10%			2%	2%	46%		5%	20%		7%	2%
HMSC	3%	3%	67%	3%	12%	3%		3%	3%						3%
ICT			30%						70%						
TL		32%	18%		9%		5%	5%	9%			18%			5%
BAFS				6%	6%		11%	28%	17%		6%	17%		11%	

4. Conclusion

Machine learning has been used to identify how SDGs have been taught in five technology-related K12 subjects in Hong Kong. The conducted module-/subject-/curriculum-level analysis indicates the strength and weaknesses of these subjects in covering SDGs in their curriculum. In the future, we aim to conduct a human verification of the results of the classifications based on machine learning. Furthermore, we also hope to classify all STEM-related subjects (e.g., geography) and other subjects in HKDSE, such that we can have a holistic understanding on how K12 students in Hong Kong have learned SDGs through the public curriculum. Furthermore, we want to know how the curriculum can be effectively aligned with SDGs. Therefore, we should collect feedback from principals, teachers, students and other stakeholders. In particular, we should identify the missing pieces in curricula and potential resources that should be provided for promoting SDG education in K12. For example, we can explore whether MOOCs can be used as a supplement for enriching SDG education in K12.

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