An exploratory study of synergistic drivers in advancing the Digital Earth agenda in Japan

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1. Introduction

We here present a progress report on our exploratory study on the different forms of synergistic drivers for advancing the scholarly goals of the Digital Earth initiative in Japanese universities. Our study consists of two components: the development of an analytical framework of synergistic drivers by drawing on the literature, and the application of the framework to newly acquired qualitative data from a wide range of higher education institutions in Japan. We first examine the typology of the synergistic drivers: i) research for student learning, ii) academics working in partnership with students, and iii) linking academic disciplines. Given the diverse higher education contexts, we take a broad definition of education with two distinct but connected forms of activities that university students and academics are commonly involved in: formal education encompasses teaching and education-related activities in different types of universities, whereas informal education includes public engagement and outreach activities in schools. We include institutional examples of the three different forms of synergistic drivers. The significance of the Digital Earth initiative and the Japanese contexts will then be highlighted.

The second part of our progress report will outline the ongoing analysis of the qualitative data collected as part of the exploratory study. There are two investigations: a) a questionnaire-based study on Japanese academics' perceptions of the synergistic drivers and their connections, and b) an in-depth case study of how students and academics from a university in Japan are working in partnership with each other to advance research and education across disciplines. The data collection and analytical methods for this part of the study will be discussed. Finally, we will conclude by highlighting the wider significance of our study in the contexts of advancing the United Nations' Sustainable Development Goals (SDGs) and potential impact on higher education policy making.

Our study is novel in a number of ways. First, our investigations bring academic development and cultural studies together through the lens of social constructs of sensei, senpai and kōhai in education systems. Second, we adopt a participatory research approach (e.g., Cohen et al 2017). In other words, students and academics in the case study are all involved as researchers and participants to critically reflect on their practices. More specifically, the use of the narrative method, an established approach in social sciences (e.g., Cohen et al 2017), will allow us to capture the complexity and nuances of the lived experience of the participants. Third, the findings of our study will not only be of interest to education developers and university policy makers but will also help inform the sustainability-related research and education activities in Japan and beyond.

2.Developing and applying the analytical framework

The principal goal of the analytical framework is to allow us to situate "working with students to enable and enhance learning through interdisciplinary research" in the higher education contexts. To this end, the framework has three inter-connected dimensions as outlined below.

2.1 First dimension: research for student learning

Research-education synergy has been an established area of applied educational research and educational development (e.g., Brew 2006). Whilst teaching-enhanced research has recently become the focus of a number of academic studies (e.g., Brew 2006; Wald and Harland 2017), most of the published work has hitherto been on the integration of research for enhanced student learning (e.g., Healey and Jenkins 2009). There are four main types of research-education synergies (e.g., Healey 2005): research-tutored, research-led, research-oriented and research-based education (Figure 1). The two parameters used in this categorization are:

- students as participants or as audience; and
- emphasis on research content or research processes/ problems

Students as participants

Research-tutored	**Research-based**
Engaging in research discussions	Undertaking research and inquiry

Emphasis on research content ———— **Emphasis on research processes & problems**

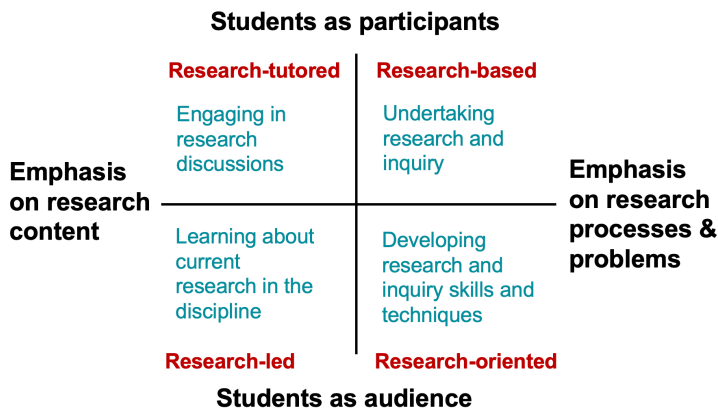| Learning about current research in the discipline	Developing research and inquiry skills and techniques
Research-led	**Research-oriented**

Students as audience

Fig. 1 Research-education synergy
(after Healey 2005)

In line with active learning, research-based education allows students to participate in research activities. However, the four approaches are complementary. The framework may be used to guide academics and their programme teams to design and enhance their curricula such that their students will benefit from a wider range of research-related activities both as participants and audience - in a coherent way. Figure 2 shows the Connected Curriculum framework that aims to promote a balanced approach to research-education synergies with a focus on research-based education. Dimensions 1, 3-6 are on nurturing inclusive learning communities, which are important for effective implementation of research-based education. Dimension 2 is on coherent and logical planning of learning activities in undergraduate and taught postgraduate curricula.
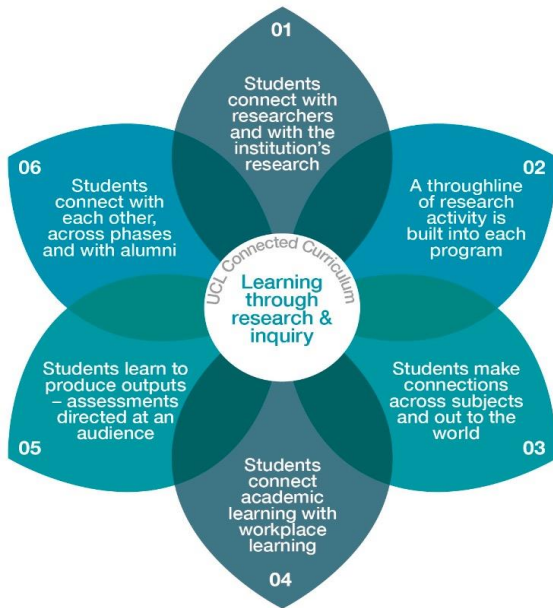
Fig. 2 The Connected Curriculum Framework (Fung 2017):
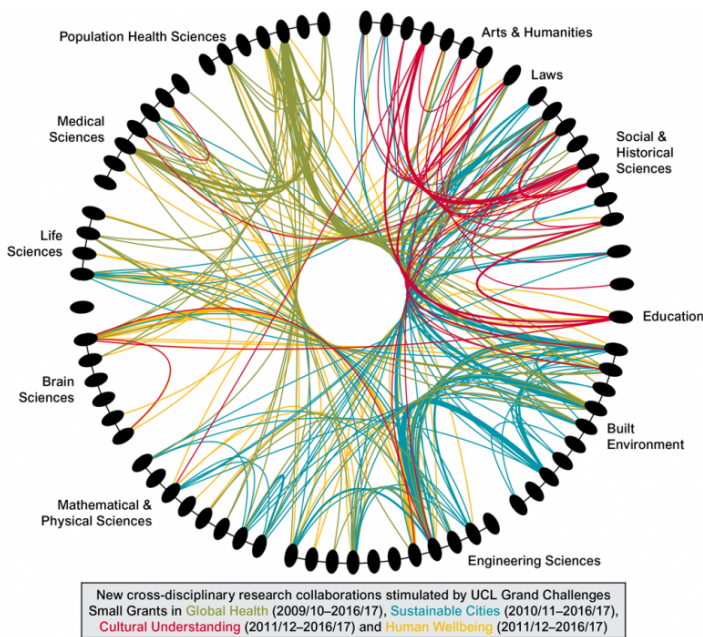an example of research-education synergy

Fig. 3 Interdisciplinary connections in research (Grand
Challenges; https://www.ucl.ac.uk/grand-challenges/about-
ucl-grand-challenges)

2.2 Second dimension: Linking academic disciplines

Cross-disciplinarity has played an increasingly important part in both research and education activities. There exist different levels and forms of cross-disciplinarity (e.g., Barry et al 2008; Barry and Born 2013). The most common forms include multidisciplinarity, transdisciplinarity and interdisciplinarity. Not only does cross-disciplinarity form the third dimension of the Connected Curriculum at University College London (Figure 2), it also underpins the Grand Challenges framework (Figure 3), which is the research framework adopted by the same university.

2.3 Third dimension: Academics working in partnership with students

Key challenges

- Inadequate resources and individual prioritisation of research over teaching activities
- Academic and student resistance to curriculum change
- Perceived differences in knowledge and experience between academics and students
- Inadequate institutional communication systems
- Tensions between external pressures and the innovations required

Key principles

1. The traditional relationship between academics and students needs to change.

2. There must be equal and reciprocal effort from students and academics.

3. Practices should be embedded from the beginning of degrees.

4. There must be robust evaluation processes and opportunities for reflection.

5. There is no 'one size fits all' solution.

Key opportunities

- Promotes interdisciplinarity and cross-departmental working
- Provides a space for staff to be recognised for excellence in teaching and offers developmental opportunities to early-career academics
- Promotes active learning, independent learning and the acquisition of transferrable skills
- Promotes equality between academics and students
- Creates opportunities for real-world links to make learning relevant and engaging
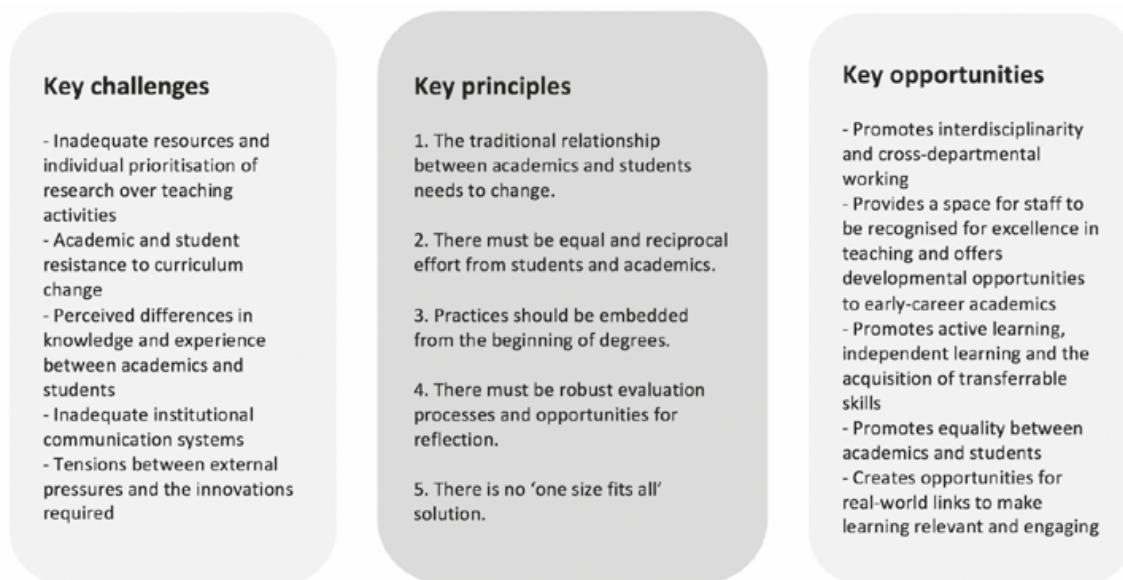
Fig. 4 Students as partners for developing links between research and education (Tong et al 2018)

According to Healey et al (2014), there are four main areas in which students can act as partners in higher education:

  i) learning, teaching and assessment;
  ii) subject-based research and inquiry;
  iii) curriculum design and pedagogic consultancy; and
  iv) scholarship of teaching and learning.

It is worth noting that i) and iii) are related to education, ii) and iv) are linked to research. Tong et al (2018) investigated the interface between research-education and students as partners. Figure 4 shows the challenges, opportunities and principles of how students may work with academics as partners to develop links between research and education at University College London (Tong et al 2018). Their main findings are compatible with the values of students as partners in Healey et al (2014). This exploratory study will help understand the complex interplay between functions and actors further by focusing on interdisciplinarity and a specific cultural context.

2.4 Applying the analytical framework to the Digital Earth and the Japanese cultural context

The Digital Earth agenda is chosen for its inherently close association with interdisciplinary research, education and public engagement between natural, social and engineering sciences. These inter-connected elements correspond directly to Dimensions 1 and 2 (Sections 2.1-2.2).

Japanese universities provide a rich cultural context for our study on the tensions and symbiotic relationships between research and teaching. As a study with a focus on students and academics as actors in the higher education system, it is important to consider the hierarchical relationships between them. Previous studies have focused on the cultural significance of the roles of the professor and the sensei in the Japanese higher education (e.g., Birnbaum 1997). In the broader contexts, the cultural manifestations and symbolisms of sensei, senpai and kōhai have been investigated in academic works on judo and kendo (e.g., Donohue 1990; Stevens 2013). These cultural studies provide reference points with which the values of student-staff partnerships can be compared. The values and social interactions between students and academics in interdisciplinary research-education projects in Japan will be studied with reference to those described in the literature on students-as-partners in Dimension 3 (Healey et al 2014).

3. Methods

Academics from seven Japanese universities have completed questionnaires on their engagement with research-education synergies and working with students as partners in SDG-related activities. They are affiliated to a wide range of institutions, from research-intensive to education-focused, and play different roles in their institutions. The qualitative data from the questionnaires will be coded thematically. The analysis on student-staff partnerships in education will draw heavily on the values-based criteria (Healey et al 2014). Based on the literature and practice on student engagement and partnership, Healey et al (2014) proposed that student-staff partnerships is underpinned by the following values: authenticity, inclusivity, reciprocity, empowerment, trust, challenge, community, and responsibility. These values will form an important lens in our data interpretation. In addition to the questionnaire-based study, we are developing a case study involving students and academics from a Japanese university reporting on their lived experience of an interdisciplinary research-learning-outreach initiative. Participatory methods based on narrative approaches will be used.

4. Conclusions: Intended impact

The research outcomes will shed new light on interdisciplinary research and pedagogical practices not only in Japan but also around the world. The outcomes will help inform university leaders in areas of policy-making, strategic priorities, as well as addressing the SDGs. Our study is particularly timely as the sustainability agenda has now entered the mainstream and may have significant influence on university policy making - the recent publication of an international university ranking based on research, education and other activities linked to sustainability by Times Higher Education[**] demonstrates the significance of this global trend.

5. Acknowledgements

**https://www.timeshighereducation.com/rankings/impact/2019/overall#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/undefined).

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