International Journal of Sustainability in Higher Education

Supplementary issue: sustainability in higher education: the Asia-Pacific region
Guest Editor: Tamara Savelyeva

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An international journal of sustainability in higher education
Vol. 18 No. 2, 2017
p. 165
© Emerald Publishing Limited
1467-6370
Editorial

Education for sustainability in higher education: the Asia-Pacific region

The construct of the Asia-Pacific region is relatively well referenced and defined, reflecting decades of studies on the immense diversity of the region’s social and geographical composition. The region involves countries in the Pacific basin: the East Asian countries of Japan, China, Taiwan, Hong Kong and the Koreas; South-East Asia; Australia; New Zealand; Russia; the USA; Canada; Mexico; Peru; Chile; Colombia; Ecuador; Central American countries; and the states of the Pacific islands of Fiji, Papua New Guinea, Melanesia, Polynesia and Micronesia. The region includes one of the world’s largest countries – China with its population of 1.3 billion, as well as one of the smallest countries – The Republic of Nauru with less than 10,000. The region is characterized by an immense diversity of languages, religions and cultures, as well as the high degree of inequality, with the most developed and poorest countries sharing the social, economic and environmental uniqueness of the Pacific Rim.

Discussion about sustainable development (SD) of the Asia-Pacific region gained its focus in the 1980s (UNESCO and UNEP, 1977, 1987; United Nations, 1987, 1992) and evolved in two stages. In its first stage from the 1980s to the early 1990s, the discussions mainly focused on the issues related to economic sustainability of the region. In response to the fast economic advances of the area, scholars (Elliott, 2012; Watters and McGee, 1997, to name a few) celebrated, criticized, condemned, investigated and analyzed the phenomenon and myth (Berger, 2004; Terry, 2015) of the Asian economic miracle led by Japan and the East Asian “Tiger” countries of Taiwan, the Republic of Korea, Hong Kong and Singapore.

However, the region paid for its rapid economic advancement with an environmental toll, which has quickly become a concern. This outcome then merged the economy-focused SD discussion, primarily within the environmental arena of studies (Elliott, 2012; Kawai and Lee, 2015). The link between the economy and the environment of the region was established to fit the early framework of sustainability discourse (Dryzek, 2005, p. 16), characterized with:

[…] imaginative attempts to dissolve the conflicts between environment and economic values […] [when] the concept of growth and development are redefined in ways which render obsolete the simple projection of the limits discourse.

labeling states of both economic and environmental affairs in the Asia-Pacific with a “crisis” tag. Elliott (2012) described an addition of the “green growth” (UNESCAP, 2010; World Bank, 2005) theme to the SD discussion as a “global green new deal” for the region, where greening local infrastructure on behalf of the governmental stimulus packages would not necessarily establish a safe link between the environment and the economy.

Yet, what role does higher education play in the context of these evolving discussions of SD in the Asia-Pacific region? This supplementary issue addresses this question by emphasizing contextualization, which involves the construction of a specific worldview, and which accepts the SD of Asia-Pacific based on two ideas. The first idea in this worldview is that the sustainability of the region was largely affected by Western colonization and that the existing Western-generated sustainability discourse,
including its manifestations in the region’s higher education arena, might be viewed as part of the post-colonial negotiation. The second element in this mindset derives from the deep connection of the region’s SD with authentic traditions and philosophies, based on the ancient views on the relationships between humans and nature (Meinert, 2013; Savelyeva, 2016).

The mainstream sustainability-related research is based on the assumption that sustainability is universal, hence, globally applicable (Savelyeva and Park, 2012). However, it is undeniable that sustainability is also specific to diverse contexts and, therefore, its meaning in higher education research varies across cultures, places and time. How do internationally accepted SD views and policies play out in the diverse and vast region of the Asia-Pacific? Conversely, how could higher education institutions in the Asia-Pacific countries illuminate our understanding of the mainstream sustainability discourses? Approaching Education for Sustainability (EfS) with a mindset of East-West negotiation and acknowledging culturally specific ecological traditions within this vast and diverse region, this special issue emphasizes contextualization; appraises emerging ideas and practices surrounding the notion of sustainability in the context of Asia-Pacific higher education; and examines the increasing integration of the Asia-Pacific region’s higher education in the globalized sustainability discourse in its contextual complexity.

Consistent with these aims, the authors from Australia, South Korea, Hong Kong, Thailand and Japan built their discussions on a range of empirical and conceptual topics to expand scholarship in relatively under-explored curricula, theoretical and policy related areas of sustainability in Asia-Pacific higher education.

In their paper, *Wheels of change in higher education: A collaborative, multi-stakeholder project as a vehicle for sustainability education*, Kristin Warr Pedersen, Emma Pharo, Corey Peterson and Geoffrey Clark from The University of Tasmania in Australia discuss how the Academic Operations Sustainability Integration Program promotes the collaboration of operations staff with Learning and Teaching – embedding on campus living laboratory activities into the curriculum. Using an end of trip bicycle facility as a case study, the authors highlight a challenge of generating a cultural shift toward re-conceptualizing Australian EfS as a holistic, whole-of-institution approach.

Young Ha Cho in the paper *Towards an Engaged Campus: Measuring and Comparing Definitive Stakeholders’ Perceptions of University Social Engagement in South Korea* explores an idea of social engagement as the way to revert the unsustainable institutional drive for creating world-class and research-driven university structures which might lead South Korean universities to lose their identities. Reporting social engagement, as being viewed negatively by university staff, the study then suggests several ways to encourage increased faculty engagement with the public, developing an idea of authentic leadership as a starting point for decision makers.

*Greening of a campus through waste management initiatives: Experience from a higher education institution in Thailand* by Visvanathan Chettiyappan, Tangwanichagaong Siwaporn, Nitivattananon Vilas and Mohanty Brahmanand addresses challenges of volunteer-led projects on one of the Thailand’s university campuses through an investigation of the three-dimensional waste segregation and recycling projects. Their findings suggest that there is no relationship between
students' sustainability knowledge, attitude, awareness and their recycling behaviors in the context of Thailand. The authors suggest a holistic, fiscal-based policy approach to support insufficient voluntary recycling initiatives held by universities in the country.

Tamara Savelyeva and Will Douglas in the Global consciousness and pillars of sustainable development: A study on self-perceptions of the first year university students provide insights into the challenge of implementation of the United Nations-based sustainable development model in the Hong Kong education system through the formal liberal studies curriculum. Along with the theme of this volume, the study findings highlight the importance of culturally sensitive sustainability views and values, which might not be detectable by linear quantitative measures. It was discovered that authentic sustainability beliefs are evident in students’ reflective notes and manifest in the city’s social movements.

Education for sustainability using a campus eco-garden as a learning environment by Chi Chiu Cheang, Winnie Wing Mui So, Ying Zhan and Kwok Ho Tsoi explores a process of creating a Chinese ecogarden as a powerful learning environment, built through challenging and culturally determined interactions between garden designers and university officials. The ecogarden structure fosters a participatory process in designing relevant sustainability teaching-learning activities.

In Education and capacity building with research a possible case for Future Earth, Yasuhiro Fukushima, Andrew Komasinski, Reiko Omoto Gakushi Ishimura and Shunsuke Managi map out an education and capacity-building framework for implementing a regional framework Future Earth in the Asia-Pacific Region. A long-term strategy to improve communication and decision-making systems is suggested. The authors view this framework as a specific way to build capacity, responding to the risks and opportunities raised by global environmental changes in Japan.

The collection of papers in this volume suggests that it is not enough to simply embed sustainability content into local curricula. Universities in the region themselves must “walk the talk” with respect to sustainability with respect to their own traditions, concerning human-nature relationships (Rickards et al., 2015). Whereby they co-create sustainability pilots and projects on and off the campuses, in a way that allows universities to embed sustainability ideas into local curriculum and provides students with genuine experiences (Savelyeva and McKenna, 2011; Savelyeva, 2012, 2013; Scott et al., 2012; Ryan et al., 2010).

Another suggestion from the volume is that higher education institutions in the region are responsible for not only providing students with a skillset but also a mindset (Denby and Rickards, 2016), awakening students to the richness of millions of years of culture and history which intrinsically linked self and nature as one – before we got side tracked by unsustainable ideologies of capitalism and consumerism.

A shift to becoming a sustainable and purpose driven society will put a demand on universities to generate mindful, sensible and purpose-driven graduates, as well as for universities to operate as purpose-driven institutions. This might then set a momentum for establishing connected conscious communities (Walh, 2016) at the
regional and international levels, which would ignite a move toward not only a sustainable society but also a restorative and regenerative one.

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References


**Further reading**


Wheels of change in higher education

A collaborative, multi-stakeholder project as a vehicle for sustainability education

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Abstract

Purpose – The purpose of this paper is to profile the development of a bicycle parking hub at the University of Tasmania to illustrate how the Academic Operations Sustainability Integration Program promotes real change through the engagement of stakeholders from across an institution to deliver campus sustainability. This case study outlines one example of how place-based learning initiatives focused on campus sustainability challenges have delivered authentic education for sustainability in the Australasian higher education setting.

Design/methodology/approach – This case study outlines the process through which a cross-disciplinary place-based learning initiative was designed, implemented and evaluated over a three-year period. The evaluation of the project was designed to assess the impact of this education for sustainability approach on both operational and student learning outcomes, and to make recommendations on the continuation of place-based learning initiatives through the Academic Operations Sustainability Integration Program.

Findings – This case study illustrates how learning can be focused around finding solutions to real world problems through the active participation of staff and students as members of a learning community. This experience helped the authors to better understand how place-based learning initiatives can help deliver authentic education for sustainability and the success factors required for engaging staff and students in such efforts.

Originality/value – The case study highlights an example of an education for sustainability initiative that was mutually driven by the operational and learning objectives of an institution, and specifically the ways in which the engagement of staff and students from across an institution can lead to the successful integration of these two often disparate institutional goals.

Keywords Campus operations, Place-based learning, Sustainable transport, Authentic learning, Bike hub, Education for sustainability (EfS)

Paper type Case study
Introduction

There is growing recognition that human activity is placing strains on the capacity of the planet to support life, and transformative changes are needed to deliver better social, economic and environmental outcomes from communities around the world (Brown and Lambert, 2013; Hughes et al., 2013; van der Leeuw et al., 2012). Higher education institutions the world over are being implicated as both critical players and key stakeholders in engaging global debate and action to address the growing number of sustainability challenges we face. This imperative is exemplified by the United Nations Decade of Education for Sustainable Development (2005-2014), which encourages higher education institutions to “provide leadership by practicing what they teach through sustainable purchasing, investments and facilities that are integrated with teaching and learning” (UNESCO, 2006, np). In Australia, the government has committed the tertiary sector “to expand its work by achieving a culture of sustainability in which education for sustainability is reinforced by continuous improvement in the sustainability of campus management” (DEWHA, 2009, p. 21). Higher education institutions themselves are also making commitments to sustainability, through such actions as signing the Talloires Declaration, which is the pledge to incorporate sustainability into institutional operations and learning (University Leaders for a Sustainable Future, 1999).

Amongst necessary top-down approaches to incorporating sustainability into higher education, bottom-up approaches to education for sustainability are becoming increasingly prevalent (Barlett and Chase, 2004; Savelyeva and McKenna, 2011), and indeed many advocates are calling for a merger of these two approaches (Sterling et al., 2013; Scott et al., 2012). Furthermore, staff members are seen to play a critical role in initiating sustainability initiatives and coordinating these across institutions and campuses (Brinkhurst et al., 2011; Moore, 2005; Scott et al., 2012). Recognising the pivotal role that staff members play in leading sustainability initiatives in higher education institutions, this article highlights how, through collaboration and support, motivated staff can enhance the sustainability of a higher education institution and contribute to education for sustainability by influencing student and institutional learning outcomes. The role of dedicated, interdisciplinary and intra-organizational staff in addressing the knowledge-action gap in sustainability has been well presented by many authors (O’Brien, 2013; Courtenay-Hall and Rogers, 2002).

There are many excellent examples of tertiary learning, where teachers help students close the knowledge-action gap by exploring their own lives or their campus using sustainability ideas or tools (Barth et al., 2012; Rickards et al., 2015). This “place-based learning” approach enables a holistic learning experience, usually on their campus and the local environment, that links “heads” (knowledge) with “heart and hands” in a meaningful and practical way (Sipos et al., 2008).

Our project uses place-based learning and moves beyond students and academic teachers working together to include other important partners such as campus operations, local council, state government and cycling advocacy groups. The only other work in Australia that we know of that systematically includes stakeholders beyond teachers and students is the Australian National University’s highly successful ANUGreen initiative, which includes campus operation staff along with teachers and students. Mcmillin and Dyball (2009) set the scene for our work by describing in detail why teaching sustainability through practice has been so effective at the Australian National University and end their paper by listing some of the projects that these students have been involved with (carbon footprint, greenhouse emissions accounting, recycling organics and offsetting travel).

The purpose of our article is to provide a detailed insight into how multi-stakeholder projects can work using a programme that integrates campus sustainability operations with...
in-class student learning activities and other stakeholders. The overarching programme is called the Academic Operations Sustainability Integration Program (AOSIP), and it has been recognised through a number of national awards in the Australasian sector as a leading example of a formalized place-based education programme in the higher education sector. In this article, we explain how AOSIP works through a case study of the design and development of an end-of-trip bicycle parking facility on the main campus of the University of Tasmania (UTAS).

This paper is also a response to Velazquez et al. (2005) who found that studies about sustainability on campus rarely mention what went wrong, which hampers learning. To that end, we present the difficulties as well as the aspects of the collaboration that were straightforward.

The institution: University of Tasmania

UTAS is the sole higher education provider on the Australian island state of Tasmania. By Australian standards, UTAS is classified as a medium-sized institution. Approximately 6,000 staff are employed, including operational, administrative and academic staff, some of whom are on research-only appointments. UTAS has a student population of nearly 30,000, of which approximately 6,000 are international students. Both teaching and research are central foci at UTAS.

Teaching at UTAS tends to be siloed into different disciplinary schools (departments). Schools and degree programmes are established around traditional academic disciplines, such as chemistry, agricultural science, medicine, philosophy, geography and fine art. Until recently, sustainability, as a topic, was taught separately across a number of disciplines at UTAS. In 2014, an interdisciplinary “breadth unit” on sustainability was introduced as an elective available to all students across any degree area; however, this unit is offered as one of a suite of breadth units that students opt-in for based on personal interest or perception of how much the topic will contribute to the learning of their main discipline. While some schools stake more claim to sustainability as central to the content of their discipline area (e.g. environmental studies, geography, education and management), others identify sustainability as a topic with varying degrees of relevance to their field (e.g. plant science, social science and law). As such, the extent to which students at UTAS are exposed to sustainability as a concept or topic area relevant to their discipline varies greatly based on their enrolled degree. Furthermore, the extent to which students have opportunities to engage authentically with education for sustainability, as something that extends beyond a content laden “topic”, into a more holistic pedagogical framework (Sterling, 2001) is even more variable and is primarily dependent on the epistemological position of the individual teachers they encounter. The recognition of education for sustainability as a holistic approach to learning and teaching is something that is understood by relatively few teaching staff at UTAS, and until recently, these individuals have carried out their work through the same isolated, siloed structure described above.

Historically, there has been a strong divide between learning and teaching policy and governance and the management of campus operations; however, the introduction of the Environmental Management Group in 2008 sought to bridge that gap. To advance UTAS sustainability initiatives, the Environmental Management Group – a volunteer-based group of interested academic and professional staff – developed the first ever Environmental Management Plan for UTAS, which called for the development of projects relevant to campus operations that could involve both academics and students, and could deliver sustainability outcomes across campus. In 2011, due to a shift to a more formalised governance structure of the group, the name was changed to the Environmental Management Committee. The Committee reported directly to
The first initiative of this group was the appointment of several new staff positions developed as a “sustainability team”, which worked in collaboration with the Environmental Management Committee.

Simultaneously in 2011, the UTAS Community of Practice Initiative was launched with the development of the institution-wide Education for Sustainability Community of Practice, a learning community comprising more than 60 staff members, from across the three main state-wide campuses. The community of practice was the first coordinated approach to education for sustainability at UTAS – aiming to bring together previously isolated staff working across the spectrum of sustainability. Enabling collaboration between a newly identified set of interdisciplinary colleagues, the community of practice has been successful at advancing the understanding of education for sustainability as a holistic pedagogic framework that requires integration of disciplinary and operational perspectives across the campus. The Academic Operations Sustainability Integration Program (AOSIP) is one of the key initiatives progressed by the community of practice.

The Academic Operations Sustainability Integration Program (AOSIP)

The AOSIP responds to calls for sustainability to be more thoroughly embedded in universities through the integration of research, service and teaching (Moore, 2005; Scott et al., 2012; ULSF, 1999). It aims to link teachers and university operations across all of the UTAS campuses. The AOSIP was developed by the sustainability team in Commercial Services and Development, a centrally positioned non-academic unit focusing on operational management of the University. In line with the UTAS Environmental Management Plan, the team identifies a set of “campus sustainability goals” that are used to engage disciplinary stakeholders in the design and implementation of campus-based sustainability projects. Through the AOSIP, students and staff engage in authentic learning activities (Lombardi, 2007) to learn about and interact with UTAS’s infrastructure and operations in an effort to enhance institutional sustainability performance. In effect, university campuses become living laboratories.

The AOSIP enables teachers to deliver disciplinary content and learning activities through the example of a locally identified sustainability challenge. In doing so, the AOSIP aims to bring real world relevance into student learning initiatives by asking staff and students to contribute practical solutions to identified campus sustainability challenges. The end result is an approach to education for sustainability that is problem-based, allowing the integration of disciplinary learning to evolve as a response to an identified problem, rather than isolated disciplines driving sustainability from their own academic perspective (Pharo et al., 2014).

Prior to the commencement of AOSIP, there were very few deliberate connections drawn between student learning and the campus environment at UTAS. Some geography, plant science and agricultural science classes have used the University’s 88-hectare eucalypt woodland estate behind the southern campus for fieldwork, and some postgraduate research projects have focused on environmental issues around campus. However, until the AOSIP was developed, none of this information was formally fed-back into institutional decision-making processes. Furthermore, no reported campus-based learning initiatives were specifically aimed at exploring or contributing to sustainability on campus. Prior to the AOSIP, education for sustainability at UTAS was more content focused and “the environment” and “community” were generalised to mean that which was outside of the campus.

Since 2011, the AOSIP has come to involve nine academic departments in a wide variety of projects from infrastructure design and delivery, to data gathering and risk assessments. All of the projects have involved both staff and students investigating campus operations,
identifying sustainability issues, and proposing interventions and feeding this information to the Sustainability Committee and other decision-making bodies at UTAS.

**AOSIP case study: a campus “bike hub”**
This case study focuses on a specific AOSIP project that ran from 2010-2012, and involved more than 100 students and staff from the School of Geography and Environmental Studies and School of Architecture and Design, in a cross-disciplinary sustainable transport project. This project involved students in the research, advocacy, design and construction of a campus “bike hub” on the southern (largest) UTAS campus, in the state capital of Hobart. The bike hub is a facility that provides secure undercover parking for more than 45 bikes, 6 rentable lockers, a bike maintenance station, a water bottle filling station and 10 electric bike-charging stations powered by 2kW photovoltaic solar panels.

The impetus for the bike-hub project was precipitated by a political and operational need to commence implementation of the relatively new UTAS Sustainable Transport Strategy. The strategy itself was the product of extensive consultation with UTAS as well as agencies responsible for transport planning and delivery, including city councils, state government and bus service providers. The sustainability team advocated for the bike-hub project because it promised to be a highly visible project that delivered on their sustainable transport goals, as well as mobilised and showcased the relatively new AOSIP. The bike hub itself involved multiple stakeholders, including:

- State government;
- Local council (Hobart City Council);
- Cycling lobby groups (Cycling South, Bicycle Tasmania); and
- University academic staff, students and operations staff.

Consultations with the UTAS Student Advisory Committee in 2010 revealed that bike transport on each of the state-wide campuses was hindered due to a lack of secure bike parking facilities available for student use. Distance between class locations and current bike parking options, bike thefts and having to leave bikes outside in wet weather were all described as reasons students chose other, less sustainable forms of transport to and from campus. Following these complaints about bike facilities, the sustainability manager saw value in this project with students as co-researchers and co-advocates for improving bike facilities on campus. The bike-hub project was designed to deliver on the Environmental Management Plan objective to involve students in campus sustainability initiatives while also providing students with education for sustainability, which would enhance their skills, their real-world experience and empower them with a sense of which contributing to change in their community (Brundiers *et al.*, 2010; Cortese, 2003; Shephard, 2008).

To harness the support of senior management, operations and institutional policy-makers, it was necessary to frame this bike-transport project in terms of the identified advantages of the AOSIP approach. To do this, an intra-institutional memorandum of understanding (MoU) was drawn up to clearly outline the mission and focus of AOSIP, the parameters of the bike-hub project and the value of the project for all participating parties. The MoU provided the framework for a project agreement that covered the budget, timelines and deliverables of the project, as well as the responsibilities and benefits for each party. It is worth noting, however, that beyond pragmatics the real value in the MoU process was in bringing operational and academic managers into dialogue about the integrated approach to education for sustainability being initiated by the AOSIP, and in essence raising awareness about this new holistic approach to sustainability on campus. It was through the MoU
process that the sustainability team began to meet and build networks with teaching academics from across the diverse schools and disciplines; therefore, a multidisciplinary and multi-stakeholder team was established that played a critical role in carrying this project through to fruition.

The bike-transport project collaboration started with the sustainability manager establishing a dialogue with teachers from the School of Geography and Environmental Studies and the School of Architecture and Design. The bike-hub project commenced in 2010 with 35 students from the School of Geography and Environmental Studies conducting transport counts by recording the number of people entering the campus, as well as identifying the different modes of transport (pedestrian, bicycle, bus, motorcycle, etc.) used at all six entry points of UTAS’s southern campus. Transport counts were repeated in 2011 by a second group of students. Following the second round of data collection, two Masters students in Environmental Studies analysed the transport data, through which they were then able to determine optimal locations for a “bike-hub” facility on the southern UTAS campus. The sustainability team simultaneously conducted a survey on cycling behaviours of staff and students on the southern campus, the results of which were combined with the transport count analysis to help inform a group of architecture students to design, and with operational staff, build the hub. The architecture students were engaged across a number of elective units, and their involvement in the bike-hub project constituted 100 per cent of their assessment tasks in each participating unit.

The design and construction phase of the project involved students building prototypes of the lockers and other components of the bike hub, for which approval was sought from a panel of reviewers. The volunteer panel comprised university staff and representatives from cycling advocacy groups. The construction of the final product required a professional, competent and insured entity to be contracted by the University to take responsibility for the design and documentation of the work. The Launceston Assistance and Research Centre (LARC) was designated as the appropriate entity to undertake this work given their established role in working with architecture students – taking on a guidance and supervisory role, for not only the final product but also student learning.

Components of the bike hub were prefabricated at the School of Architecture and Design, and under the direction of Commercial Services and Development staff, they were then installed on the southern campus in 2012. The final promotion and communication phase of the bike-hub project was undertaken as part of an undergraduate student project in the School of Geography and Environmental Studies. Students developed a communication strategy outlining the benefits of sustainable transport to staff and students on campus. This involved collecting additional transport data and writing speeches and a brochure about the benefits of sustainable transport for presentation to the UTAS Vice-Chancellor and the Tasmanian Government’s Minister for Sustainable Transport at the official opening of the bike hub in October 2012. A student from the School of Journalism then prepared the draft press release for the UTAS Media Office, as the final step in the bike-hub project.

**Participant evaluation**

From an operational perspective, the bike-hub project delivered on all three objectives of the UTAS Sustainable Transport Strategy, which requires efforts that:

(1) maximize access to the University by healthy and sustainable transport options;
(2) reduce the incidence of single occupant vehicle use and unnecessary travel; and
(3) reduce greenhouse gas emissions from the University transport sources.
More specifically, the project provided enhanced bicycling infrastructure to the southern campus, increased the safety of bicycling and pedestrian routes at the campus, encouraged a different modal choice for transport to the campus and thus helped lower the collective UTAS carbon footprint from transport. To investigate the learning outcomes of this project, formal and informal feedback was sought from students, peers and industry. Formal feedback was collected through our University’s end of semester student evaluations of teaching and learning – a survey sent to students at the end of each teaching semester. Students answered a series of questions using a Likert scale (strongly agree, agree, neutral, disagree, strongly disagree and not applicable). Additional feedback was solicited from students and industry through email surveys. The staff was interviewed and participants were asked to write a reflection on their experiences via an email to one of the authors. The data collection was approved by the University’s Social Science Human Research Ethics Committee (Ethics reference number H0011876).

Students in both geography and architecture reported positively on their experience with the bike-hub project by selecting “agree” or “strongly agree” in surveys. They used the open comments section of the survey to give more detailed feedback and mention points not covered by the formal questions. All architecture students and 95 per cent of geography students said that due to their participation in these activities, they were motivated to achieve the learning outcomes specified for their class. All architecture students and 90 per cent of geography students said that the learning experiences in their class had helped them to achieve the stated learning outcomes of the activity.

For architecture students, the intended and achieved learning outcomes were to:

• develop and enhance their design skills by incorporating first hand office experiences in design, documentation and construction;
• critically reflect on learning experiences; and
• operate in a professional manner through the development of skills in project management and administration.

For geography and environmental studies students, the intended and achieved learning outcomes were to:

• communicate information about climate-change adaptation to a broad audience;
• develop communication materials for a community client; and
• reflect on their experiences with their client and the extent to which their experiences matched their expectations.

In open-ended evaluation comments from 2010 and 2011, architecture students noted the most helpful aspect of the activity was the “hands-on nature of the course and the realistic accountability of the project” and “real-life scenarios and integration with architects”. They commented that there needed to be more of this type of task in university learning because it included the complexity of a real-life project, including dealing with budgets, ethics, design, clients, tasks and the various problems associated with real-life tasks of being an architect.

In the student evaluation comments from 2010, geography students noted that the most helpful aspect of the activity was “to be able to apply some of our learning to the wider community”; the “integration with other academics and professionals”; and “the many open discussions which are based on an open and flexible university organization”. An example of a more descriptive comment provided by a student:

I really enjoyed being part of the bike-hub project. Although we were not involved in setting up the initiative, it was great to gain experience in the practicalities of making something like this go ahead
(i.e. movement counts, research, surveying). In this case, I think it was important to have students involved to encourage a sense of ownership and appreciation of the new resource. Also, I enjoyed being a part of the project because I find it very exciting when the work I do in class can help to have an impact in the real world.

My involvement with the UTAS Bike Hub has allowed me to apply class lessons to a real world setting by critically evaluating approaches to maintain social and ecological resilience in the face of climate change.

The journalism student and the environmental management students were not assessed formally and were motivated to take part to add to their work experience, rather than being compelled to participate as part of formal assessment. We have no formal student evaluation results from these students; however, continued communication with the journalism student revealed that she was “delighted” to get a published story in a major newspaper as well as an item on the television news. As a bonus, she made some valuable connections with professional media staff through the University’s media unit, who control all the press releases from the University.

While the authors would like to be able to follow-up with participating students on whether this activity has helped them in their graduate lives, we have no immediate plans to undertake that work. This is partly due to the difficulty in attributing a skill that was useful in the workplace to a relatively small activity conducted years before and undertaken just once in their degree. However, we continue to monitor the immediate outcomes and reflections of students as a result of their participation in AOSIP activities, and have a small collection of anecdotal data through personal emails of the positive impact of the programme on the graduate experience.

To determine whether the bike parking hub is helping shift people onto bikes for their transport to and from university, the authors continue to count the numbers of pedestrians, bike riders, motorcyclist and bus passengers on an annual basis. Those results are presented in a separate paper under development that specifically focuses on modal shift. However, we can report here that there has been a measureable increase in the number of people riding a bike to campus despite little improvement to the safety of city streets en route to campus.

External stakeholders were also very positive about the achievements of the students and staff who participated in this project. We received ongoing positive feedback from the peak bicycle advocacy group, Bicycle Tasmania, and the local government bicycle facilities coordinator. The Minister for Sustainable Transport, in opening the bike hub, stated that:

UTAS is to be commended for planning for the future, with a focus on sustainability, and the result is fantastic. This bike hub is an example of how these challenges can be turned into opportunities, where infrastructure is more people focused and getting from one location to another is a pleasurable experience. This hub is also an inspiring example of students and staff working together, with the State Government and Hobart City Council (UTAS, 2012).

A number of unexpected outcomes of the project included the recognition the programme received as a result of the bike hub. The University’s Vice-Chancellor congratulated the work at the public opening, stating that: “This facility is a product of our students’ dedication and passion for environmental sustainability. I extend my thanks to them and to the staff who have supported this project” (UTAS, 2012). One month later in the internal University newspaper, the Vice-Chancellor further stated that: “Bike hubs across UTAS show how our teaching and research programmes can be integrated with our organisational philosophy” (Rathjen, 2012, p. 2).
The bike-hub project has been highly regarded by peers within the University and from across the Australasian education sector. The project was one of a suite of AOSIP projects that together saw UTAS win the national 2012 Australasian Campuses Towards Sustainability Award of Excellence based on a poll of peer institutions in Australia and New Zealand. The AOSIP was then recognised with a National Office for Learning and Teaching award for Programs that Enhance Learning in 2015. The project also won the Cycling Promotion Fund’s Australian Bicycling Achievement Award in March 2013 and an internal Vice-Chancellor’s Teaching Award for Programs that Enhance Learning in 2013.

**Challenges to achieving operational sustainability**

Despite high-level recognition of the work of the sustainability team, there are ongoing challenges to ensuring funding for the AOSIP. Funding cuts to the Australian tertiary sector have resulted in universities needing to rationalize expenditure and focus on key strengths, with particular attention to those that bring money into the institution or deliver cost savings. These budget cuts are a significant challenge to securing funding for the on-ground sustainability works that are central to the AOSIP model. While AOSIP has the potential to save and generate funding, the bike-hub project prioritized student learning and experience over cost savings. An “off the shelf” bike hub could have been purchased for a similar amount and the location for it could have been chosen from anecdotal evidence. While being relatively cost-neutral, the additional “cost” in making this an AOSIP project was to take a project that operational staff would have completed in 6-9 months without student involvement to one that took nearly two years with attendant operational staff time costs. The added time reflected academic schedules and the need to demonstrate and undertake the entire decision-making process within this constraint. To some, this has unfortunately highlighted an example of a student-centred activity that slowed down a delivery schedule, which may challenge the sustainability team in making a case for similar types of AOSIP projects.

While it is necessary to recognise and celebrate the efforts of the staff and students involved in the bike-hub project, it is also important to note that the project is not sustainable in its own right. The project was resource intensive in terms of staffing and required long project timelines. With its focus on the construction of bike hubs, the project is also limited in terms of geographic expansion and interdisciplinary reach. While the plan is for eight major bike hubs to be constructed across all campuses in the next four years, the financial, geographic and pedagogic limitations of such a project make this a finite focus for the AOSIP. Therefore, the ongoing challenge at UTAS is to continue to build on the success of the bike-hub project through ongoing support of the AOSIP model. Support is needed to ensure the delivery of other sustainability campus projects in the future (Mcmillin and Dyball, 2009). The process of integrating operations with learning and teaching needs continued commitment and proactivity from managers and staff is needed if education for sustainability is truly to be embedded as a holistic pedagogy and practice at UTAS.

The biggest challenge to the sustainability of the AOSIP model is in ensuring ongoing support for the sustainability team to work in partnership with staff responsible for academic programmes at UTAS. While the networking capacity of the sustainability team is extensive in terms of their motivation and capabilities to build partnerships, the team often has to justify why they choose to “deploy” their work to academic staff and students across the institution. Traditional approaches to dividing campus operations from student learning activities continue to challenge the team, as they struggle to shift our institutional culture towards a more holistic understanding of education for sustainability.
The relatively small sustainability team of 2.7 staff (at full time equivalent) has a broad range of responsibilities, including the need to address a number of on-campus sustainability challenges across a suite of initiatives and focus areas. To achieve this, a number of projects in addition to the bike-hub project have been allocated to the AOSIP, including exploring renewable energy options, building eco-efficiency studies, a peak oil risk assessment, a sea level rise risk assessment for university facilities, carbon management, waste auditing, biodiversity studies and land management, as well as promotional activities. These have drawn on the work of staff and students from the disciplines of engineering, business, geography, agriculture, architecture and urban design. To date, however, these initiatives have relied on the existing networks of the sustainability team. Therefore, a key challenge is to engage senior managers to recognise the need for the sustainability team to continue to build working relationships with staff and students from across the broad range of academic programmes at UTAS. The project was also more work than normal for the academic staff that are under time and financial pressure to take easier options for assessment than a complex, collaborative “real” project.

One of the key successes of the AOSIP has been overcoming previously identified barriers to interdisciplinary teaching at UTAS, including the siloed nature of curriculum and funding and insufficient resources to support staff in central coordination positions (Pharo et al., 2012). The leadership provided for the AOSIP by the centrally located (and non-academic) sustainability team has been central to the success of this approach. It is through this central leadership that the AOSIP has been able to ground education for sustainability at UTAS in real-world challenges, enabling interdisciplinary academics to blur the boundaries of the disciplines and work together to address local challenges. As such, the sustainability team has been able to impact positively on student learning, while highlighting that sustainability challenges on campus are a collective responsibility of all staff and students.

While the sustainability team has often been forced to justify why they network with the academics side of the University, it is exactly these partnerships that have led to the success of the AOSIP in delivering both operational and academic outcomes for sustainability. Continued funding and support of this integrated facilitation of the AOSIP is central to the success of the programme and UTAS’s efforts to support and enable authentic education for sustainability.

Solutions and recommendations
Through governance and policy commitments such as the UTAS Environmental Management Plan and the signing of the Talloires Declaration and a Sustainability Policy, UTAS has committed to ensuring its operations as well as its research and teaching are directed towards sustainable outcomes. However, the challenge to follow through on this commitment will require broad institutional support and a cultural shift towards re-conceptualizing education for sustainability as a holistic, whole-of-institution approach. This case study reiterates the findings of numerous other studies that highlight the critical role played by a centrally located staff leader for identifying, integrating and achieving sustainability outcomes (Barlett, 2004; Brinkhurst et al., 2011; Norgaard, 2004; Jahiel and Harper, 2004). Based on the challenges of securing continued funding and support of the AOSIP as a truly integrative programme, the ongoing employment of staff whose job is specifically to integrate sustainability initiatives with learning, teaching and research on campus is critical to the success of such an initiative.

Our case study also unexpectedly highlighted the usefulness of involving influential people in inspiring change, a recommendation in line with the change management literature (Gill, 2002; Gilly et al., 2008). The bike hub was useful in raising the profile of education for
sustainability through the official launch, where the State Minister for Sustainable Transport and the Vice-Chancellor of the University both rode electric bikes and spoke in glowing terms about the beautiful, functional bike hub and the staff and students who made it happen in spite of many hiccups. The concrete (plus wood and steel!) achievement of the collaboration has helped these two senior figures think of the University as a proactive collaborator that is capable of driving sustainability education. This has led to continued collaborations that have contributed to the state becoming a United Nations Regional Centre of Expertise in Education for Sustainable Development (2015).

Future research directions
This case study highlights that students are highly motivated to engage in real-life experiences they can visibly link to their learning. However, there is more work to be done to document student outcomes in both the short and long term. For example, it would be of great benefit to evaluate whether and to what impact students thought that their AOSIP involvement was useful in their working life. It could be that the activity helped make their studies more engaging without providing much in the way of skills or networks that were useful once they finished their studies. It could also be that such projects do deliver the authentic assessment opportunities that build the skills often identified by employers as lacking from a purely theoretical educational experience. This follow-up information would be difficult to collect but would be possible with the involvement of enough students and careful tracking of their contact details on leaving the University.

The key role of the sustainability manager and other campus operations staff in the AOSIP cannot be overstated. The manager provided the central leadership that guided this collaborative project and integrated it into various agendas and university goals. The sustainability manager was important in a practical sense in undertaking the purchase and works orders needed to construct the facility, as well as negotiating the funding and supervising the site works. The manager was also important in being able to harness different staff and student cohorts over a long period of time, with each group filling a particular role in this long-term project. It is important to remember that the manager’s role was only viable because the academic staff and students provided the person-power to get things done. Some social network analysis would be interesting to formally document the many stakeholders, their relationships and the degree to which they interact. These constructed networks have been shown to be more powerful than formal structures in terms of achieving real outcomes (Serrat, 2009). Complimentary research into the most efficient strategies to activate and maintain these networks would also be of value.

Conclusions
The Australian higher education sector is attempting to build resilience to what seems to be a string of budget cuts from the federal government. Simultaneously institutions continue to commit to global and national initiatives to work towards a more sustainable future. In such an unpredictable and stretched climate, programmes like the AOSIP emerge as potential vehicles through which economic, environmental and educational goals can be met. As is often the case, it is sometimes hard for people to “see the forest through the trees”, and there is a significant amount of work to be done before activities such as those described in this article are recognised as core business of the University.

This case study has highlighted how the UTAS’s Academic Operations Sustainability Integration Program (AOSIP) helped a multidisciplinary team of professionals, students, academics, industry, not-for-profits, state government and local council officials, to collaborate on a project to enhance sustainable transport to the largest University campus in the state of Tasmania, Australia. Through the design, development and advocacy of a
bike-hub project, AOSIP fostered connections between academics and professional staff and used this collaborative network to situate the University as a living laboratory of teaching and learning. The project adapted to take advantage of the people and resources that were available to eventually build a facility that is well used and of which the University is proud.

The sustainability team that established and managed the AOSIP has made significant progress in meeting operational goals for sustainability and has thus been the critical element in UTAS successes at achieving its national and international commitments to work towards a sustainable future. Additionally, through involvement in an institution-wide Community of Practice for education for sustainability, the sustainability team has been able to ensure that learning is embedded in the UTAS operational approach to sustainability. The potential of the AOSIP model to continue to integrate learning and teaching with campus operations is only as limited as the support such an initiative receives from senior managers, teachers and academics from across the disciplines. It is our hope, and our aim, that this support is maintained and that the acknowledgement and celebration of the AOSIP, as a model of education for sustainability’s best practice, continues into the future.

Acknowledgments
The authors would like to extend special thanks to Anna Lyth who authored the Sustainable Transport Strategy and supervised the student work on the movement analyses. Thanks also to the team within Commercial Services and Development and in particular to our senior operational staff Matt Smith and Jacinta Young for supporting the enabling framework as first developed by Kamal Singh, the University’s previous sustainability manager. Thank you to Joan Rodrigues for overseeing the contracting details; Ken Steele for managing the site construction works; Mark White for assiduously working out the electrical connections required for the photovoltaic panels, LED lighting and e-bike charging stations; Graham Lord and Tom Beattie for swiftly completing the landscaping in time for the official launch; Heather Knibbs for organizing the locker hiring scheme; and Rowena Zwart as the all-rounder sustainability officer that helped fill in the student data collection roster gaps. Special thank you also to Christie Denman, Architect from the Launceston Assistance and Research Centre (LARC) who worked with students from the School of Architecture and Design on the delivery of this project.

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Further reading


About the authors

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Towards an engaged campus
Measuring and comparing definitive stakeholders’ perceptions of university social engagement in South Korea
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Abstract
Purpose – This paper aims to measure and rigorously compare the perceptions of South Korean university social engagement between faculty and students, two definitive stakeholders identified by stakeholder theory – but considerably heterogeneous, to understand how South Korean campus embraces social engagement in practice. To that end, this study delves into the conceptual framework of university social engagement and selects a highly internationalized, research-oriented, four-year comprehensive South Korean university campus that has long sought to become engaged in communities as the research site.

Design/methodology/approach – Methodologically, exploratory and confirmatory factor analyses were used to identify the factor model that successfully fit the data of the study. Factorial invariance tests and latent mean analysis were then conducted to measure and strictly compare the between-group mean differences.

Findings – According to the findings, neither faculty nor students had positive perceptions of their institution’s social engagement in terms of leadership, participatory decision-making, curriculum and instruction, institutional supports and systemic mechanism. That is, two definitive stakeholders on campus similarly perceived that social engagement has not yet been institutionalized as a core value and therefore embraced in practice. Based on these findings, this study discussed several implications for university decision makers. Specifically, the institutionalization of and the need for authentic leadership in university social engagement were emphasized as a means to encourage and facilitate the delivery of practical, beneficial services to the public.

Research limitations/implications – As with all studies, there are certain limitations that must be noted. The sample for this study represents the experiences and expectations of faculty and students at only one institution. Therefore, the experiences of individuals at this single university are not necessarily representative of all South Korean universities. In addition, given that the public service missions of South Korean universities emanated from Western thoughts (Duke, 2008; Ward, 2003), social engagement in the present study has been discussed and conceptualized according to the dominant Western scholarship.

Practical implications – As both faculty and students similarly perceived, participatory decision-making and systemic mechanism do not work properly, and therefore, social engagement as an institutional value cannot strongly take root on campus. Based on the scale used, this study identified communication and organizational supports as the likely issues that obstruct the institutionalization of social engagement. In relation to communication, Boyte and Hollander (1999) emphasize that it is important that stakeholders are well aware of the engaged effort of the institution. Then, the voices of stakeholders need to be acknowledged as valuable feedback so that university decision makers and stakeholders can discuss mutually important issues and concerns (Minnesota Higher Education Services Office, 2003). Furthermore, the relevant literature consistently contends that engaged effort can only be productive with continuous and systemic
organizational supports (Boyte and Hollander, 1999; Holland, 1997; Minnesota Higher Education Services Office, 2003; Weerts and Sandmann, 2008). That is, the engaged work of teaching, research and service should be thoroughly assessed and reported to stakeholders on a regular basis. The implication in this study is that university decision makers should make greater effort to design and implement policies and regulations that enable organizational supports to continue.

**Social implications** – For social engagement to be valued in practice, the relevant literature (Kellogg Commission, 1999; Garlick and Langworthy, 2008; Minnesota Higher Education Services Office, 2003; Peterson, 2009) advises that top institutional leaders need to encourage interdisciplinary scholarship that includes research, teaching and learning; develop incentives to encourage faculty involvement in engaged work; support engagement so that it is incorporated into the curriculum and instruction; and secure funding for engagement. The fundamental insight that these suggestions provide to university decision makers is crystal-clear: social engagement must be authentically prioritized in the decision-making process.

**Originality/value** – The quantitative and descriptive findings of the study seek to provide one further step toward the objective of establishing the groundwork for future research on university social engagement in Asian context. Further, replication studies with various Asian cases and research designs may result in tangible improvements to the theorization of Asian university social engagement.

**Keywords** Public service, Factorial invariance test, Latent mean analysis, Social engagement, South Korean case, Sustainability of higher education

**Paper type** Research paper

**Background**

Lamenting the loss of the spirit of public service in the twenty-first century higher education, Macfarlane (2007, p. 26) asserted that:

> [...] the collegiality of faculty life has been replaced by a less communal and more isolated existence, institutional communities are strained by the growth in the size of universities, and academic relations with students have become increasingly impersonal in the wake of massification.

As research competitiveness becomes a notable deciding factor that affects the very existence of universities in the twenty-first century, public service and social engagement, which are essential values for sustainability of higher education, have a relatively difficult time maintaining their value in the normal course of institutional activities (Alperovitz et al., 2008; Boyte and Hollander, 1999; Kezar, 2005).

The current state of South Korean higher education is no exception. In this regard, Kang (2008) critiqued South Korean universities, almost all of which have tried to become world-class research institutions in recent years, despite their very different institutional missions and organizational capabilities. The history of higher education in South Korea is relevant to Kang’s argument. A period of 70 years following its national liberation in 1945 has provided South Korean universities with the opportunity to expand and massify (Kim, 2008; Shin, 2005). In general, South Koreans’ high demand for education has been regarded as the explanation for the expansion of South Korean universities (Cho, 2006; Kim, 2005; Lee, 1992; Son, 1994, 1995). In the late 1970s, South Korea underwent rapid industrialization and was therefore in need of a skilled workforce. Thus, higher education was recognized as a path to upward social and career mobility, which, in turn, played a role in stimulating the expansion of universities and increasing demographic and psychosocial demands for higher education (Kim, 2014). However, the supply-centered approach should also be regarded as an acceptable explanation for the expansion in the late 1970s and 1980s (Son, 1994, 1995). During this period, South Korean society was being industrialized through strong state initiatives. Because civil society was still immature, the government as the provider of education had unchallenged power to decide whether the educational demands of individuals were reflected in national policy (Son, 1995). In a similar vein, Garneir et al. (1989, p. 280) stated that:
A strong state can affect the calculations of individuals about the worth of education in the following ways: through the establishment of multiple educational systems, by the restriction of access, and by the control of expansion in both systems mandated by the overarching concern with educational quality […] Recent evidence suggests that […] educational providers do not necessarily provide what is demanded. Educational history also suggests that educational providers sometimes anticipate demand. In other words, the study of educational expansion must examine supply.

Specifically, according to the policy agenda of manpower supply for economic development during the 1980s, the South Korean government enlarged existing colleges and universities, absorbed two-year colleges into four-year universities and encouraged the establishment of new universities (Kim, 2005). In addition, the university student population liberalization policy of the 1990s enabled universities that met certain government criteria to freely adjust or increase their student populations.

These policies and changes to the higher education system over the years unexpectedly caused South Korean universities to become virtually identical in many respects. Consequently, South Korean universities lost the opportunity to identify themselves through functional differentiation (Kim, 2005, 2011). Moreover, since the 2000s, the government has strategically emphasized research productivity to improve the global competitiveness of South Korean universities (Palmer and Cho, 2012). As a result, there has been a growing sentiment that nationally competitive universities are simply equal to research-oriented institutions (Shin, 2009). This misperception has driven South Korean universities to become obsessed with their research prowess (Lee, 2012), and this obsession, in turn, has been the stumbling block in efforts to provide students with opportunities to learn something meaningful in unstructured, real-world situations and to conduct scholarship relevant to and grounded in the public need (JoongAng Ilbo, 2009).

South Korean universities still represent one of the few types of institutions that affect the sustainability of their society. However, South Korean society also wants to be convinced that the university presence nets a positive contribution by creating human capital and conducting research and innovation that meet the needs of the public (Cho, 2008; Garlick and Langworthy, 2008). Thus, university engagement with the public need should be an issue of mutual concern to both universities and society (Peterson, 2009).

Purpose
Social engagement, which refers to a partnership between a university and civil society (Zlotkowski, 2007), traces its historical roots to the public service missions of the mid-nineteenth-century land-grant universities in America (Duke, 2008; Ward, 2003). In the land-grant university tradition, an institution of higher learning is viewed as a training ground for democratic life and civic practice (Alperovitz et al., 2008). In this context, public service missions strive toward the enhancement of the reality and practicality of higher learning (Scott, 2006). Presently, public service is defined as an institutional mission of both public and private universities (Boyer, 1990; Newman et al., 2004) and is regarded as important in both Western and non-Western contexts (Min and Chau, 2012).

However, there is a lack of empirical knowledge concerning university social engagement in South Korea and, more broadly, in Asia, where the principles of social responsibility are less developed for sustainability of higher education (Aamir et al., 2014). Because there has been little reporting to an international audience of how Asian universities appreciate their institutional values, the question remains whether faculty and students necessarily embrace social engagement in practice. Moreover, very little research has been conducted to empirically examine how institutional values are perceived on campus (Ferrari and Velcoff, 2006).
Against this background, the goal of this study was to determine how social engagement is perceived on a South Korean campus. Universities engage in relationships with many groups internally and externally and either influence or are influenced by them (Pfeffer and Salancik, 1978). To use the terminology of Freeman (1984), these internal and external groups are stakeholders. Indeed, it was important in this study to identify and maintain a good focus of stakeholders who possess valid, reliable information and experiences concerning how social engagement is valued and reflected in their institution. In that regard, Mitchell et al. (1997, p. 869) suggested three factors – power, legitimacy and urgency – for classifying stakeholder salience in terms of the priorities of organizational attention. Salience refers to the degree to which an organization assigns priority to competing stakeholder claims. Salient stakeholders hold power of negotiation with relational legitimacy with the organization, and therefore their claims call for immediate organizational attention. In this model, binary salience, in which one either does or does not have the three attributes, is used to identify three types of stakeholders: the definitive stakeholder holds all three attributes with decision makers and consequently gains immediate and high attention, whereas latent stakeholders and expectant stakeholders possess, respectively, only one and two attributes, resulting in low and moderate organizational attention.

In higher education settings, institutional values should be shared with salient stakeholders so that their expectations and demands stay relevant to institutional goals and objectives (Mainardes et al., 2013). In previous studies (Chapleo and Simms, 2010; Mainardes et al., 2012; Moraru, 2012), researchers identified faculty and students as the definitive stakeholders of the greatest salience and priority to universities because, based on certain findings, these two groups value and respect an institutional identity the most and have an unequalled impact on university decision-making in comparison with other competing stakeholders. In contrast, stakeholders such as students’ families, local governments and local communities that host universities were classified as having the lowest degree of salience.

Based on the literature reviewed above, in this study, faculty and students were identified as the most salient and as the definitive stakeholders who are able to provide valid, reliable information. Focusing on these two groups, the goal of this study was to rigorously compare the between-group similarity and/or difference in terms of their perceptions of university social engagement and to then find meaningful implications for top institutional leaders. The group comparison in this study was designed to provide a descriptive and exploratory investigation of the definitive stakeholders’ perceptions to help establish the groundwork for future research in university social engagement in an Asian context. Accordingly, the following research question guided this investigation: To what extent are perceptions of university social engagement similar and/or different between faculty and students?

To achieve this goal, a highly international, research-oriented, four-year comprehensive South Korean university located in Seoul was selected as the research site, and the conceptual framework of university social engagement was explored. This university has long defined social engagement as a core institutional value, as expressed in its mission statement. Because the mission statement provides the structure for developing the objectives that the institution attempts to accomplish (Bingham et al., 2001), institutional values become a pillar of assessing institutional performance (Ferrari and Velcoff, 2006).

University social engagement

*Theoretical contexts*

Public service missions broadly underscore the usefulness of knowledge and academic research to citizens, and institutions of higher learning are called upon to be socially engaged
in building viable communities (Scott, 2006). Engagement enables university campuses to be more closely associated with the realities of contemporary life via two-way and symmetric responsiveness to the public need (Duke, 2008; Kezar, 2005; Macfarlane, 2007; Maurrasse, 2001; Ramaley, 2005; Ward, 2003; Zlotkowski, 2007). In that regard, Boyer (1996, pp. 19-20) introduced the concept of scholarship of engagement, which entails “connecting the rich resources of the university to most pressing social, civic, and ethical problems” and, at a deeper level, “creating a special climate in which the academic and civic cultures communicate more continuously and more creatively with each other in order to enrich the quality of life for all”. Similarly, Checkoway (2002) referred to the scholarship of engagement as scholarship for the common good or as public scholarship that draws on the expertise of a given discipline, makes connections with audiences beyond the campus and connects the faculty’s endeavors and student learning with the public. Public scholarship elevates engagement to the level of scholarship by encouraging the incorporation of research and teaching into public work and allowing both to be of practical benefit to the public (Alperovitz et al., 2008; Boyer, 1996; Fogelman, 2001; Thomas, 2000; Ward, 2003).

**Conceptual frameworks for implementation**

Grounded in the above-mentioned ideas of Boyer and Checkoway, the term, engaged institution, in this paper refers to a university that is closely interwoven in the fabric of its society. Specifically, in engaged institutions, top institutional leaders commit to social involvement, the faculty design and implement their research and teaching in close connection to the public need, the students are actively involved in social issues and service and the public-university partnership is based on reciprocal and mutual trust and respect (Holland, 2001, 2005; Maurrasse, 2001; Ramaley, 2005; Shannon and Wang, 2010; Ward, 2003). These salient features serve as the foundation for the conceptual frameworks that define the core dimensions of university social engagement in the present study.

Table I shows the frameworks that have been frequently noted in the relevant literature. The institutional values defined in the mission statements of higher education settings may be conveyed through administrative operations, academic programs and policies and student services, and they play a pivotal role in balancing the relationship between institutional goals and the public need and integrating the objectives held by diverse stakeholders (Ferrari and Cowman, 2004). Likewise, the dimensions suggested by the frameworks represent critical areas in which social engagement must be accepted as an academic, administrative, policy, institutional, pedagogical and practical priority.

The frameworks thematically reviewed in Table I define social engagement as a complicated construct that shares at least five factors representing the critical dimensions in which engagement is to be institutionally valued. First, leadership is significant because “engagement will not develop by itself, and it will not be led by the faint of heart” (Kellogg Commission on the Future of State and Land-Grant Universities, 1999, p. 11). Leadership, defined as the mindset, words and actions of top institutional leaders, affects the processes by which a campus evolves into an institution in which its identity and culture of social engagement are embedded (Schein, 2004). Second, engaged institutions commonly value participatory decision-making. The voices of stakeholders are reflected in the decision-making process through policy and institutional arrangements, power relations, governance, organizational structures, management and administration (Minnesota Higher Education Services Office, 2003). Third, engaged institutions promote the integration of engagement into the curriculum and student learning experiences. An engaged curriculum and pedagogy serve to motivate faculty, students and the public to become actively involved in teaching, learning and scholarship based on mutually beneficial and respectful collaborations (Driscoll, 2008). High-quality forms of engagement ensure that active
citizenship and public work are integrated throughout students’ curricular and co-curricular experiences (Garlick and Langworthy, 2008; Minnesota Higher Education Services Office, 2003).

Fourth, institutional supports focus on issues such as hiring, promotion, tenure, rewards, policies, roles, resource allocation and accessibility to institutionally invigorate faculty contributions to public work (Boyer, 1990; Boyte and Hollander, 1999; Hikins and Cherwitz, 2010; Holland, 1997; Kellogg Commission on the Future of State and Land-Grant Universities, 1999). The fifth factor consists of systemic mechanism spanning a full range of forms and procedures that enable public work to continue to be organized, assessed and documented under campus initiatives (Minnesota Higher Education Services Office, 2003). The systemic mechanism includes adequate professional human resources, faculty and staff training and development and a series of institutional evaluations and data collection, accumulation, analysis and documentation.

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<td></td>
<td>Pedagogy, Epistemology</td>
<td>Forums for fostering public dialog</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Faculty development</td>
<td>Social issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Faculty roles and rewards</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enabling mechanisms</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Garlick and Langworthy (2008)</td>
<td>Informed dialog and partnerships with community</td>
<td>Accessibility, Responsiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Governance, Management, Administration</td>
<td>Innovative research</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Learning and teaching</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leadership</td>
<td>Governance and power relations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Faculty role and incentives</td>
<td>Outcomes and impacts</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kellogg Commission on the Future of State and Land-Grant Universities (1999)</td>
<td>Responsiveness</td>
<td>Integration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Respect for partners</td>
<td>Coordination</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Academic neutrality</td>
<td>Resource partnerships</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accessibility</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table I. Frameworks of university social engagement
Methods

Scale
This study used a scale that Cho (2011) developed to measure South Korean university social engagement. At the initial stage of scale development, item selection, adaptation and categorization were based on the information obtained from the relevant literature described in the above-mentioned frameworks. Then, 626 randomly sampled university stakeholders (faculty, students, staff, college-prep schoolteachers and higher education policy analysts) participated in the survey, and 25 items were selected as valid for measuring South Korean university social engagement via an exploratory factor analysis (EFA) and a two-parameter logistic and graded response model tested using Multilog version 7. The selected items were included on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), and the item characteristic curves confirmed the appropriateness of the five-point response scale. Finally, the scale development concluded that the items were clustered as five conceptually related factors, which are designated in the present study as leadership, participatory decision-making, curriculum and instruction, institutional supports and systemic mechanism[1]. Table II shows the structure of the scale with the 25 items validated by both theoretical considerations and psychometric tests.

Leadership consists of the ways that top institutional leaders develop and support social engagement at all levels on campus. Participatory decision-making measures the degree to which the institution supports participatory decision-making on campus. Curriculum and instruction measure the degree to which academic programs and activities support multiple high-quality forms of social engagement. Institutional supports are defined as institutionalized efforts (e.g. policies, regulations, norms) to encourage and facilitate engaged work on campus. Systemic mechanism refers to campus structures, procedures and systems that are supportive of social engagement. Table II lists the items that belong to each factor.

Research site
The university selected as the research site for this study is a large, highly international, research-oriented, four-year comprehensive institution of higher learning located in Seoul. The university has been one of the most competitive institutions in South Korea, ranking consistently between sixth and ninth over the previous decade. The university’s social engagement could be summarized as follows.

The university has long been guided by its founding spirit to pursue the creation of a civilized society. Therefore, it has defined university social engagement for sustainability of the society as its primary institutional priority. In performing its institutional mission, the university has actively sought to be engaged in communities for collective betterment and to play the role of a good, responsible citizen who contributes to building a better society (Kyung Hee University, 2012a). During the previous six decades, based on its humanistic spirit, the university has undertaken several historically monumental social and civic initiatives to attain and protect human rights, freedom, equality and peace at the local, national and global level (Kyung Hee University, 2012b). In recent years, the university has innovatively reorganized its liberal arts college to cultivate mature, well-rounded citizens who are actively engaged in critical social and public problems by providing community-based experiential learning.

Participants
The survey was administered to 469 full-time faculty and 2,195 fourth-year undergraduates via the online e-mail survey system provided by the university. A total of 162 faculty and 368 students voluntarily completed the survey. The response rates for the faculty and students were 34.5 and 16.8 per cent, respectively.
Table II: The composition and parameter estimates of the five-factor model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Faculty</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leadership</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Top institutional leaders give a consistent and sustained voice to the broad public purposes of the university as an engaged agent for public good</td>
<td>1.335 (0.885)</td>
<td>1.170 (0.720)</td>
</tr>
<tr>
<td>Top institutional leaders take leadership in creating an institution that evolves to reflect the diverse culture of our communities</td>
<td>1.126 (0.878)</td>
<td>1.301 (0.822)</td>
</tr>
<tr>
<td>Top institutional leaders create and improve infrastructures that sustain creativity, flexibility and public contributions</td>
<td>1.291 (0.927)</td>
<td>1.299 (0.806)</td>
</tr>
<tr>
<td>Top institutional leaders support and create multiple opportunities to develop the public leadership skills and capacities of diverse members of the institution</td>
<td>0.944 (0.861)</td>
<td>1.061 (0.672)</td>
</tr>
<tr>
<td>Top institutional leaders encourage members of the institution to become actively engaged in society (voting, volunteering, civic networks, etc.)</td>
<td>1.080 (0.810)</td>
<td>1.156 (0.733)</td>
</tr>
<tr>
<td>Top institutional leaders clearly define social engagement as a primary goal of the institution</td>
<td>1.000 (0.738)</td>
<td>1.000 (0.670)</td>
</tr>
<tr>
<td><strong>Participatory decision-making</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decision-making includes campus stakeholder voices</td>
<td>1.258 (0.918)</td>
<td>1.055 (0.758)</td>
</tr>
<tr>
<td>Decision-making includes community voices</td>
<td>1.000 (0.773)</td>
<td>1.000 (0.737)</td>
</tr>
<tr>
<td><strong>Curriculum and instruction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service learning and other community-based forms of education exist throughout the departments and disciplines of the institution</td>
<td>0.664 (0.549)</td>
<td>0.700 (0.494)</td>
</tr>
<tr>
<td>Multicultural education is effectively coordinated and emphasized for all students</td>
<td>1.020 (0.733)</td>
<td>0.788 (0.557)</td>
</tr>
<tr>
<td>The curricula and courses intend to challenge students’ imaginations, draw on students’ experiences and interests and cultivate students’ talents and public identity</td>
<td>1.258 (0.892)</td>
<td>0.950 (0.688)</td>
</tr>
<tr>
<td>Students help build and sustain public cultures through conversations, arguments and discussions with others different from themselves in experience, culture, background, ideologies and views</td>
<td>0.919 (0.743)</td>
<td>0.991 (0.692)</td>
</tr>
<tr>
<td>Students have multiple opportunities to help create knowledge and do scholarship relevant to and grounded in public problems</td>
<td>1.000 (0.744)</td>
<td>1.000 (0.786)</td>
</tr>
<tr>
<td><strong>Institutional supports</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchasing and procurement consider public and community impact</td>
<td>0.906 (0.749)</td>
<td>0.673 (0.545)</td>
</tr>
<tr>
<td>Facilities management considers environmental and social outcomes and opportunities</td>
<td>1.008 (0.816)</td>
<td>0.830 (0.597)</td>
</tr>
<tr>
<td>Faculty roles and rewards (promotion, tenure, assessment, teaching and learning, etc.), promote social engagement</td>
<td>1.143 (0.862)</td>
<td>0.904 (0.691)</td>
</tr>
<tr>
<td>Admissions and finance consider the public and democratic purposes of higher education and the diverse cultural and civil society</td>
<td>1.025 (0.840)</td>
<td>1.163 (0.732)</td>
</tr>
<tr>
<td>Faculty appointment considers engaged responsibility</td>
<td>1.000 (0.690)</td>
<td>1.000 (0.673)</td>
</tr>
<tr>
<td><strong>Systemic mechanism</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adequate professional staff and/or coordination effectively support engagement</td>
<td>1.000 (0.851)</td>
<td>1.000 (0.646)</td>
</tr>
<tr>
<td>Engaged efforts and outcomes of the institution are systematically reported to and shared with communities</td>
<td>1.118 (0.940)</td>
<td>1.131 (0.681)</td>
</tr>
<tr>
<td>Engaged work of the institution is systematically assessed</td>
<td>0.919 (0.825)</td>
<td>1.287 (0.787)</td>
</tr>
<tr>
<td>Engagement data of the institution continue to be aggregated and used for assessment</td>
<td>0.933 (0.784)</td>
<td>0.994 (0.674)</td>
</tr>
</tbody>
</table>

**Note:** The parameter estimates are unstandardized (standardized values shown within parentheses), and all values are statistically significant at $\alpha = 0.001$. 
Analytic approach
Because the two most salient but heterogeneous stakeholders on campus were selected as the sample, their perceptions of social engagement should be rigorously measured and fairly compared as offsetting their essential difference. For this reason, latent mean analysis (LMA) was conducted rather than multivariate analysis of variance. LMA, in contrast to traditional statistical techniques that potentially use error-laden composites, theoretically uses error-free constructs that include latent constructs when testing hypotheses (Hancock, 1997) and, therefore, is relatively free of measurement errors (Hancock, 1997; Hong et al., 2003). However, configural, metric and scale invariances should be assumed so that heterogeneous groups may be validly compared according to latent variable means (Steenkamp and Baumgartner, 1998). This assumption implies that research results across heterogeneous groups cannot be compared until the measurements are comparable (Blunch, 2008). To test the assumption that the latent variables fall under the same scale, invariance tests between the faculty and student groups were performed using the maximum likelihood estimation method.

Prior to the LMA, an EFA and a confirmatory factor analysis (CFA) were conducted to confirm the factor structure that most successfully fit the data in this study. The EFA was performed to explore the underlying structure of the university social engagement scale that this study used as using maximum likelihood estimation with oblique rotation, and a factor loading $> \pm 0.40$ was set as the cutoff criterion. CFA was also conducted based on maximum likelihood estimation. The model fit tests in the CFA mainly depended on three fit indices: the non-normed fit index (TLI), the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). According to the previous literature (Hong et al., 2003; Hu and Bentler, 1999; Landis et al., 2000; Schumacker and Lomax, 2010), a value greater than 0.90 is desired for the TLI and CFI to be accepted. With regard to the RMSEA, a value of 0.06 is accepted as a reasonable cutoff point. More specifically, Browne and Cudeck (1993) suggested that a RMSEA of less than 0.05 represents a good fit, values between 0.05 and 0.08 represent a reasonable fit and values exceeding 0.10 represent a bad fit. Although the chi-square test is extremely sensitive to the sample size, its significance was also examined to determine the model fit. PASW 18.0 and AMOS 18.0 were used in the EFA and CFA.

Tests for validity and invariance
Validity test by exploratory factor analysis and confirmatory factor analysis
The EFA was conducted to explore any possible models that better fit the data in the present study, and several factor structures that fit the data were identified (Table III). In general, it is desirable to choose the model with the least number of factors if the difference in the model fit is less than 0.01. Although both were adequate in terms of the RMSEA, the four- and five-factor models failed to prove a significant fit difference of greater than 0.01. Therefore, the EFA confirmed that the four-factor model better fit the data.

The CFA was then performed to compare the fit indices between the four-factor model identified by the EFA and the five-factor model conceptually constructed based on the theoretical discourse Table IV to determine which model yields a better fit.

<table>
<thead>
<tr>
<th>Model</th>
<th>$\chi^2$</th>
<th>df</th>
<th>P</th>
<th>RMSEA</th>
<th>% of variance explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-factor</td>
<td>617.392</td>
<td>228</td>
<td>0.000</td>
<td>0.061</td>
<td>45.436</td>
</tr>
<tr>
<td>Four-factor</td>
<td>440.604</td>
<td>206</td>
<td>0.000</td>
<td>0.050</td>
<td>48.419</td>
</tr>
<tr>
<td>Five-factor</td>
<td>323.503</td>
<td>185</td>
<td>0.000</td>
<td>0.041</td>
<td>51.496</td>
</tr>
</tbody>
</table>

Table III.
EFA results
Table V presents the chi-square and descriptive values for the four- and five-factor models. According to the TLI, CFI and RMSEA values for the groups, the five-factor model fits the data better than the four-factor model. Therefore, the five-factor model is appropriate for application to the two heterogeneous stakeholder groups. Based on the results, configural invariance was achieved, meaning that the pattern of fixed and non-fixed parameters is identical across the two heterogeneous stakeholder groups.

The parameter estimates of the five-factor model are provided in Table II. The model originally included 25 items but was trimmed to 22; the factor loadings of three items (one from leadership and two from participatory decision-making) were below the cutoff criterion and were thus eliminated from the LMA.

### Descriptive statistics

Table VI presents the correlation matrix among the subscale scores by group. Because maximum likelihood estimation was used, the normality assumption must be met to prevent distorted results. Hong et al. (2003) suggested that the normality assumption for all variables is well met when the skewness is less than 2 and the kurtosis is less than 4. Both the skewness and kurtosis coefficients for the faculty and student groups are less than these cutoff criteria.

### Invariance tests

The multigroup invariance was tested to examine the structural invariance between the two groups. Invariance tests were hierarchically performed in the order of the nested models. The fit indices of Model 1, which is the baseline model presented in Table VII, supported the identical configuration of salient and non-salient factor loadings across the two groups. In addition, the baseline structure fit the data in that the chi-square values obtained by the groups summed to the chi-square value of Model 1.
For the obtained ratings to be meaningfully compared, it is necessary to confirm that the two heterogeneous groups respond in the same manner. Therefore, the metric invariance was tested by constraining the factor loadings to be equal. Under metric invariance, the scale intervals can be seen as being equal across the two groups (Steenkamp and Baumgartner, 1998). Therefore, the score difference on the items can be accepted as a meaningful resource for comparing the between-group differences.

As shown in Tables VII and VIII, the chi-square value resulting from the constraints increased from 684.492 to 721.619, gaining 17 degrees of freedom. The metric invariance was a nested model within Model 1. The chi-square difference can be useful for testing the statistical significance of the fit improvement between the nested models. The chi-square difference was 36.927 with 17 degrees of freedom, which indicates statistical significance at the level of 0.01. Based only on this result, it could be said that the metric invariance was not supported. However, it is not desirable to use the chi-square difference as the only criterion for determining the fit of nested models because it is often of little value depending on the sample size (Hong et al., 2003; Schumacker and Lomax, 2010). To make a more accurate decision regarding the fit of the nested models, the chi-square difference test is better used and compared with the main fit indices, such as the TLI, CFI and RMSEA (Hong et al., 2003).

### Table VI.

The correlation coefficient, standard deviation and mean by subject group

<table>
<thead>
<tr>
<th></th>
<th>1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>3&lt;sup&gt;c&lt;/sup&gt;</th>
<th>4&lt;sup&gt;d&lt;/sup&gt;</th>
<th>5&lt;sup&gt;e&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Faculty</strong> (n = 86)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.52**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.68**</td>
<td>0.41**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.58**</td>
<td>0.67**</td>
<td>0.48**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.71**</td>
<td>0.61**</td>
<td>0.64**</td>
<td>0.69**</td>
<td>–</td>
</tr>
<tr>
<td>M(SD)</td>
<td>2.83 (0.88)</td>
<td>2.42 (0.83)</td>
<td>2.76 (0.67)</td>
<td>2.66 (0.80)</td>
<td>2.33 (0.78)</td>
</tr>
<tr>
<td>Skewness</td>
<td>–0.30</td>
<td>0.52</td>
<td>–0.19</td>
<td>0.33</td>
<td>0.25</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>–0.42</td>
<td>0.80</td>
<td>0.03</td>
<td>0.64</td>
<td>0.06</td>
</tr>
<tr>
<td><strong>Students</strong> (n = 368)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.40**</td>
<td>–</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.51**</td>
<td>0.38**</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.61**</td>
<td>0.54**</td>
<td>0.51**</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.60**</td>
<td>0.44**</td>
<td>0.54**</td>
<td>0.62**</td>
<td>–</td>
</tr>
<tr>
<td>M(SD)</td>
<td>2.70 (0.73)</td>
<td>2.15 (0.76)</td>
<td>2.62 (0.72)</td>
<td>2.62 (0.62)</td>
<td>2.44 (0.64)</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.16</td>
<td>0.48</td>
<td>0.04</td>
<td>0.11</td>
<td>0.28</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>0.14</td>
<td>0.14</td>
<td>–0.16</td>
<td>0.25</td>
<td>0.47</td>
</tr>
</tbody>
</table>

**Notes:** (1) <sup>a</sup>Leadership, <sup>b</sup>participatory decision-making, <sup>c</sup>curriculum and instruction, <sup>d</sup>institutional supports, <sup>e</sup>systemic mechanism; (2) **<sub>p < 0.01</sub> and Likert-type scale from 1 (strongly disagree) to 5 (strongly agree); overall mean (SD): factor 1 [2.73 (0.76)], 2 [2.20 (0.78)], 3 [2.65 (0.71)], 4 [2.63 (0.66)], and 5 [2.42 (0.67)]

### Table VII.

Selected fit indices for invariance tests

<table>
<thead>
<tr>
<th>Model (nested)</th>
<th>χ²</th>
<th>df</th>
<th>TLI</th>
<th>CFI</th>
<th>RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1: configural invariance</td>
<td>684.692</td>
<td>398</td>
<td>0.930</td>
<td>0.940</td>
<td>0.040</td>
</tr>
<tr>
<td>Model 2: metric invariance</td>
<td>721.619</td>
<td>415</td>
<td>0.929</td>
<td>0.936</td>
<td>0.040</td>
</tr>
<tr>
<td>Model 3: scale invariance</td>
<td>831.201</td>
<td>437</td>
<td>0.913</td>
<td>0.918</td>
<td>0.045</td>
</tr>
<tr>
<td>Model 4: partial scale invariance</td>
<td>763.535</td>
<td>432</td>
<td>0.926</td>
<td>0.931</td>
<td>0.041</td>
</tr>
<tr>
<td>Model 5: factor variance invariance</td>
<td>780.892</td>
<td>437</td>
<td>0.924</td>
<td>0.928</td>
<td>0.042</td>
</tr>
</tbody>
</table>

Perceptions of university social engagement

195
Because these three fit indices did not substantially deteriorate, the metric invariance can be regarded as being fairly supported. A scale invariance test was then conducted to determine whether the “group differences in the observed items are due to differences in the means of the underlying construct(s)” (Steenkamp and Baumgartner, 1998, p. 80). This test was performed by holding the intercepts equal across the two groups. The chi-square difference between Models 2 and 3 did not support the scale invariance. Moreover, the TLI, CFI and RMSEA also deteriorated. Therefore, a partial measurement invariance test was conducted to continue the multigroup analyses (Byrne, 2010). This test revealed that the significant increase in the chi-square value and fit indices resulted from a lack of scale invariance in the following five indicators: 29 (leadership); 11 (participatory decision-making); and 15, 16 and 17 (institutional supports). By relaxing these indicators, the partial scale invariance model (Model 4) yielded a substantial improvement in fit compared to the full-scale invariance model (Model 3). Hence, Model 4 was evaluated against Model 2. Although the chi-square difference between these models still did not support the partial scale invariance, the TLI, CFI and RMSEA improved substantially compared to the full-scale invariance. Provided that at least one item in each latent construct is invariant, multigroup analyses can continue on the basis of the partial scale invariance (Byrne, 2010; Hong et al., 2003; Steenkamp and Baumgartner, 1998).

Because the configural, metric and partial scale invariances were acceptable, the latent mean differences were calculated. For the LMA, the means of the latent variables for a reference group should be fixed at zero when estimating them for other groups. Under this setting, the estimated latent mean values for other groups represented the mean differences from those of the reference group. With its latent mean parameters fixed at zero, the faculty was designated as the reference group. However, the latent group mean differences must be translated into Cohen’s $d$ value to understand their effect size based on common metrics (Hong et al., 2003). This index can be calculated by dividing the means of the two groups by the pooled standard deviation across the groups (Vogt, 2005). The effect size is generally interpreted under the rule of $d < 0.2$ (small), $d < 0.5$ (moderate) and $d < 0.8$ (significant) (Cohen, 1988). However, the homogeneity assumption should be met for the pooled standard deviation for the $d$ value computation to be used. The assumption can be tested by fixing the variance values to be equal across the two groups. As shown in Table VIII, the chi-square difference obtained by comparing Models 4 and 5 was 17.357 with 5 degrees of freedom. The assumption was rejected at the significance level of 0.01. However, the TLI, CFI and RMSEA values showed only insignificant changes, which indicates that the variance values can be seen as being fairly equal across the two groups. Therefore, the $d$ value can be computed.

**Table VIII.**

<table>
<thead>
<tr>
<th>Model</th>
<th>$\Delta \chi^2$</th>
<th>$\Delta df$</th>
<th>$\Delta$ TLI</th>
<th>$\Delta$ CFI</th>
<th>$\Delta$ RMSEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test of metric invariance: Model 1 vs Model 2</td>
<td>36.927</td>
<td>17</td>
<td>0.001</td>
<td>0.004</td>
<td>0.000</td>
</tr>
<tr>
<td>Test of scale invariance: Model 2 vs Model 3</td>
<td>109.582</td>
<td>22</td>
<td>0.016</td>
<td>0.018</td>
<td>0.005</td>
</tr>
<tr>
<td>Test of partial scale invariance: Model 2 vs Model 4</td>
<td>41.916</td>
<td>17</td>
<td>0.003</td>
<td>0.005</td>
<td>0.001</td>
</tr>
<tr>
<td>Test of factor variance invariance: Model 4 vs Model 5</td>
<td>17.357</td>
<td>5</td>
<td>0.002</td>
<td>0.003</td>
<td>0.001</td>
</tr>
</tbody>
</table>

**Latent mean analysis results**

Table IX shows the LMA results. None of the factors showed a statistically significant latent group mean difference. In other words, the faculty and students, the two definitive stakeholders, did not differ in their perceptions of their university’s social engagement in terms of leadership, participatory decision-making, curriculum and instruction, institutional supports and systemic mechanism. Furthermore, the mean values of each factor scored less
than 3 on the five-point response scale for both groups (Table VI). These results indicate that both groups did not perceive the present level of their university’s social engagement as being high and that there was congruence between their perceptions.

Specifically, both groups similarly perceived that there is little respect for participatory decision-making. This result suggests that particular and selected minority groups are given opportunities to take part in the decision-making process. The groups similarly perceived that their engaged work and outcomes are not systematically managed, coordinated and assessed in line with the public need as expected. Moreover, both groups shared the view that those who hold important positions in university governance have not tried hard enough to devise a structured policy framework to value and reward their engaged work and outcomes. They also perceived that the curriculum and instruction are not well integrated into community-based experiential learning. Finally, the leadership of the top institutional decision makers has been perceived as not being effective in fostering and sustaining a culture in which social engagement is respected and accepted as part of the institution’s identity.

**Discussion and conclusions**

Although the LMA in this study contributed to error-free and rigorous comparison of the faculty’s and students’ perceptions of their institution’s social engagement, any discussion beyond the latent mean differences between the two groups is likely to be speculative and tentative. However, the findings of this empirical study at least support the conclusion that the faculty and students, the two definitive stakeholders on the campus, similarly perceived that social engagement has not yet been embraced as a core value and used in practice. The findings also suggest that social engagement exists only at the superficial level of the mission statement.

In fact, most South Korean universities have long been contributing to their communities through services such as *pro bono* work, volunteer activities and sharing of campus facilities. However, Moon (2011) raised the question of whether the work of engagement of South Korean universities has been authentically institutionalized and practically valid for the public good and sustainability of the society. The findings of this study also lead to similar questions regarding South Korean universities: Have South Korean universities ever seriously considered designing and implementing social engagement policies or programs that respond to and serve the public need? To the extent that there has been social engagement, has it been fragmentary, piecemeal, unilateral and *ad hoc*? Unless South Korean universities are able to respond to these questions, there remains a long road ahead toward the goal of authentic engaged scholarship. Taking these questions into account, the findings of the study have yielded several implications for South Korean university decision makers in terms of the institutionalization and practice of social engagement.

### Table IX.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Faculty (n = 86)</th>
<th>Students (n = 368)</th>
<th>Cohen’s $d$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Latent mean</td>
<td>Latent mean $(p)$</td>
<td></td>
</tr>
<tr>
<td>Leadership</td>
<td>0.000</td>
<td>−0.124 (0.164)</td>
<td>0.196</td>
</tr>
<tr>
<td>Participatory decision-making</td>
<td>0.000</td>
<td>−0.053 (0.615)</td>
<td>0.084</td>
</tr>
<tr>
<td>Curriculum and instruction</td>
<td>0.000</td>
<td>−0.145 (0.106)</td>
<td>0.204</td>
</tr>
<tr>
<td>Institutional supports</td>
<td>0.000</td>
<td>0.199 (0.072)</td>
<td>0.314</td>
</tr>
<tr>
<td>Systemic mechanism</td>
<td>0.000</td>
<td>0.093 (0.280)</td>
<td>0.159</td>
</tr>
</tbody>
</table>

**Notes:** The latent mean values for faculty were set to zero; *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$; faculty is a reference group**
Effective leadership moves institutions toward social engagement (Weerts and Sandmann 2008). This statement suggests that an engaged institution does not create itself. The Kellogg Commission on the Future of State and Land-Grant Universities (1999) and the Minnesota Higher Education Services Office (2003) suggested that top institutional leaders transform their thinking about service; encourage interdisciplinary scholarship including research, teaching and learning; develop incentives to encourage faculty involvement in engaged work; and secure funding to support engagement. By doing so, engagement becomes a priority on campus and a central part of the institution’s mission. This is a thought-provoking suggestion for South Korean universities. Most of all, it is important that top institutional leaders of South Korean universities sincerely demonstrate to stakeholders that they value relationships with the community. To demonstrate this commitment, it is critical that leaders be visible and develop two-way communication between themselves and other stakeholders. To improve communication, it is important that stakeholders are well aware of the engagement efforts of the institution (Boyte and Hollander 1999). The voices of stakeholders then need to be acknowledged as valuable feedback so that university decision makers and stakeholders can discuss mutually important issues and concerns (Minnesota Higher Education Services Office, 2003).

Indeed, engagement can only be productive with continuous and systemic organizational supports (Boyte and Hollander, 1999; Holland, 1997; Minnesota Higher Education Services Office, 2003; Weerts and Sandmann, 2008). The implication of this study is that top institutional leaders should make greater effort to design and implement policies and regulations that enable the organizational supports to continue. Holland (1997) suggested that institutional policies and regulations related to retention, promotion, tenure, hiring, budgeting, admission and facility management should be redefined and guided by academically based, publicly oriented teaching, research and service. To enable the institutional supports of South Korean universities to have a positive effect on their engaged work, the administrative and managerial resources and structures need to be systematically aligned to promote a two-way relationship with stakeholders (Weerts and Sandmann 2008). Such a systemic mechanism enables engaged work to be thoroughly recorded, data-driven, assessed and reported for the stakeholders on a regular basis (Minnesota Higher Education Services Office 2003).

When all these suggestions are combined, the fundamental insight that this study provides to South Korean university leaders is crystal-clear: social engagement must be authentically prioritized in the decision-making process.

Limitations
As with all studies, there are certain limitations that must be noted. The sample for this study represents the experiences and expectations of faculty and students at only one institution. Therefore, the experiences of individuals at this single university are not necessarily representative of all South Korean universities. In addition, given that the public service missions of South Korean universities emanated from Western thought (Duke, 2008; Ward, 2003), social engagement in the present study has been discussed and conceptualized according to the dominant Western scholarship. Despite these limitations, the quantitative and descriptive findings of the study represent a step toward establishing the groundwork for future research in university social engagement in an Asian context. Further replication studies of additional Asian cases and research designs may result in tangible improvements to the theorization of Asian university social engagement.
Note
1. For more detailed information, please refer to Cho (2011)’s paper listed in bibliography at the end of the paper.

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Greening of a campus through waste management initiatives

Experience from a higher education institution in Thailand

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Department of Energy, School of Environment Resources and Development, Asian Institute of Technology, Klong Luang, Thailand, and
Chettiyappan Visvanathan
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Abstract

Purpose – This paper aims to describe the effects of 3R (reduce, reuse and recycle) waste management initiatives on a campus community. It ascertains the environmental attitudes and opinions of the residents and investigates their behavioral responses to waste management initiatives. Practical implications for enhancing sustainable waste management are discussed in this paper.

Design/methodology/approach – Demonstration projects on waste segregation and recycling, as well as waste reduction campaign, were set up on the campus to ascertain people’s attitudes and investigate their behavioral responses toward 3R practices. Data were collected through a questionnaire survey, observations, interviews and the project’s document review. A waste audit and waste composition analysis was carried out to assess waste flows and actual waste management behaviors and measure the change in the recycling rate.

Findings – 3R waste management initiatives had positive effects on people’s attitudes about resources, waste management and consciousness of the need to avoid waste, but these initiatives did not affect recycling and waste management behavior. A voluntary approach-only cannot bring about behavioral change. Incentive measures showed a greater positive effect on waste reduction to landfills. Nevertheless, the demonstration projects helped to increase the overall campus recycling from 10 to 12 percent.

Originality/value – This paper addresses a literature gap about the 3R attitudes and resulting behavior as part of campus sustainability of higher education institutions in a developing country. The authors’ results revealed hurdles to be overcome and presents results that can be compared to behavioral responses of people

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The authors wish to thank Miss Phyoe Thet Khaing for fieldwork assistance, technical and information support from the Office of Facility and Assets Management, AIT.

International Journal of Sustainability in Higher Education
Vol. 18 No. 2, 2017
pp. 203-217
Emerald Publishing Limited
1467-6370
DOI 10.1108/IJSHE-10-2015-0175

The current issue and full text archive of this journal is available on Emerald Insight at:
www.emeraldinsight.com/1467-6370.htm
from other developed countries. These findings can be used as a guide for higher education institution’s policy-makers, as they indicate that voluntary instruments alone will not yield effective results, and other mechanisms that have an impact on people’s behavior are required.

Keywords  Thailand, Recycling, Campus sustainability, Higher education institution, 3R, Packaging waste

Paper type  Research paper

1. Introduction

Consumerism and convenience following a buy-use-dispose system (or a linear approach) accelerate resource use. Presently, there has been an increase in waste generation in most of the developing countries. This has resulted in a large volume of municipal solid waste (MSW) being discarded into landfills (Ngoc and Schnitzer, 2009). Total MSW generation in Thailand in 2013 was about 26.8 million tonnes. About 5.2 million tonnes were recovered and recycled and only 7.4 million tonnes were suitably handled, while the rest of the MSW was unsuitably disposed (Pollution Control Department, 2013). Packaging waste in Thailand accounts for a major proportion of municipal solid waste. The proportion increased due to lifestyle changes. In 2001, of the 14.1 million tonnes of waste discarded, 3.4 million tonnes (24 per cent) were packaging waste. This number rose to 31 per cent in 2004 (Chulalongkorn University, 2004). There has so far been no updated data available on packaging waste in MSW. However, it is projected to increase as MSW volumes in Thailand have been rising by about 10 per cent annually (Mungcharoen, 2006).

Higher education institutions (HEIs) are change agents in society. They require services and infrastructure, including waste management on the scale of a small city. They also have a recognized role in achieving sustainability (Vagnoni and Cavicchi, 2015). HEIs are considered role models in their communities, as well as leaders in social and environmental responsibility (Velazquez et al., 2005; Zhang et al., 2011). Generally, HEIs can become engaged in sustainable development in two ways. First, they can form linkages between knowledge and dissemination in the community. Second, they contribute to societal development through outreach and use of knowledge to serve society (United Nations, 2011). Recently, HEIs have been called upon to commit to the development of sustainable practices by the United Nations Conference on Sustainable Development or Rio+20. As a result, many HEIs around the world are engaging in sustainable practices with concrete and tangible programs on their campuses. The International Sustainable Campus Network (ISCN) was established to promote and provide a platform for exchanging information, ideas and best practices among colleges and universities. This was done to achieve sustainable campus operations and to integrate sustainability and research (ISCN, 2015). ISCN has members from more than 20 countries. Many HEIs worldwide put waste management activities as a beginning point for campus sustainability initiatives. For instance, Massey University implemented a source separation and concourse-based recycling program in New Zealand (Kelly et al., 2006), and a recycling market program in Japan encourages students to donate used books, furniture and electronic appliances to be reused by new students. The Moving Towards Zero Waste program in the United Kingdom aims to implement reuse schemes in student residence halls of their campus (Zhang et al., 2011). Similarly, many HEIs in Thailand have shown their commitment to create green campuses by promoting reduction, reuse and recycling (3Rs) of waste through various voluntary initiatives (Table I).

Implementation of 3R programs has long been regarded as an alternative approach to traditional waste management practices. Many studies emphasized the benefits of minimizing the amount of waste sent to landfills, as well as the factors influencing recycling rate. However, the lack of information about attitudes and behavior of well-educated people
in response to 3R programs and associated effects to MSW stream has remained as information gaps that hinder progress toward campus sustainability (Kelly et al., 2006).

Controlling consumption is the most important goal for effective source reduction and sustainable waste management. People’s choices, behaviors, awareness and attitudes about waste generation and management serve as precursors to achieving sustainable development (Jackson and Michael, 2003). The present study primarily focused on sustainable initiatives in HEIs promoting “3R” practices. It is believed that 3R programs implemented on campuses positively influence the awareness of the campus community, as well as its attitudes and behaviors. To validate this hypothesis, the current study investigated how people’s attitudes and behaviors were influenced by sustainable 3R initiatives in an HEI. The Asian Institute of Technology (AIT), an international higher education institution located in Thailand, was used as a case study.

2. Methodology
2.1 Context of study area
Located in Pathumthani Province, Thailand, the AIT plays a leading role in promoting sustainable development in the Asia-Pacific region through higher education, research and outreach. It is committed to becoming a sustainable institution as evidenced by its adhering to voluntary commitments resulting from Rio+20. This requires teaching sustainable development across all disciplines, encouraging research and dissemination of knowledge about sustainable development, developing green campuses, supporting local sustainability efforts, engaging and sharing information with international networks (United Nations, 2011). AIT is a multi-cultural educational institution of about 3,000 persons from more than 40 countries, including students, staff members and their families. While AIT’s orientation is purely international, their waste management handling practices follow Thailand’s law and regulations. Tha-Khlong Municipality has the direct responsibility to collect and transport waste generated on the campus for final treatment and disposal.

The physical infrastructure of AIT includes office buildings, laboratories, a conference center, accommodations, sport facilities and commercial establishments. Waste generation is primarily from three areas. These are staff and student housing, academic buildings and

<table>
<thead>
<tr>
<th>HEI</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>King Mongkut’s University of Technology Thonburi</td>
<td>Implemented “no plastic foam for food” initiative on the campus in 2005 and promotes the use of personal reusable mugs and tumblers under its waste management policy</td>
<td>KMUTT (2010)</td>
</tr>
<tr>
<td>Thammasat University</td>
<td>Established a recyclable waste bank and launched waste separation campaigns under its sustainable university action plan in 2014-2017</td>
<td>Thammasat University (2014)</td>
</tr>
<tr>
<td>Mahidol University</td>
<td>Declared its 3R policy to reduce plastic bag use; and implemented a tumbler project that encourages the use of personal beverage containers for discounted merchandise and a waste segregation project</td>
<td>Mahidol University (2013)</td>
</tr>
<tr>
<td>Chulalongkorn University</td>
<td>Initiated a styrofoam food-packaging reduction initiative and established a central waste management recycling center to promote waste separation as part of their green university policy in 2011</td>
<td>Chulalongkorn University (2012)</td>
</tr>
</tbody>
</table>

Table I. Waste management programs in HEIs (Thailand)
commercial areas. Typical mixed waste collection was adopted on campus, where the residents discard waste into a one-bin system without separation.

The waste stream on the AIT campus is illustrated in Figure 1. Waste from bins is collected and temporarily stored at a campus-based transfer station before being sent for final disposal at landfills by the Tha-Khlong Municipality. The informal sector is a key player in recyclable waste collection and segregation for recycling. A small fraction of the recyclables (especially the packaging waste including plastic and glass bottles and metal cans) is sorted and sold by the housekeeping staff and waste collectors (janitorial staff) to earn extra income. A small amount of segregated food waste is utilized as animal feed. These basic waste management facilities did not guarantee an optimized waste segregation and utilization on the campus.

Since 2014, AIT has operated under the concept of being “a Sustainable Living Laboratory”, integrating its components to transform itself into a green campus. For this, campus-wide solid waste programs were launched and initiatives were carried out by groups of student-volunteers, with the support from faculty and the Office of Facilities and Asset Management (OFAM). This demonstration set up aims to increase people’s awareness and promote 3R practices on campus. It mainly included a voluntary approach and incentive measures, segregation of recyclable packaging waste by installing packaging-waste segregation bins to sort recyclable packaging (plastic bottles, glass bottles and metal cans in particular). The bins were located at prominent locations across the campus. A plastic bag reduction campaign was carried out in collaborative action with convenience stores in the institution, and a cash-for-trash program was initiated, which allowed people to sell their segregated recyclables to waste buying shops.

These initiatives were introduced and communicated continuously from the beginning of the project by distributing information door-to-door, internal e-mails, the AIT webpage, posters/banners, presentation of 3R initiatives to students at special annual events, e.g. orientation day and food fairs. Information was given about project activities, locations and the number of waste separation facilities, as well as information to raise awareness to inform people about the ways in which they can participate and to encourage the residents to contribute toward greening of their campus. Results of these initiatives were recorded and reported through campus media and e-mails on a monthly basis.

2.2 Research approach and methodology framework

3R solid waste initiatives were used to determine if the availability of these options could have positive impacts on the waste management behaviors and environmental attitudes of the campus community. A mixed method approach was applied to gather qualitative and
quantitative data. An overall framework for the methodology of this study is presented in Figure 2. The results were obtained through waste audits, waste composition analysis, field observations, key informant interviews and fieldwork records and were used to assess the actual behaviors of the community. Furthermore, the survey was designed to ascertain people’s attitudes, knowledge and self-reported behavior regarding sustainable solid waste practice. Quantitative data of the 3R performance results and waste composition analysis was gathered on a monthly basis beginning in August of 2014. A questionnaire survey was undertaken during a 3-month period, October to December 2014.

2.3 Sample and data collection
The questionnaire survey was carried out using a simple random sampling method. The sample size was determined according to Yamane (1967). The survey involved about 12 per cent of the total campus population. The questionnaire was organized into three sections. The first section was related to general information about respondents, followed by questions that assessed self-reported awareness, attitudes and perceptions of waste and resource issues. The last section included questions to determine methods used to dispose of recyclable waste. Responses were expressed using check boxes. A five-point Likert scale was used to measure attitude and opinion as follows: strongly disagree = 1, disagree = 2, indifferent (neither agree nor disagree) = 3, agree = 4 and strongly agree = 5. Additional space was given in the survey for the respondents to make written comments and suggestions.

The sample was split into two groups. These were respondents who cooperated and actively participated in the 3R sustainable solid waste management initiatives (hereafter, referred to as “Group A”) and those who did not (hereafter, referred to as “Group B”). The purpose of classifying the sample into these two groups was to determine the effect of 3R initiatives on people with the same (high) education level but different levels of involvement in campus 3R programs. Their awareness, attitude and knowledge were assessed to determine whether the 3R initiatives translated into behavioral changes or not. Results revealed 46.5 per cent of respondents belonged to “Group A”, while 53.5 per cent fell into “Group B”.

A t-test was used to elucidate the different levels of awareness and attitudes about resource and waste issues, disposal and recycling. A chi-square test for independence was utilized to explore the relationship between the 3R program and the campus community’s environmental consciousness. Lastly, correlation analysis was used to examine the
relationship between the amount of waste sent to landfills and the performance of 3R solid waste projects on campus. Waste composition analyses, field observations and key informant interviews were done to investigate material flows and the effect of 3R initiatives on these flows. The characterization of waste was performed according to the ASTM (American Society for Testing and Materials) D5231-92 standard method (ASTM, 2008). Secondary sources of data were obtained from the cash-for-trash records maintained by the OFAM, 3R solid waste project records and key informant interviews.

3. Results and discussion

3.1 Existing situation of waste quantity and characteristics

AIT generates about 1.3 tonnes of waste per day, which corresponds to 0.5 kg per capita. This value is comparable with that of other Thai universities (Table II). At the national level, Thailand’s urban areas generate approximately 1.2 kg waste per capita each day. In an attempt to control waste generation, national policy aims to limit daily per capita solid waste generation to not more than 1 kg (ONEP, 2012; PCD, 2013).

Although waste generation rate in AIT and many of Thailand HEIs does not exceed the 1 kg per capita limit targeted by national government, it is gradually increasing as can be noted by comparison with previous studies (Soulalay, 2006; Dev, 2007), particularly due to the increasing use of packaging. Evidence of this is revealed by a field survey conducted in 2014 on the AIT campus. It was found that packaging waste had the second largest share in the campus MSW stream (36.2 per cent by wet weight), after food waste (55 per cent). Further detailed analysis of discarded packaging showed that plastic constituted the highest amount (25 per cent), followed by glass (6.5 per cent) and metal (1.6 per cent). When compared to the previous study, there was an increase in the proportion of packaging waste. Notably, of total packaging waste at the campus transfer station, the proportion of recyclable packaging waste in MSW stream was 34 per cent and that which could not be recycled was 66 per cent. This implied that an increasing amount of non-recyclable waste was being sent to uncontrolled landfills, which is common in Thai municipalities.

Controlling the generation of waste has been quite challenging due to weak regulations and the lack of effective policy mechanisms to control waste generation and disposal. The MSW market has no economic incentive for waste reduction. This is true for HEIs as well. AIT pays a fixed waste collection fee to the municipality of only 8,000 Baht a month (approximately US$250/month). This is an example of the lack of incentives to reduce waste according to the weight and volume. Furthermore, recycling is not as widely practiced as it should be, thus providing considerable opportunity for improvement in MSW management.

3.2 Environmental attitudes about resource and waste management issues

Respondents from the two previously defined groups were asked to indicate their level of agreement with a series of statements. Figure 3 shows the score for each statement. Campus residents who were not involved in any 3R campus sustainability programs appeared to have less awareness and concern about 3R practices and waste issues than those who were

<table>
<thead>
<tr>
<th>HEIs in Thailand</th>
<th>Waste generation per capita (kg)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian Institute of Technology</td>
<td>0.5</td>
<td>Authors</td>
</tr>
<tr>
<td>Prince of Songkhla University</td>
<td>0.3</td>
<td>Prince of Songkhla University (2011)</td>
</tr>
<tr>
<td>Thammasat University</td>
<td>0.4</td>
<td>Thammasat University (2009)</td>
</tr>
<tr>
<td>Nakhon Ratchasima Rajabhat University</td>
<td>0.2</td>
<td>Viriya (2015)</td>
</tr>
</tbody>
</table>
more informed about the importance of waste separation for recycling and how they influence 3R activities. An independent sample t-test was done to compare the levels of awareness and attitudes of “Group A” and “Group B” respondents. This study found that “Group A” respondents showed different attitudes and levels of awareness. They strongly believed in the positive role of recycling for better waste management. There were significant differences between these groups as indicated by t-tests \((p \leq 0.05)\). Furthermore, a very significant difference was observed in terms of the level of acceptance of the policy of charging for shopping bags \((p < 0.01)\).

### 3.3 Environmental consciousness

Differences in levels of environmental consciousness of waste reduction between “Group A” and “Group B” are presented in Figure 4. Majority of “Group A” respondents had a higher level of environmental consciousness about waste reduction. About 20 per cent stated that they very often refuse to take plastic bag from grocery shops, while about 17 per cent of “Group B” said no to plastic bags. However, there was a higher percentage of “Group B” respondents that stated that they never (13.7 per cent) or rarely (27.9 per cent) refuse to take plastic bags, compared to people of “Group A” who responded in the same way at rates of 3.7
This revealed that “Group A” respondents “sometimes” to “very often” engaged waste avoidance, whereas “Group B” “rarely” to “never” did so when asked about refusing to take plastic bags from shops. The relationship between environmental consciousness and 3R campus initiatives and their effect on campus community awareness among “Group A” and “Group B” was examined. It was found that significant relationships exist between “Group A”, who actively participated in 3R campus initiatives, and their responses to “Do you refuse to take plastic bags from shops/convenience stores?” ($\chi^2 = 13.97, df = 3, p = 0.003$) according to the chi-square test for independence.

In short, recycling and resource efficient attitudes of respondents who cooperated and actively participated in 3R activities were found to be positive on resource and recycling issues, especially about accepting charges for plastic shopping bags, which differs from those who did not. Similarly, the study revealed a significant relationship between waste avoidance when purchasing products and active participation in 3R programs.

### 3.4 Knowledge on waste management hierarchy

In sustainable solid waste management practice, the first priority in the waste hierarchy is accorded to “reduction of waste” followed by “reuse” and “recycling”. Although 3R knowledge is not essential for individual 3R practices, it explains the intention or effort in adopting a specific behavior (Wang et al., 2014). Respondents were asked to prioritize the importance of “reduce”, “reuse” and “recycle” by ranking them based on what they understood. If a respondent makes the correct selections by choosing “reduce” as the first priority, then “reuse” and “recycling” as the second and last, respectively, it was concluded that he/she understands the concept and principle of sustainable waste management.

Environmental knowledge regarding the priority of the 3Rs among campus residents is shown in Table III. Response of “Group A” was the most accurate as they ranked “reduce” as the first option, followed by “reuse” and “recycle”. On the other hand, “Group B” perceived that “recycle” is the most important. Even though an HEI is a highly educated community, the 3R waste hierarchy was clearly not grasped by all. It was also found that a minority of “Group A” did not understand differences in the priorities of recycling and reducing waste.

Respondents who cooperated and actively participated in 3R initiatives had a more accurate and better understanding of sustainable waste management options compared to the group that did not. Recycling was often perceived as the most preferential option. These results revealed that environmental knowledge and perception of the 3R’s can significantly determine campus community awareness and its behaviors in waste reduction efforts.

<table>
<thead>
<tr>
<th>Sample group</th>
<th>1st priority (%)</th>
<th>2nd priority (%)</th>
<th>3rd priority (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduce</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Group A”</td>
<td>39.6$^a$</td>
<td>33.3</td>
<td>27.1</td>
</tr>
<tr>
<td>“Group B”</td>
<td>32.1</td>
<td>30.5</td>
<td>37.1$^a$</td>
</tr>
<tr>
<td><strong>Reuse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Group A”</td>
<td>27.1</td>
<td>40.3$^a$</td>
<td>32.6</td>
</tr>
<tr>
<td>“Group B”</td>
<td>26.8</td>
<td>40.1$^a$</td>
<td>32.9</td>
</tr>
<tr>
<td><strong>Recycle</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“Group A”</td>
<td>33.3</td>
<td>26.4</td>
<td>40.3$^a$</td>
</tr>
<tr>
<td>“Group B”</td>
<td>41.1$^a$</td>
<td>29.3</td>
<td>29.9</td>
</tr>
</tbody>
</table>

**Note:** $^a$ The highest percentage among the same group of each column (priority ranking)
detected significant differences in terms of attitudes and environmental consciousness among groups. However, the waste management hierarchy and waste reduction should be highlighted and put into action through proper policy measures to achieve the goal of sustainable consumption. Recycling options or building a recycling culture alone may lead to priority being given to recycling practices, which would result in the increased use of resources.

3.5 Effect of 3R solid waste campus initiatives on people’s behavior

3.5.1 Waste disposal behavior. There were four alternatives to dispose of recyclable packaging waste in the campus. These were to:

1. discard and mix with general waste;
2. self-segregate recyclable waste at its source and give it to housecleaners;
3. segregate and sell waste to earn money through a “cash-for-trash” program; and
4. bring segregated waste-to-waste separation facilities.

Overall, discarding unseparated waste in a single bin was still the primary disposal method. Figure 5 shows that a large percentage of respondents disposed of recyclable packaging waste by mixing it with general waste (38 per cent), even though 3R programs provided residents with other waste disposal options. It was found that a relatively low percentage of respondents brought recyclables to recycling facilities (19 per cent). Interestingly, 38 per cent of respondents voluntarily segregated recyclables and gave them to housekeepers for sale. Only 5 per cent of respondents collected and sold them for extra income. People opined that “inadequate waste separation facilities” and “inconvenience” were the main hindrances to their practice of waste separation. Most respondents who answered open-ended questions raised technical issues and requested for an increase in the number and location of easily accessible waste separation bins. Notably, most of issues cited were of a technical nature and indicated a lack of information (Table IV).

This study also statistically tested differences between waste disposal methods of people who cooperated and actively participated in 3R initiatives and the group that did not. Surprisingly, there was not a statistically significant difference between the two groups in their disposal behaviors. The 3R programs did have positive effect on awareness and
environmental attitudes, but not on disposal and waste management behaviors. This finding contradicts a previous investigation by Lee and Paik (2011) who examined Korean recycling behavior, and concluded that environmental attitudes affect recycling and waste management behaviors. In the context of developing country, 3R related knowledge and environmental attitudes does not necessarily translate into practice, unless identified barriers are addressed. Also, appropriate policy instruments and correct mechanisms are required.

3.5.2 Campus waste stream and actual performance behavior. A previous study cautioned that self-reported behavior may differ from actual behavior (Barker et al., 1994). To test this, the current study also examined actual behavior by doing a packaging-waste separation project, a cash-for-trash program, a waste audit and waste composition analysis.

Of the total packaging waste by weight, the percentage of potentially recyclable packaging (metal cans, plastic bottles and glass) was 31 per cent, while non-recyclables (e.g. styrofoam, plastic bags and paper/plastic cups) was about 69 per cent. The main sources were convenience stores, food vendors, cafeterias and coffee shops. On campus, most students do not cook, but rather they buy food from shops that offer single-use packages, which cannot be recycled. Therefore, the proportion of single-use packaging is on the rise.

Around 31 per cent of all packaging was potentially recyclable, but it remained in the MSW stream. This could have been diverted from the stream to ensure resource recycling rather than being sent for downstream management. People might argue that if they do not practice waste sorting, waste pickers will do it anyway. Therefore, source segregation might be overlooked. Although the traditional waste management system of developing cities included the important role of informal sector in the recycling system, upstream waste separation should be promoted. It will not only increase the level of awareness, but also build and contribute to a higher recycling rate. However, the large proportion of recyclable packaging found in the campus MSW stream indicated that people discard both recyclable and non-recyclables with general household waste, even though voluntary 3R initiatives were in place to encourage people to engage in 3R practices.

3.5.3 Correlation between the campus 3R program performance and waste proportions at transfer station. It is believed that the proportion of recyclable packaging found at campus final transfer station was reduced when a higher amount of recyclable waste was collected through 3R waste separation and recycling programs. The percentage of recyclable packaging at the transfer station may have a significant relationship with effectiveness of 3R initiatives. To investigate this, the total weight of recyclable packaging from the waste separation project and the cash-for-trash program were used to determine if they influenced the amount of packaging waste that remained in the MSW stream.

<table>
<thead>
<tr>
<th>Technical issue (43.4%)</th>
<th>Knowledge issue (34.7%)</th>
<th>Awareness issue (17.3%)</th>
<th>Others (4.6%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Not much access to recyclable bin allocated for packaging waste or food waste”</td>
<td>“I am confused with the classification of general waste and recyclable waste”</td>
<td>“Time consuming”</td>
<td>“Inconvenient as I want to throw all types of waste in a plastic bag”</td>
</tr>
<tr>
<td>“Inadequate number of recyclable bins”; and also “distances/location between recyclable cage bin and general bin”</td>
<td>“There is lack of clarity in the labels of the bin”</td>
<td>“Too many type of waste to be separated”</td>
<td>“Inappropriate disposal of waste in the bins is discouraging, and demotivates me to do the segregation”</td>
</tr>
</tbody>
</table>

Table IV. Qualitative comments and suggestions by respondents
Recycling activity through the cash-for-trash program had a positive effect on reducing the proportion of recyclable packaging remaining in the MSW stream, whereas the recyclable packaging-waste separation project did not. Financial incentives and consistent participation in the cash-for-trash program are possible explanations for this positive result. Those who participated earned money by selling recyclables. However, there was no incentive or perceived benefit in the packaging-waste separation project. The current study found a significant negative correlation between the cash-for-trash program results and the proportion of recyclable packaging sent to the transfer station. Pearson’s r data analysis revealed a strong negative correlation, \( r = -0.96, p < 0.001 \), using a two-tailed analysis (Table V). Results of the recyclable packaging-waste separation project did not have a significant relation with the amount of waste sent for disposal \( (r = 0.22, p = 0.62) \). To reduce waste through voluntary measures, there is a need to create more and better waste recycling infrastructure, which may require financial support. Alternatively, 3R activities with incentives (cash-for-trash program) had a greater effect than voluntary measures in this HEI context.

3.6 Effect on campus waste flow
The campus packaging waste flow with 3R measures in place was assessed as illustrated in Figure 6. The annual waste generation at AIT is about 529 tonnes. Waste flow at AIT is predominantly linear in its nature. Most of the generated waste is sent to the AIT transfer station and then to final disposal in uncontrolled landfills. Of the total packaging waste from AIT, 196.1 tonnes produced annually, about 173.3 tonnes (88.3 per cent of total) was sent to landfills. It was estimated that 60.8 tonnes of this was potentially recyclable and 135.3 tonnes was non-recyclable. The ratio of non-recyclable

<table>
<thead>
<tr>
<th>Variables</th>
<th>% recyclable packaging found at final transfer station</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recyclable packaging-waste separation</td>
<td>0.22</td>
</tr>
<tr>
<td>Cash-for-trash</td>
<td>-0.96**</td>
</tr>
</tbody>
</table>

Table V. Correlation results between variables

![Figure 6. Flow of packaging waste](image)
to recyclable packaging can be used as an indicator of consumption behavior to track the impact of 3R initiatives in the community. Through the efforts of waste pickers on campus, about 20 tonnes per year (33 per cent of recyclable packaging) was collected, which resulted in a significant recycling rate. Generally, in developing countries, the recycling rate achieved by the informal sector can often be in the range of 20-50 per cent (Wilson et al., 2009).

Due to the 3R campus initiatives, it was determined that the amount of recyclable packaging increased by approximately 2.8 tonnes annually (approximately 1.28 tonnes through the packaging-waste separation project and an additional 1.52 tonnes through cash-for-trash activities), boosting the recycling rate by 1.8 per cent, to an overall recycling rate of 12 per cent for all packaging waste. Based on these findings, the AIT campus needs to improve its recycling rate to meet the national target of at least 30 per cent of all waste generated (PCD, 2012) by setting attainable recycling targets and regulatory measures. Most important, restriction of single-use packaging should be undertaken to control the use of disposable packages on the campus. This could help to reduce non-recyclable waste, which constitutes a significant amount of the MSW stream (69 per cent) on campus.

For the 31 per cent of the material that is potentially recyclable, diverting waste away from disposal can be done by increasing participation in waste segregation programs and other voluntary 3R initiatives, along with provisions for a proper recycling infrastructure on campus. However, better management of packaging waste on the AIT campus will not be successful and sustainable, unless the use of non-recyclable packaging is reduced at the point of generation.

4. Conclusions and recommendations
3R solid waste initiatives have positive effects on environmental attitudes and consciousness of the need to avoid producing waste in a highly educated community. The presence of 3R initiatives creates an accurate understanding about options in sustainable waste management. However, these initiatives did not affect recycling and waste disposal behavior. Three barriers to good recycling practices were inadequate recycling infrastructure, inconvenience, and a lack of specific and clear information about what can and cannot be recycled. Results of the current study demonstrated that in the context of developing countries, environmental attitudes, awareness and knowledge do not affect recycling behavior. This finding is in contrast to responses of people in developed countries.

The 3R initiatives on the AIT campus may take some time to have an impact. It also depends on other factors such as participation and project information. However, the presence of recycling facilities and visible campaigns at AIT increased the recycling rate by 1.8 per cent to 12 per cent. Although the current recycling rate has not yet reached the national target of 30 per cent, these initiatives have established recycling loops as sustainable options that minimize waste to final disposal. The result of this study shows a huge opportunity for the AIT community to improve its recycling rate by enhancing its ongoing 3R initiatives and increasing participation. These are key requirements for increasing and maximizing the campus-recycling rate.

Based on these findings, despite the fact that HEI community is well aware of waste and resource issues, building a recycling culture and bringing 3R practices into action for a successful 3R system requires some prerequisite actions. These include developing a complimentary package of clear directions and gaining a commitment on the part of the institution to implement green actions such as 3R initiatives. Implementation of a basic waste separation infrastructure is first needed. The lesson learnt from this study is that the
most important factor to engage an HEI community in 3R practices is continuous communication of 3R activities, along with information about waste management results and achievements. In particular, the amount of waste reduction and waste recycling are considered basic indicators. It should be acknowledged that these actions are a part of job creation and income generation in the informal sector. This can potentially enhance the waste recycling rate on campus. However, to raise awareness among inactive residents, there is a need to ensure them that individual actions contribute to positive impacts by diverting waste from landfills. Generally, these people were demotivated to practice 3R, because they did not believe in an operational and waste collection system, which dumps all types of waste and mixes them together downstream.

To achieve the goal of campus sustainability, there is a need to build a 3R culture within the campus community by creating recycling infrastructure and making it convenient for people to practice waste segregation. Waste management programs must ensure that introduction of recycling facilities will not cause over consumption of resources. Based on research findings, voluntary measures are not sufficient to promote pro-environmental behavior in a developing country’s context. Even though environmental awareness and increasing knowledge through voluntary 3R initiatives is important to guide people’s behavior, 3R activities should be promoted with economic and fiscal measures and a ban on single-use packaging under the framework of a clear waste management policy.

At AIT, a recycling-only effort was not a sustainable solution because non-recyclable packaging tends to increase and comprises a large percentage of the material in the MSW. One of the strategies to curb the generation of non-recyclable packaging waste is to develop suitable alternatives, such as economic incentives/disincentives and regulatory measures for avoiding the use of disposable packaging. Alternatively, decision makers may consider installing or improving water fountains on campus and ensure their water quality. This is a potential way to reduce the use of plastic bottles. Charging for grocery bags and plastic food trays, as well as banning the use of styrofoam and one-time use of packaging for food and beverage containers, may bring about behavioral changes. These could be initially implemented at many campus events, e.g. sport days and food fairs. It might be also adopted in many HEIs in developing countries with the similar socio-economic background. Next steps for further improvement include monitoring performance of an increased waste management infrastructure and levels of participation, using the suggested campus waste management indicators. Campus sustainability reporting is a recommended communication tool for following-up, keeping people informed, sensitized and encouraged to practice 3R activities. This can serve as source of reliable information for institutional decision-makers for proper intervention.

In the long run, voluntary measures should also be promoted to consistently sensitize and encourage people to reduce waste generation. Additionally, incentive measures could potentially have greater impact on waste reduction and minimization. Therefore, incentive measures are strongly recommended for HEIs in developing countries. This can be done in conjunction with development of a campus waste-management policy and by setting up waste-reduction targets. Campus waste-management policies should use a mix of regulatory and incentive measures along with voluntary participation to establish sustainable loops of resources and waste management. It is hoped that this study influences institutional decision-makers rather than guiding people with only voluntary initiatives. It might be better to investigate how the use of motivational measures, incentives and regulatory mechanisms impact people’s behavior.
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Global consciousness and pillars of sustainable development

A study on self-perceptions of the first-year university students

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Abstract

Purpose – This paper aims to provide data on the self-perceived state of sustainability consciousness of first-year Hong Kong students.

Design/methodology/approach – Within a mixed-method research design framework, the authors conducted 787 questionnaires and collected 989 reflective narratives of first-year students of a university in Hong Kong, who were enrolled in the General Education course.

Findings – Attributed to students’ immersion in compulsory sustainability education modules within liberal studies programs in secondary through higher education (HE), the quantitative results revealed an increase in the self-perceived knowledge and behavioral aspects of sustainability consciousness of Hong Kong students and their low engagement in sustainability-related civic, campus or action groups. However, qualitative results revealed three aspects of the students’ sustainability consciousness: intentionality to make a difference; engagement with complex questions about identity, society and nature; and eschatological perspectives, which included imaginative, future-oriented and action-oriented approaches to critical reflection, supported by the rhetoric of hope, promises and commitment for better future.

Originality/value – The study provides insights into the challenge of implementation of the United Nations-based sustainable development model in the Hong Kong educational system through the formal liberal studies curriculum. It advances the field by constructing a momentum for conceptual changes in sustainability education research toward design of the non-linear and culturally sensitive frameworks for sustainability implementation in HE. This allows to utilize universities’ unique capacities for fostering students’ sustainability consciousness in a continuous and systemic way.

Keywords Asia-Pacific, Sustainability curriculum, Eschatological perspective, Global higher education, Sustainability consciousness, Sustainable development model

Paper type Research paper

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The study No. R9183 was supported by the Hong Kong Governmental University Grant Committee Fund under its Early Career Schema. The authors acknowledge Dr Zhu Jinxin for his valuable assistance with quantitative data analysis.
1. Introduction
A concept of sustainable development (SD) and its three pillars – economic growth, social inclusion and environmental balance – have been serving as a guiding, grounding and unifying framework for the sustainability movement in higher education (HE) since the late 1980s. Proposed by the United Nations in 1987 (World Commission on Environment and Development, 1987), the three-pillared model not only aligns campus sustainability-related policies, strategies and practices with global, national and local development but also applies the SD model across disciplines in university classrooms, aiming to build the awareness of sustainability-minded citizens. Universities generally acknowledge the SD concept as its guiding framework for campus sustainability and practically adapt its three-pillared frame to diverse cultural, political, economic and social contexts outside campus walls. By doing so, the sustainability movement challenges the widely celebrated ideology of development[1] (National Association of Scholars, 2015). On the other hand, the UN-based model has not been giving HE a role of major importance in the process of SD. Those writing about the SD model in HE tend to focus on gaps and challenges of sustainability implementation process on campus, but not on the important role education might play in fostering sustainability-conscious actions, attitudes and values of university students. Sustainability researchers, on their part, have also stopped short of acknowledging HE, and education in general, as a significant agent of SD (Savelyeva et al., 2015).

At the same time, the educational research on three isolated sustainability movements (Savelyeva and McKenna, 2011; Savelyeva, 2013) – campus greening, sustainability sciences and education for sustainability (EfS) – has been providing rigorous data for the rapidly developing scientific discourse on sustainability in HE that suggests universities make a difference (Filho et al., 2015). These rich data create a clear image of how sustainability has evolved in international academic settings over the years and what tangible contributions sustainable universities make to a society. However, the benefits of sustainability implementations in academia through greening, sciences and curricula to its main beneficiaries – a young generation of students – are less certain. More to that, an “unrecognized tangible dimension” (Burford et al., 2013) of shaping sustainability consciousness of students within the walls of HE systems remains omitted from educational research and policy discourses (Filho et al., 2015). Could sustainability be engraved, or “ensouled”[2] (Savelyeva and Park, 2012) in the minds and hearts of university students?

This study is built upon the idea that HE institutions are major agents that challenge the UN-based model of SD. The researchers argue that universities ground sustainability implementation in localized sustainability discourses and, by doing so, utilize their unique capacities to the “ensoulment” of sustainability in their students in continuous and systemic ways. In the context of this study, continuity implies that universities align their sustainability implementation strategies with those in secondary schools and other levels of formal and informal education. In this study, the researchers refer to the EfS aspect of the campus sustainability movement[3] and its curricular manifestations to explore different dimensions of students’ sustainability consciousness (O’Sullivan and Taylor, 2004). The researchers apply a notion of self-perceived sustainability consciousness which was developed by university students in Hong Kong, who take a mandatory liberal studies course in their institute after taking and passing an exam on the three-year compulsory New Senior Secondary Liberal Studies (NSS LS) curriculum, where sustainability is included as a module of study.

The study also stresses the importance of understanding and analyzing the self-perceived sustainability consciousness of first-year university students, resulting from their continuous engagement in sustainability through compulsory liberal studies curricula. For the purpose of this study, the researchers operationalized sustainability consciousness as a way of constructing one’s reality through a reflective process of formulating personal and
2. Related research on sustainability consciousness

Current research discourses on issues related to sustainability consciousness (Gennore, 2009; Jensen, 2002; Kegan, 2000; Maiteny, 2002; O’Donoghue and Lotz-Sisitka, 2002; Rosenthal, 2009; Scott, 2002; Taylor, 1989) tend to focus on:

- issues related to transformative learning, its theoretical developments and possibilities for classroom applications; and
- non-behavioral approaches to studies of sustainability consciousness.

First scientific discourse – transformative learning – has to do with a quality of learning that generates sustainable changes and permanent shifts in values, beliefs and attitudes of both teachers and learners (Sterling, 2003). In the words of Senge (1990, p. 13), transformative learning “involves a movement of mind [that] gets to the heart of what it meant to be human”. Other important characteristics of transformative learning are that it grants one the ability to re-create oneself; to do something one never thought to be capable of; and to re-perceive the world and one’s relationship with it (Senge, 1990, p. 14). It is an equivalent to deep learning in Australian theoretical schools (Biggs, 2003), also referred to as a triple-loop learning in the USA (Flood and Romm, 1996) and epistemic learning in the UK (Bawden, 2000, 2010a, 2010b).

The research on transformative learning issues involves theoretical models (Bateson, 1973; Biggs, 2003; Savelyeva, 2009; Sterling, 2003) and their practical applications.

Bateson’s (1996) model of transformative learning is the earliest one and is seminal to all the models that followed. Conceptually, Bateson recognizes three stages to transformative learning: factual learning, when a student is given set of alternatives and he/she is able to learn within a paradigm; contextual learning, when a student understands a nature of the context and is able to form a paradigm; and “a corrective change in a system of sets of alternatives from which choice is made” (Bateson, 1973, p. 293, cited in Sterling, 2003, p. 129), when a student learns about his/her own character and worldview. Interpreting this model, some researchers (Skolimowski, 1994) suggest that transformative learning is unattainable, as it requires a special predisposition of students’ mind. Others (Bateson, 1972; Sterling, 2003) view transformative learning as practical and attainable, but challenging.

The study adapts the latter interpretation of Bateson’s model and describes environmental aspects of sustainability consciousness of university students in Hong Kong as doable and achievable. The previous international studies of the curricular implementation processes (Savelyeva, 2009, 2012, 2013) by means of transformative learning revealed that transformative learning is conditionally attainable[4]. One of the conditions that directly relates to the current study of Hong Kong teachers and students’ self-perceptions of their sustainability consciousness is the importance of cultivating...
teachers’ intrinsic values for ensuring educational quality of transformative learning. This particular finding corresponds with the works of Hong Kong researchers (Carless, 1997; Lee, 2010; Lee and Efird, 2014; Savelyeva and Lee, 2011) who have contributed to the international studies on transformative learning and stress the importance of cultivating teachers’ intrinsic values for the success of learning to deal with change. Two illustrative examples are the studies of Lee (2010) and Savelyeva and Lee (2011), who conducted investigations on teachers’ perceptions shortly after the implementation of the new curriculum.

3. Advances of sustainability education in Hong Kong
Until recently, local HE institutions followed the international trend of discipline-specific integration of sustainability into science and engineering fields of study (Rusenko, 2010; Vaughter et al., 2013). Recent educational and curricular reforms (Education and Manpower Bureau, 2005; EDB and CDC, 2009) that merged the city’s post-colonial educational structure with the Chinese educational schema allowed to break this trend and place sustainability within liberal studies as one of the core aspects of globalization.

By including liberal studies in the examination and assessment exercise (Hong Kong Examination and Assessment Authority, 2014), the curricular reforms brought the subject to a whole new level and introduced pioneering approaches to global and sustainability education. This approach at the level of national curriculum challenged the traditional curricular boundaries of sustainability education, which internationally has a status of an elective, extra-curricular subject, activity (Lipcombe et al., 2008) or a short-term greening or environmental literacy initiative (Savelyeva and McKenna, 2011) in the non-formal educational sector. Placing sustainability within liberal studies and viewing it as one of the core globalization aspects[5] (Savelyeva, 2016) challenged the traditional approach to HE sustainability as a narrow topic of environmental conservation, greening and innovation within science, engineering or market-based courses and programs.

The new curricular arrangements intended to meet the growing international demand for educational transformation (Sterling, 2003) of a generation of the global-minded (Hanvey, 1976/2004) and sustainability-conscious (O’Sullivan, 1999; O’Sullivan and Taylor, 2004) young citizens who “understand the contemporary world and its pluralistic nature” and who have high “capacity for life-long learning and can face the challenges of the future with confidence” (CDC and HKEAA, 2014, p. 1).

The first batch of prospective sustainability-conscious secondary school graduates sat their first Hong Kong Diploma of Secondary Education Examination in 2012. In 2014, over 19,000 (Hong Kong Census and Statistics Department, 2014) of the graduates entered the tertiary education system, which for over a decade has been adapting liberal education and sustainability programs. Because of the recent implementation of the reforms, the studies on its effects on Hong Kong youth have been limited. One of the examples of the Education Bureau (EDB) research initiative has been conduct to a number of NSS LS implementation surveys in 2014/2015 (Ref. No EDB(CD/C&S/PROj)/ADM/150/4/4(10). However, the recent student movement has shown the urgency for focusing our understanding of the most immediate impacts of the curriculum changes on its main beneficiary – Hong Kong secondary school graduates who are currently studying in tertiary institutions. This study of sustainability consciousness of freshmen university students in Hong Kong has involved the first and second (2014 and 2015) batches of school graduates and allowed us to triangulate the results with the upcoming findings of EDB and other pilot research studies conducted in Honk Kong (Douglas et al., 2013; Zhu et al., 2014).

It is hypothesized that within a formal educational setting, a sustainability curricular module ignites transformative learning, which fosters a sense of global awareness and
increases the sustainability consciousness of young Hong Kong citizens who have entered tertiary education; this might be a common case also for many other secondary school graduates who did not enter the tertiary education system. As Hanvey (1976/2004, p. 2) suggested, “every individual does not have to be brought to the same level of intellectual and moral development in order for a population to be moving in the [global] direction.”

4. Research scope

4.1 Research design

This investigation into students’ sustainability consciousness used a mixed-method design. Within the mix-method design framework, the researchers used a random sampling technique and collected the data using 787 questionnaires and 989 written reflective narratives from first-year students enrolled in the compulsory General Education course at one of the universities in Hong Kong in 2013-2015. This aided our research efforts to understand the complex nature of the formulation of students’ self-perceived sustainability consciousness and the curricular factors that influenced this process.

The questionnaire data from three returns were excluded because the respondents had not taken the Hong Kong Diploma of Secondary Education so had not been influenced by the secondary school Liberal Studies curriculum. In total, 38 returns were excluded because of illogical or inaccurate responses on participation in sustainability-related activities. There were 395 valid questionnaires from the first cohort (academic year 2013/2014) and 351 valid responses from second cohort (academic year 2014/2015). The gender ratio of respondents was 69 per cent female to 31 per cent male students, which is typical of this particular university’s student gender ratio. The findings of the students’ reflective narratives and questionnaires were reviewed and analyzed to serve as a verification procedure for confirming the credibility of the mix-method study (Cresswell, 2003). The university, which was conveniently selected for this study, is one of the eight public HE institutions in Hong Kong, with a focus on both education and sciences. The University maintains the top position in educational subjects in Asia and the world according to the 2016 QS World University ranking system.

4.2 Data collection procedures

The student questionnaires were conducted using hard copy versions to ensure greater participation of the locally based participants than conducting the survey on-line and allow for greater control of the data collection process (de Leeuw et al., 2008). The questionnaires were in English and Chinese (traditional characters) to ensure that students’ responses were not influenced by language ability. The research team distributed the questionnaires during lectures of the compulsory General Education courses in March 2014 and October 2014. The student survey procedure was designed to take no longer than 15 min in total from distribution to collection of completed forms.

The student narrative reflections were collected electronically, using the Institute’s Mahara® platform during the four semesters of the 2013 and 2014 academic years. All narratives were written in English and submitted on-line as part of the General Education course requirements.

4.3 Instruments

The questionnaire instrument was adapted from three highly reliable instruments: EAI, children’s sustainability attitudes and knowledge scale (Leeming and Dwyer, 1995), Cronbach’s alpha 0.88-0.99); children’s attitudes towards the environment scale (Musser and Malkus, 1994), Cronbach’s alpha 0.73-0.83); and sustainability value-based scale (Shepherd et al., 2009), Cronbach’s alpha was 0.89 (Table I). The questionnaire included five scales and a background question on gender. Three scales were designed to measure
students’ perceptions of the effect of the Liberal Studies program on their environmental knowledge (knowledge increase scale with eight items and Cronbach’s alpha of 0.939); their perceptions of the effect of the Liberal Studies program on their environmental behavior (behavior change scale with nine items and Cronbach’s alpha of 0.937); and their perceptions of the effect of the Liberal Studies program on their active participation in environmental group activities (group participation decision scale with three items and Cronbach’s alpha of 0.949). Another scale measured students’ participation in environmental group activities (group participation scale with three items and Cronbach’s alpha of 0.668), and the last scale measured students’ perceptions of other influences that might affect their understanding of environmental issues (other influence scale with six items and Cronbach’s alpha of 0.749).

Given the complex nature of the qualitative inquiry into students’ sustainability consciousness, the qualitative focus of the second part of the study on interpretation and emergent design set the researchers as primary instruments of data collection and analysis of students’ reflective narratives (Creswell, 2003; Watt, 2007). Through the practice of reflexivity (Russell and Kelly, 2002), the researchers wrote short memos (Maxwell, 1996) and kept a research journal to create a personal narrative for the data collection and analysis process. The research journal included a record of the pilot studies and served as a memory prompt for the multiple reflexive levels. The researchers drew on the journal excerpts for creating meaningful connections between literature and the context of students’ narratives, research reflexivity and the researchers’ evolving understanding of sustainability consciousness and the ways it manifested in students’ reflective narratives.

4.4 Data analysis

The quantitative data were analyzed using SPSS(V21)® software. Confirmative factor analysis (CFA) was performed using a BASE feature of MPLUS® software for analyzing quantitative data. The qualitative data were analyzed manually. The research used a thematic approach to data analysis performed across its articulated, attributional and emergent levels of interpretation to ensure the clarity of interpretations and make analysis more transparent to stakeholders.

For the analysis of the students’ reflective narratives, the researchers used an open-coding feature of the NVivo(V10)® software for reading the narratives and coding passages in the margins. The researchers applied coding-recoding strategy to ensure dependability of their findings (Table II).

In this study, analysis was aided and framed through the use of a thematic clustering technique, which might be defined as a classification of similar items into groups, where the number of groups and their forms are unknown (Aldenderfer and Blashfield, 1984; Henry et al., 2005). The researchers approached the data set with a lens of a grounded theory to identify different aspects and instances of manifestations of students’

Domain: Sustainability values Module: Affective belief

Please indicate how much you agree or disagree with the following statements (1 = strongly disagree 2 = disagree 3 = neutral 4 = agree 5 = strongly agree) 請指出你多大程度上同意或不同意下列句子 (1.極不同意 2.不同意 3.中立 4.同意 5.極同意)

I perceive myself as very concerned about sustainability-related issues in my community/我認為自己十分關注區內與可持續性相關的議題. 1 2 3 4 5

Source: Adapted from Wiseman et al. (2012)
sustainability consciousness in the textual data. The researchers then used the clustering technique to reduce the data to a manageable size, which helped to structure an analytical framework for further data analysis. Resulting from clustering this new analytical structure allowed the researchers to revisit the data set and identify overarching themes that underlined the resulted aspects of students’ sustainability consciousness. This framework facilitated the identification of themes that would be meaningful within and across all cases.

4.5 Limitations

The limitations of this study had to do with its quantitative and qualitative methods. The first limitation was reliability of the students’ responses to the perception survey, which was based on their individual understanding of the key concepts and ability to distinguish sustainability-related ideas resulting from the NSSLS with any other sources of sustainability related information. Another limitation was representativeness of participants, which had to with accessibility issue and led to low generalization of findings. The researchers addressed the limitation of representativeness by describing the specifics of the Hong Kong student population and using a mix-method design to access possibly generalizable characteristics of the students’ sustainability consciousness. The researchers also recognize the overall limitation of using linear statistical modeling in educational research field, where any attempt to predict or explain human behavior is limited, as humans are hard to predict. To increase the power of linear modeling in the studies of sustainability consciousness, the researchers suggested the use of a more sophisticated model statistics in the future studies, as well as consideration of the culturally specific knowledge about Confucius heritage. In the present study, a selection of students with culturally distinct learning characteristics ($n = 787$) added a limitation of a relatively insufficient sample size for performing sophisticated quantitative analysis. The limitations of the qualitative part of this study included researchers’ biases and also a challenge of interpreting the complexity of findings, derived from the voluminous qualitative data ($n = 989$). The researchers addressed these limitations by stressing the trustworthiness of the results through three data quality indicators: research credibility, transferability and dependability.

<table>
<thead>
<tr>
<th>Phase of the research</th>
<th>Codes used</th>
<th>Description of codes</th>
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<td>Qualitative analysis of students' reflective narratives</td>
<td>I-PI/EI/TI</td>
<td>Identity, including prior identity, engaged identity and transformed identity</td>
</tr>
<tr>
<td></td>
<td>C-CT/CD/CC/CHK</td>
<td>Cultural issues related to Taoism/Daoism, Confucius tradition, Hong Kong heritage</td>
</tr>
<tr>
<td></td>
<td>In- InD/InH/InB/InO</td>
<td>Intentionality to make a difference, rhetoric of dreams, hopes, references to past experiences, cultural biases and openness to alternatives</td>
</tr>
<tr>
<td></td>
<td>E- EI/ES/EN/Ec</td>
<td>Engagement with complex questions about identity, society and nature. Commitment to better future</td>
</tr>
<tr>
<td></td>
<td>Es-EsH/EsP/EsA/EsH</td>
<td>Eschatological perspectives, including future-oriented rhetoric of hope, possibility, aspirations and harmony</td>
</tr>
</tbody>
</table>
5. Results
5.1 Students’ perceptions of the effect of liberal studies program on their sustainability knowledge

Students’ perceptions of the influence of the Liberal Studies program on their environmental knowledge was measured using the knowledge increase scale. This scale had eight items, with a common item statement: “Has your knowledge of the following issues increased as a result of the Liberal Studies program?” These items were climate change, air quality, waste disposal, biodiversity, nature conservation, industrial pollution, renewable energy and ozone layer depletion. There were four response categories to indicate increase in knowledge: no change, slightly more, more and much more. Results from students of the two cohorts (2013/2014 and 2014/2015) are presented in Figure 1.

Results from both cohorts showed that a large percentage of students perceived that their environmental knowledge had increased because of the Liberal Studies program. Most indicated that they knew more or slightly more as a result of the Liberal Studies program. The percentage of cohort 2014/2015 students who perceived their knowledge had increased because of the Liberal Studies program (slightly more, more or much more) were larger than those of cohort 2013/2014 students. This results mirrored the existing linear sustainability-related behavioral models (Heimlich and Ardoin, 2008; Kollmus and Agyeman, 2002) which view knowledge as one of the necessary but not sufficient factors (Robelia and Murphy, 2012) impacting student’s environmental sensitivity and behavior. The difference in the two cohorts’ perceptions based on the lower no change item (in 2014/2015) might be explained by the longer immersion in the curriculum for the 2014/2015 student cohort and prolonged teachers’ training and greater experience after the first year of the new curriculum. In total, 20 per cent of the 2013/2014 cohort’s students responded that the curriculum made no change in their perceptions of their knowledge of biodiversity and ozone layer depletion. Although quite alarming, this result could be due to the fact that these items were not part of the student examination (HKEAA, 2014) in these particular years; therefore,
they might not be covered by the teachers. On the contrary, topics of climate change, air pollution, nature conservation, renewable energy and industrial pollution are included in the curriculum as core topics as the most relevant to Hong Kong. Another explanation of the low students’ perception of their knowledge increase in items of biodiversity and ozone layer depletion might be the limitation of the instrument and understanding that perception surveys, unlike other types of surveys, measure perceptions only and often are mistaken with knowledge questionnaires (Herbert, 2013). Applying this limitation to the results of our study, students may have been answering questions based on their absolute knowledge rather than based on what they perceived had been learned in school.

5.2 Students’ perceptions of the effect of Liberal Studies program on their sustainability behavior

Students’ perceptions of the influence of the Liberal Studies program on their environmental behavior was measured using the behavior change scale. This scale contained two sets of items, that is, recycle and protection. The recycle set had three items with a common theme of “As a result of what you learnt in the Liberal Studies Program, do you recycle more”. The items were recycle paper, recycle metals and recycle plastic. There were four response categories: no change, slightly more, more and much more.

The protection set had six items. It asked “As a result of what you learnt in the Liberal Studies Program, do you do less of the following”: The items were use air conditioning, use water, waste food, use plastic bags, spend money on clothes and spend money on electronic goods. The four response categories were: no change, slightly less, less and much less. Both the Chinese and English versions of the items were provided in the questionnaire, and each corresponding response category for the two parts were the same in Chinese. Therefore, the same coding method was used for these two parts, that is, no change was coded as 1, slightly less or slightly more as 2, more or less as 3 and much less or much more as 4. The percentage distributions for the items of behavior change scale for both cohorts are presented in Figure 2.

Results from the two cohorts showed that just over 50 percent of students from the two cohorts believed that their environmental behavior had changed as a result of what they had learnt in the Liberal Studies program. These percentages, however, were less than those of students who perceived that their environmental knowledge had changed. A larger percentage of cohort 2014/2015 students perceived that their environmental knowledge had changed because of Liberal Studies program than cohort 2013/2014 students.

About 40 per cent no change in students’ perceptions of their sustainability behavior resulted from the NSS LS curriculum was not a surprise. The results added to the decades of behavioral data analysis dedicated to a question of translating, transmitting and transforming environmental knowledge into environmental behavior or action by means of education (Brick and Lewis, 2016; Corraliza and Berenguer, 2000; Hines et al., 1986). The results confirmed the overall challenge of impacting students’ behavior with the formal curriculum within a short span of time. The findings also acknowledged another limitation of a perception survey instrument – complexity of data interpretations. There are complex factors, such as students’ personality types (Brick and Lewis, 2016); situational factors (Corraliza and Berenguer, 2000); and emotional and attitude factors (Pooley and O’Connor, 2000), that might affect students’ perceptions of their sustainability-related behavior change. The findings also supported our initial assumption that students might learn sustainability as part of their exam preparation, disconnected from real life experiences. A curriculum design might also explain the low numbers of student self-perceived behavior change: the NSS LS curriculum does not include community-based, project-based or hands-on
component, which result in no change in students' perception of their sustainability-related behavior at about the 40 per cent level. A steady increase in number of students' behavior perceptions in the 2014/2015 batch of the most recent school graduates in comparison to the 2013/2014 batch might be also due to their longer immersion in the curriculum. Social factors, such as the 2014 student movement, might also have an impact on students' perception of their sustainability-related behavior.

Change in individual behavior or action has been a key indicator of measuring curricular success of any sustainability-related initiative in Western sustainability education discourse, both its behavioral (Hines et al., 1986) and critical (Posch, 2003; Stevenson et al., 2003) branches. However, the results of this study might reflect the culturally specific focus of a Confucian heritage learning tradition, which emphasizes on academic achievement, diligence in academic pursuits and the significance of education for moral self-cultivation (Chan and Rao, 2009) in a learner in relation to a collective rather than focus change in individual student’s behavior. The cultural specifics of the underlying Confucius heritage tradition are partially responsible for an “Asian learner paradox” (Watkins and Biggs, 2005). The resulted 50 per cent ratio in the self-perceived behavioral increase of 17-years-old Hong Kong school graduates might indicate a healthy, culturally specific dynamics of sustainability behavior caused by the implementation of the curriculum in Confucius heritage classrooms. This could reflect the recently emerged socioecological approach in sustainability education discourse (Kyburz-Graber et al., 2006), which is built on the assumption that targeting an individual change does not form an adequate approach to the multilayered challenge of environmental problems (Kyburz-Graber, 2013).

5.3 Students’ sustainability-related group activity participation

Students’ environmental group activity participation was measured using the group participation scale. This scale includes three items with a common theme of “Have you done any of the following”: The items were donated money to an environmental group (e.g. Friends of the Earth (HK), Green Power, etc.), joined an environmental group and volunteered or been

<table>
<thead>
<tr>
<th>Activity</th>
<th>2013/14</th>
<th>2014/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycle paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycle plastic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use air conditioning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use plastic bags</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend on clothes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spend on electronics</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Figure 2. Students' self-perceived behavior change (percentage)](image)
paid for work in an environmental organization. There were two response categories: yes and no. The percentage distributions for the items of the group participation scale for both cohorts are presented in Figure 3.

Results showed that between 23.21 and 24.49 per cent of the students from cohort 2013/2014 took part in the listed environmental group activities and between 16.52 and 20.51 per cent of the students from cohort 2014/2015 took part in these activities. Compared to the students from cohort 2013/2014, fewer students from cohort 2014/2015 participated in the listed activities. These results, however, were not consistent with the results that the percentages of cohort 2014/2015 students who perceived that their environmental knowledge and environmental behavior had changed because of Liberal Studies program were larger than those of cohort 2013/2014 students. These results might also reflect the local specifics of schooling, affected by the Confucian heritage tradition, where learning “delves not around ideas of intelligence, ability, and competence”, but “cultivating personal virtue, self-development […] under parental guidance for social purposes” (Li, 2009, p. 40). The system keeps students overworked so that they have no time to pursue any personal hobbies and interests or join social groups. So, low participation in organized sustainability-related activities would be expected at this age group of Hong Kong students, who just went through what Ishisada (1974) coined with a term “examination hell”. Although it is noted that Western literature indicates that participation promotes awareness and behavior change, it was not a factor for Hong Kong students in this study.

A follow-up question to each item of the group participation scale asked whether the Liberal Studies program had influenced students’ environmental group activities participation (group participation decision scale). The common theme for these questions was “If yes to any of the above, was this decision as a result of the Liberal Studies program you studied at school?” The response categories were yes or no. The percentage distributions for the items of the group participation decision scale for both cohorts are presented in Figure 4.

As shown in the results, among the students who participated in the activities listed in the group participation decision scale, larger percentages of students from cohort 2014/2015

![Figure 3. Students’ self-perceived group participation (percentage)](image)
perceived that their participation in these activities was as a result of the Liberal Studies program, compared to those of students from cohort 2013/2014. However, these results are inconsistent with the results that less students from cohort 2014/2015 participated in the activities listed in the group participation scale than those from cohort 2013/2014. The fact that students have participated in the sustainability-related activities was actually very surprising given the pressures that students were under meeting the demands of the educational system based on the Confucius heritage principals of self-perfected learning and parents’ expectations of the school system. The results showed students’ tendency for family and not community engagement that also might be explained by the family-centered social norms of Confucian heritage culture.

5.4 Students’ perceptions of other influences on their sustainability understanding

Students’ perceptions of other influences that had increased their understanding of environmental issues were tested using the other influence scale. This scale contained six items with a common theme of “Have other influences increased your understanding of environmental issues?” The items were other school lessons or activities, TV, newspapers/magazines, internet, family and friends. The response categories were yes or no. The percentage distributions for these items for both cohorts are presented in Figure 5.

Results indicated that students from the different cohorts rated similarly in the other influence scale. There were three exceptions to this: “Other school lessons or activities”, internet and newspapers/magazines. Compared to students from cohort 2013/2014, a larger percentage (1.44 per cent more) of students from cohort 2014/2015 believed that other school lessons or activities had increased their understanding of environmental issues, whereas a lower percentage of students from cohort 2014/2015 indicated that the internet and newspapers/magazines affected their understanding of environmental issues. The differences in the percentages were 4.23 and 10.86 per cent, respectively.

These findings indicate that family or friends are not important factors that might influence students’ perceptions of their level of sustainability consciousness. These confirm the results of the recent findings reported in the Hong Kong based study by Cheung et al.
(2015), who warned about powerful media influences on the formation of Hongkongers’ understanding of sustainability. Considering the important place which family takes in the lives of students in Confucus heritage culture (Koo and Wong, 2009; Savelyeva et al., 2015), the results might be an alarming indication that these items are not discussed within the powerful systems of family or among friends.

The CFA of the linear model used in this study partially supported a set of the researchers’ initial observations (Figure 6), and that constant models may not be the best and only ones for investigating a complex construct of students’ sustainability consciousness.

The factor analysis clearly identified the significant differences between 2013/2014 and 2014/2015 students’ cohorts in their perceptions of sustainability-related knowledge and behavior increase due to NSS LS (subscales knowledge increase and behavior increase). The results of the CFA confirmed that the relationship between students’ perceptions of their knowledge and behavior increase due to NSS LS curricula and other factors were all significant, with the correlation coefficients ranging from 0.110 to 0.595. The $R^2$ values of knowledge increase, behavior change, group participation decision and other influences were 0.019, 0.008, 0.019 and 0.031 respectively. Such low $R^2$ values were expected and might be explained by the limitations of the linear approach to explain complexity of human behavior and perceptions. The results also show that the cohort difference in students’ perceptions of their participation in sustainability-related group activities (subscale group participation decision) was not supported. This finding showed that students’ decisions to participate in sustainability-related group activities were not affected by any variables, which might point to limitations of the perception scale adapted for this study.

The $R^2$ results presented in Table III showed that most of the estimates were not significant, except the $R^2$ for other influences in the final model. This finding indicates that neither gender nor cohort differences generated much variance in the dependent variables.

The qualitative analysis of students reflective narratives revealed three aspects of students’ sustainability consciousness, which were derived from the three clusters generated after the thematic cluster analysis: intentionality to make a difference based on dreams, strong cultural biases, openness to alternatives and commitment for better future; engagement with complex questions about identity, society and nature; and eschatological perspectives in description and analysis, which included rhetoric of hope, possibility and harmony. These three aspects we based on the two overarching themes of identity and culture. The theme of identity included three thematic clusters: students’ reflections on their
Notes: The coefficients relating to cohort and gender were standardized as STDY and others as STDYX. Significant effects are shown as an arrow with solid line and non-significant effects as an arrow with dotted line. Non-significant correlations between the latent variables are not shown. Females were coded as 0 and males as 1; cohort 2013/14 was coded as 0 and cohort 2014/15 as 1. Air Con = use air conditioning; Donation = donated money to a sustainability-related group; Join = joined a sustainability-related group; Work = volunteered or been paid for work in a sustainability-related organization; School = other school lessons or activities; News./Mag. = newspapers/magazines

Figure 6.
CFA for students' sustainability group activity participation
Prior identity; engaged identity or identity in action; and transformed identity. The theme of culture included reflective references to the principles of Taoism, Confucius teaching and Hong Kong heritage. The narrative items related to human relationship with nature constituted a critical underlying theme which illustrated instances of students’ identity transformation in all the three aspects of their sustainability consciousness resulted in this study (Figure 7).

Considering the vast amount of the data generated from our qualitative investigation, we provide only short excerpts derived from most descriptive pieces of students’ narratives.

5.4.1 Intentionality to make a difference. The theme included reflective students’ narrations describing their dreams, hopes and expectations with the rhetoric of hope, positive outlook in their past and future, openness to alternatives and commitment to a better future. Students acknowledged their cultural biases as a positive stabilizing feature that helped to sustain them, in an otherwise confusing swirling sea of a multitude of worldly alternatives and global solutions of which to select from. Upon analyzing complex social and environmental issues, students remained committed to creating and building a sustainable

Table III.

<table>
<thead>
<tr>
<th>Predictor (model)</th>
<th>Knowledge increase</th>
<th>Behavior change</th>
<th>Group participation</th>
<th>Other influences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>0.001</td>
<td>0.000</td>
<td>0.023</td>
<td>0.028</td>
</tr>
<tr>
<td>Gender and cohort</td>
<td>0.019</td>
<td>0.008</td>
<td>0.019</td>
<td>0.031*</td>
</tr>
<tr>
<td>Change in ( R^2 )</td>
<td>0.018</td>
<td>0.007</td>
<td>-0.004</td>
<td>0.003</td>
</tr>
</tbody>
</table>

Note: *Stands for significance at \( \alpha = 0.05 \) level

Figure 7.

Aspects of students’ sustainability consciousness
future for themselves and for the betterment of their countries of origin. One student reflected on his/her group’s first intercontinental videoconference experience that took place in conjunction with other international students who hailed from divergent countries as being inspiring, motivational and uplifting:

It really raised my self-esteem to see how good we [his/her Hong Kong class] was [sic] at this [international] videoconference. They [students from other countries] were different, some made me laugh. But we managed to find an alternative solution [to a sustainability problem], because we have only one bright future.

5.4.2 Engagement with complex questions about identity, society and nature. Students also reflected on personal issues of their engaged and active identity on both individual and social levels, whereby some indicated this as an intricate and convoluted journey of growth, fluid transformation and exploration. One student contemplated on his/her Hong Kong identity in response to the “One Country – Two Systems” on-going socio-political struggle in his/her city as an important effort of achieving balance between one’s subjected nationhood and public governance:

There are many disputes in the community that are complex and cannot be resolved fully, such as disputes between Hong Kong and Mainland China over identity [of the city and] its people […] I see education is the ways to establish a good quality of local citizenship, so we could comprehend the differences between the two places. This might decrease the conflict and increase national identity of my [Hong Kong] people.

Given that Taoism teachings comprise a core form of students’ general curricula and local education, it was not surprising to find that some students under an assured voice also referred to the ancient Taoist Chinese principles of unity with nature, morality of a collective action and the attainment of assuming a greater sense of responsibility. Thus, it was not uncommon to find student descriptions exuding the Taoist virtues of the Yin-Yang philosophy of universality, holistic tendencies and cosmic interconnectedness:

According to Taoism, everything is interrelated, and change in one thing leads to change in others. If we see the universe as a whole, it means that if one major party goes down, another follows. All the living things within the universe are interrelated to each other. Although we rank a living creature’s priority by its place on an evolutionary tree and creature’s usefulness to a human, this does not really rank the value of a creature. The value of a creature should not be evaluated based on the usefulness.

We should see universe as a whole as everything is connected to one and other.

5.4.3 Eschatological perspectives. In formulating their written reflections, descriptions and analyses of sustainability-related issues, students utilized a critical approach with evidence that can be surmised as being imaginative, future-oriented and action-poised. They were encouraged to be expressive; hence, majority of the participants integrated spontaneous hand drawings, e-doodles made using apps on their mobile devices, whimsical poetic stanzas, lyric excerpts from K-pop songs and vivid YouTube video examples to convey their viewpoints on sustainability and other related issues.

One of the students composed a short poem describing their learning as a metaphorical excursion, which revealed a trove of symbolically representative themes expounding on destiny, dreams, inventiveness, hope and excitation. The semantic analysis of the poem illustrates students’ perception of changing identity and on-going transformation, described with the rhetoric of dreams, hopes and future-oriented action:

Since very young, in mother’s care

I dreamed one day to go to college.
I set myself on a bumpy journey
And stumbled, at last I climbed a college wall.

Just now as a college student
I always hope one day to return back
To the happy days I ran all the way
Laughing and enjoying the innocence

Of my long absence.

In a close examination of the students’ varying points of view on contradistinctive aspects of sustainability, students often turned to a rhetoric of fortuity, aspiration and possibility. In one case, a student described his/her perception of a sustainable city as a wistful, ephemeral entity in direct literary reference to Ursula K. Le Guin’s (1973/1997) short philosophical fiction *The Ones Who Walk Away from Omelas*:

> Every day is full of hope here and people strive to leave even more harmonious. Just like people in a utopian city of *Omelas* [by Ursula Lequin] who lived in the city that never existed in the human consciousness, we make Hong Kong real. It is possible to us.

When self-reflecting on themselves, their inner transformations, identity and the impact of contemporary issues affecting them in their society, students repeatedly referred to the concept of harmony as one of their main principles to merge contrasting notions of disparity. One student described his/her views on educational reforms as a worthy process of forming a compatible and consistent whole, in spite of the daily onslaught of modern urban stressors:

> I think the most suitable words for me to describe my [approach to education] are through living a harmonious and cheerful life that always changes. Teachers are pressured [in our city], and we have to deal with many [social] controversies and sometimes unrests. Striving for harmony in a positive way makes changes easier to sustain.

6. Discussion

The quantitative results revealed an increase in the self-perceived knowledge and behavioral aspects of the sustainability consciousness of Hong Kong students. These point at the increase in students’ knowledge-attitude-behavior axis due to their immersion in compulsory sustainability education modules within liberal studies programs in secondary through HE. At the same time, students’ self-reported engagement in sustainability-related civic, campus or action groups remained low.

However, the qualitative analysis of students’ reflective narratives revealed that beneath these visible or self-declared behavior and knowledge changes, lies imaginative, future oriented and critical approaches to describing and analyzing their views on their identities, nature and their notion of social, environmental and economic sustainability. These results add to the discussion on transformative learning based on Bateson’s (1972) model that emphasize on the importance of one’s ability to imagine, articulate and “endeavor to enact principles of ideal cohabitation” (Code, 2008, p. 24) rather than to display sustainability action as the end-result of sustainability education.
Furthermore, grounded in reflexive criticality, students’ narratives revealed what Gayá and Phillips (2015) refer to as future-oriented and action-oriented “eschatological imagination”. It includes aspects such as rhetoric of hope, possibility and harmonization of contrasts. Our results echoed Gayá and Phillips’ work when, reflecting critically, students were able to connect sustainability with emotional, relational and ethical aspects of their own experiences that, in turn, triggered their engagement with complex questions about identity, society and nature. By doing so, students gradually and meaningfully re-discovered and re-constructed their own nature-related worldviews, setting a foundation for the construction and practical manifestations of their sustainability-related realities.

Assigning to imagination an important role in a process of fostering students’ sustainability consciousness, we challenge the simplistic assumptions of attitude–behavior relationship and stress the importance of contextual factors and changes unrelated to students’ attitude and intention. We join Arbuthnott (2009, p. 153) to caution that “sustainability education must not stop at value and attitude change because considerable evidence indicates that behavior does not flow directly from our attitudes and intentions”. The focus on contextuality that resulted from our study contributed a sociological discourse that distinguishes a person’s eschatological imagination and social imagery, where imagination refers to an explicit set of skills or abilities and imagery deals with a more elusive construction of one’s personal and social identities (Taylor, 2004). In the context of our research, students’ social imagery appeared as a set of self-realizations, understandings, understandings and self-constructions of common expectations related to their future, that might give them a stronger sense of an interconnected and shared life and contribute to social identity. Taylor (2004) envisioned such a type of imagery might trigger a society where each individual is an “immediate to the whole”.

Mapping the results of this study against the original three-pillar UN model, we argue that the model might be useful, as it underlines the curricular module that helps to raise sustainability awareness, increase knowledge and support the environmentally friendly behavior of Hong Kong freshman students. The model has, however, highly anthropocentric and compartmentalized structure, which results in a lack of its completeness and continuity (NAS, 2015). A sustainability implementation guided by such a model is an approach which might yield no results. To address this problem, researchers (Burford et al., 2013; Filho et al., 2015; Velasco and Harder, 2014) propose to enhance the UN model with a “missing pillar” (Burford et al., 2013) that would “consciously and systematically incorporate a deeper, at once more internal and more contextual dimension, designated variously as cultural-aesthetic, political-institutional, or religious-spiritual” (Velasco and Harder, 2014, p. 6554).

Students’ strong cultural biases yet openness to alternatives and commitment to the better future that were revealed in this study underscore contextuality as an important condition for the formation of sustainability consciousness. In this sense, contextuality might be linked with the proposed additional pillars to the UN model, such as culture [Dessein et al., 2015; Hawkes, 2001; United Cities and Local Governments (UCLG), 2010], ethics or values (Barford et al., 2013; Shephard, 2010) and institutionalization (Velasco and Harder, 2014). However, we argue that the additional pillars might not enhance the framework, which stands on a single foundation of anthropocentric assumption about the relationship between humans and nature. The variety of non-Western philosophical and scientific traditions from across the world offer different foundations to the localized sustainability movements that shape sustainability consciousness of their people (Savelyeva, 2016).

The Hong Kong students’ reflective narratives include ideas of harmony and human-nature unity, which suggests the driving ideas about human–nature relationships within the localized sustainability discourse and grounded in Confucianism. Confucian tradition, which does not separate nature and humans and does not assume human
superiority over nature, shapes its own anthropocosmic and cosmoanthropic foundation to the regional sustainability discourse (Savelyeva, 2016). We argue that these ontologies (hierarchy of beings) originated from the localized Confucian tradition shape local students’ perceptions and worldviews that might differ from those of their Western peers. This addressed the problem of anthropocentrism by supporting Bateson’s (1979) argument about the perceptual domain of knowing, which has emerged in Western sustainability literature and brought about a new field and arena of “perceptual ecology” (Thomashow, 2002).

7. Conclusion
Since the inception of sustainability education in the late 1970s, HE institutions are among the frontline agents that advance the underlying UN policy model of SD in research, curricula and community practices. Universities acknowledge the model as their guiding framework and, by implementing it in the diverse cultural, political, social and economic contexts, challenge the overall idea of development. The study pointed to the benefits of a possible shift in research approaches – from the simplistic analysis of students’ sustainability behavior and attitudes to a more contextual investigation of their sustainability consciousness. The latter allowed the greater inside into future- and action-oriented mindsets of the students, which were filled with the rhetoric of hope, possibility and harmonization of social contests; openness to alternatives; and a commitment to the better future, much in line with the emerging discussions about eschatological imagination and social imagery. Both quantitative and qualitative results suggest that sustainability education, implemented as part of the formal compulsory liberal studies curriculum in a continuous (secondary to high education levels) manner, increases students’ knowledge-attitude-behavior axis and fosters their sustainability consciousness through a process of transformative learning and identity building.

There is no doubt that the UN-based model proves itself useful on the grounds of HE, yet, its anthropocentric and compartmentalized structure, which is lacking continuity, slows down sustainability implementation in diverse cultural and educational contexts. We believe that refraining from mechanistic policy models and focusing on students’ culturally specific root beliefs about human–nature relationships might help to trigger and “ensoul” sustainability in their hearts and minds. Direct and practical reference to the more localized, non-Western sustainability traditions and philosophies which assume anthropocosmic and commoanthropic kinds of relationships between humans and nature instead of enhancing the UN model with different kinds of “fourth pillars”, might yield better results and target foster sustainability consciousness of our young generations.

Notes
1. Education of sustainable development is viewed by NAS as the established ideological force that promoted neoliberal idea of sustainable growth and development.
2. Savelyeva and Park (2012) use a metaphor of ensoulment to describe the need for re-focusing current campus sustainability model in favor of curriculum that fosters sustainability values rather than dominant focus on campus greening, science and public relation efforts.
3. Savelyeva and McKenna’s (2011) three-fold model of the campus sustainability movement includes three aspects: education for sustainability, sustainability sciences and campus greening.
4. Other conditions for the Savelyeva’s model include international, interdisciplinary and innovative curricular features
5. In this study, globalization is viewed in reference to a strategic goal of EDB to globalize Hong Kong’s curricula, where globalization is approached as a post-colonial stage of the city’s development.
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Further reading


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Education for sustainability using a campus eco-garden as a learning environment

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Abstract
Purpose – This paper aims to explore stakeholder perspectives of the role of a campus eco-garden in education for sustainability (EfS). It will combine the perspectives to highlight a powerful learning environment (PLE) for university students to realize the concept of EfS.
Design/methodology/approach – Semi-structured interviews were conducted to reveal stakeholder understandings of a campus eco-garden, as well as its associated expectations of learning activities and education outcomes. Three stakeholder groups were interviewed, designers, educators and environmental and non-environmental subject-related students.
Findings – All three stakeholder groups expected cognitive learning of EfS to be enhanced by the eco-garden. The use of affective learning was not strongly expected by the stakeholders. Psychomotor learning was believed to be the most difficult to realize. To fulfill the potential of the eco-garden in EfS, all stakeholders suggested learning activities and roles for both students and teachers. The combined perspectives of the stakeholders helped to visualize a PLE to aid EfS.
Practical implications – This study underlines the importance of effective communication of expectations between stakeholders. It underlines the importance of integrating educational activities with the eco-garden as a PLE, highlighting the roles of teachers and students. It also sheds light on the importance of introducing a cultural component to the EfS program.
Originality/value – This is the first study to apply the PLE theory to enhance EfS with the aid of infrastructure. Both users and designers reveal their views on the planning of the campus eco-garden, especially in its educational function. The study is possibly the first to reveal the differences in expectations between designers and other stakeholder groups (teachers and students) using Konings et al.’s (2005) combination-of-perspectives model.

Keywords Campus eco-garden, Eco-centric world view, Expected education outcome, Garden-based learning (GBL), Powerful learning environment (PLE), Stakeholder perspective

Paper type Research paper

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The authors are grateful for the financial support of the Central Reserve Fund, the Education University of Hong Kong, on the project “Green Education for Ecogarden” (Ref. No.: 03A08) for the planning and implementation of the education programme associated with the eco-garden. Gratitude is extended to Mr Brian Ho-yeung Ip and Ms Hoi-lam Yeung for their logistical support of the interviews and data transcription. The constructive advices of the anonymous reviewers are also highly appreciated.
Introduction
Sustainable development has been proposed as one of the core literacies with which a twenty-first-citizen should be equipped. Education is key to providing such literacy (Dale and Newman, 2005). Indeed, higher education institutions were highlighted in the Rio +20 conference because of their significant role in the pursuit of sustainable development.

EfS should focus on the understanding of humanity’s relationship with the environment; to achieve this, gaining holistic experience is more desirable than traditional one-way lecturing (Bosselmann, 2001). Gaylie (2009) presents a well-illustrated case-study of how a campus “learning garden” in a tertiary institution can be used to nurture an eco-centric world view, as well as give students a strong sense of belonging to the garden. In line with Gaylie (2009), we argue that even a conventional garden with limited ecological resources (such as biodiversity) could still transfer deep knowledge of biodiversity, ecology and environmental protection to tertiary students and foster pro-environmental attitudes and behavior. The students could cognitively benefit if the garden has been planned to demonstrate environmental technical advancements.

This study discusses the potential use of a campus eco-garden to enhance undergraduate affective, cognitive and psychomotor learning experience for EfS. The study also serves as part of the participatory process (Könings et al., 2010) in the development of an eco-garden established in mid-2016 at a university in Hong Kong. The eco-garden was created by renovating an abandoned garden and converting it into part of the campus infrastructure to support EfS. The study uses the combination-of-perspectives (COOP) model of Könings et al. (2005) and collects the views of major stakeholders on the expected function and utility of an eco-garden within the scope of education for sustainability (EfS). This creates a powerful learning environment (PLE) for undergraduates to acquire and realize the concept of EfS.

Literature review
Garden-based learning and education for sustainability
Garden-based learning (GBL), defined as the use of a school garden for educational purposes, has been found to be effective in nurturing student literacy in science, mathematics and the environment (Blair, 2009; Williams and Dixon, 2013). Rowe and Humphries (2004) provide an overview of how a modified ecological garden (including natural resources, e.g. trees, crops and water features) can be used to acquire environmental literacy in both primary and secondary schools. GBL has been widely adopted in the USA during the past two decades in primary schools (Desmond et al., 2004). However, little research has investigated the role of gardens as an educational resource in tertiary education.

A recent study by Gaylie (2009) is one of the few studies on how to use a campus garden to change student attitudes toward eccentenzism. By facing problems during the development of the garden, students had to critically discuss solutions regarding issues of social and environmental justice. This prompted students to reflect upon their attitudes toward the environment. The development of a sense of belonging and emotional engagement with the garden increased its affective influence, making the GBL in Gaylie’s course a successful approach to nurturing pro-environmental attitudes.

There are no studies illustrating the effectiveness of GBL in promoting pro-environmental behavior in school-based settings, although GBL was found to be effective in altering behavior in nutrition education (Heim et al., 2009; Parmer et al., 2009). The only similar examples of using a garden for promoting behavioral change were those based on botanical gardens in a non-formal educational context (Ballantyne and Packer, 2005). There is then a knowledge gap in how we can use GBL to promote pro-environmental behavioral change.
Powerful learning environment for education for sustainability

Transforming pro-environmental attitudes into actual behavioral change has long been challenged in environmental education (Kollmuss and Agyeman, 2002; Arbuthnott, 2009). Various factors – perceived control over the effectiveness and outcomes of pro-environmental behavior and the inconvenience and additional costs of pro-environmental behavior – were found to significantly hinder pro-environmental behavior. Arbuthnott (2009) suggests different strategies to promote behavioral change in an E&F context. For example, specific examples of how pro-environmental concepts can be implemented; feedback on the effectiveness of pro-environmental behavior can be provided so that the people can “visualize” their contribution to the environment; habit-changing support programs can be introduced to change anti-environmental habits.

A PLE could be a useful approach to aid a habit-changing program. It could also help people visualize the efficiency of their pro-environmental behavior. A PLE emphasizes on the creation of an effective and comprehensive learning environment for student-oriented and student-driven learning. Students take an active role in the knowledge or behavior acquisition process, whereas teachers aid the learning (Volman and van Eck, 2001; Hayes, 2007). PLE has been widely applied in computer-supported visual environments (Lehtinen, 2003; Vosniadou and Kollias, 2003). However, there has been limited application in other educational fields. Kangas (2010) suggests that a nature-related facility, such as a garden, could be one of the most important components of the PLE; its function would aid transfer of knowledge and enhance informal learning experiences (Kangas, 2010).

From a practical perspective, PLE refers to a learning condition that can strengthen student knowledge and self-initiated and regulatory skills by the completion of a series of meaningful and challenging tasks, within a peer-supported atmosphere (De Corte, 2003). Van Merriënboer and Paas (2003) set out four blueprint components of a PLE, namely, learning tasks, supportive information, procedural information and part-task practice. A PLE should provide an authentic environment for establishing meaningful learning tasks as the first step, supported by relevant theories (information). Subsequently, the information to be delivered should be divided into appropriately sized units, taking into consideration the student cognitive loading. Finally, the tasks and information should be delivered in a well-planned sequence. Vermunt (2003) points out that, among the eight common learning environments such as project-centered learning and problem-based learning, aiding the self-directed, meaning-directed learning of students is the ultimate goal of establishing a PLE, whereas undirected or reproduction-directed learning is regarded as a low-quality learning process.

Stakeholder expectations for creating powerful learning environment

The benefits of an eco-garden cannot be fully realized until it is known what teachers and college students think of it and how they plan to use it. The matching of teachers and students’ perceptions of learning outcomes has been found to be of vital importance in student learning processes (Brophy, 1987; Könings et al., 2005, 2014a). The high but appropriate expectations of teachers and students can enhance student motivation, which should in turn enhance learning effectiveness (Brophy, 1987). However, a mismatch in expectations can also occur between the instructional designers, teachers and students. This can adversely affect the successful establishment of a PLE (Elen and Lowyck, 1999; Könings et al., 2005). Könings et al. (2005) suggest a participatory approach, the COOP model, to incorporate all expectations of different stakeholder groups in the design stage of a PLE. The COOP model emphasizes on the feedback loop of students advising both instructional designers and teachers to modify the PLE.
The expectations of these three different principal stakeholders in a teaching-learning process governs student learning outcomes and collectively determines if the teaching-learning process is optimal. Understanding stakeholder expectations of the roles of an eco-garden in EfS is thus crucial if the educational benefits of the eco-garden are to be maximized. This study, conducted in the mid-development stage, explores different stakeholder perspectives on the eco-garden and the possible use of the eco-garden in EfS. In this study, the design group is a little different from instructional designers described in the COOP model (Könings et al., 2005). The design group did not have much of an academic background. However, in designing the eco-garden, they considered its educational function, described in the subsection of case description. This study not only benefits the development and refinement of the existing eco-garden but also provides suggestions for establishing an eco-garden or ecological landscape in any tertiary educational institution.

Case description – campus eco-garden
An eco-garden integrates ecological and environmental concerns into the landscape of a garden. It aims to foster the physical and spiritual well-being of human life. It also aims to improve the surrounding environment, for example, by affecting the microclimate of urban regions (Attia, 2006). An eco-garden provides an extensive range of environmental, social, recreational, health and public educational benefits to sustain the well-being of the local community (Subramaniam, 2002; Bernholt et al., 2009). It is believed that an eco-garden could be a convenient tool on a University campus, which would aid the development of a PLE (De Corte, 2003) for students at the University to learn about ecological concepts, sustainable agriculture and modern technology in renewable energy. It could also be used as a “learning garden” to nurture the student pro-environmental attitudes (Gaylie, 2009).

The eco-garden design shares much with an idea of Rowe and Humphries (2004), but with much more deliberation on various state-of-the-art concepts of environmental sustainability. Chen and Wu (2009) emphasize on the unique role of Chinese traditional culture in the design of a modern sustainable landscape, integrating the ecological and cultural conservations through the principle of the “unity of man with nature”. Various models and theories applying the concept of Qi, such as Feng Shui theory and Ying-Yang Dualism, etc., have been utilized to guide the design of traditional Chinese gardens (Chen and Wu, 2009). In this study, the designers incorporated a Taoist ideal of natural spontaneity and Neo-Confucian naturalistic cosmology in the design of the eco-garden. The design was inspired by Taoist philosophy: “Nature, earth and I have the same root; myriad things and I are one entity” and “Humans follow the earth as a rule. The earth follows heaven as a rule. Heaven follows the Dao as a rule. The Dao follows itself as a rule”. The design was also influenced by Neo-Confucian naturalistic cosmology, which emphasizes on the organic holism that regard the universe as a unified unit instead of a detached mechanistic entity and dynamic vitalism inherent in material force (Tucker, 1991). The designers wanted to promote visitors’ awareness of harmony between nature and humans through enjoying and appreciating the natural environment as a unit both renewable and vital.

To achieve educational aims, the designers planned to overlay the necessary demonstration units for sustainability education upon the original garden setting. The demonstration units are closely related to environmental sustainability concepts; the use of renewable energy, the efficient usage of resources and the conservation of biodiversity (Goodland, 1995). A visiting route was developed to introduce how environmental sustainability was achieved through wisdom in the past and how it is attained in the modern world with the development of innovative technology. The sustainable components include a herb spiral, an aquaponic system, a constructed wetland, an eco-pond, organic farmland
with compost, a water wheel, photovoltaic systems for solar energy, solar and hybrid lamps, a rain garden and a butterfly garden.

Plate 1 shows the Chinese-style facilities in the eco-garden. The design of the eco-garden, renovated from an abandoned garden, is thus based on three principles:

1. Not greatly altering the original setting and retaining the basic structure of the garden;
2. Adding innovative features to aid the teaching and learning of EfS; and
3. Using all facilities inside the eco-garden to demonstrate harmony between nature and humanity.

Figure 1 shows the layout of the eco-garden at the University. The operational systems of the sustainable eco-garden in terms of resource recycling and energy conservation among the units are summarized in the flow diagram (Figure A1).

Methodology

Research questions

Two research questions were proposed to explore the potential of creating an eco-garden-based PLE in a higher education setting for EfS through the consideration of different stakeholder perspectives:

RQ1. What kinds of use of the eco-garden do stakeholders think would enhance undergraduate affective, cognitive and psychomotor learning of EfS?
**RQ2.** What is the range of different stakeholder perspectives regarding the eco-garden, which could aid the creation of an eco-garden-based PLE?

**Participants**
Three groups of principal stakeholders were invited to take part in the study on a voluntary basis; designers; educators; and students pursuing environmental studies-related programs (ENV students) and non-environmental studies-related programs (NENV students). The following gave their consent to be interviewed: six from the designer group (the project initiator staff of the Estate Office of the University, the architects of the designing vendor and the architects of the construction vendor of the eco-garden); three educators specializing in the teaching and learning of environmental subjects; seven ENV students; and eight NENV students.

The six-member designer group were the main idea contributors in the 14-member design and construction committee of the eco-garden. Three educators accounted for 15 per cent of the lecturers who teach environmental studies-related subjects. The 15 students interviewed were randomly selected from 4 out of the 15 non-environmental studies-related undergraduate programs and 4 out of 6 environmental studies-related programs in the university.

**Data collection**
Semi-structured interviews were conducted with each stakeholder to examine their understanding of the eco-garden and its role in sustainable environmental education. An interview protocol was designed consisting of two parts. The first part examined understanding of the eco-garden in terms of its functions and values. The second part explored the roles of the eco-garden in sustainable environmental education in terms of its educational purposes, teaching activities and the roles of the teachers and students. The following are examples of interview questions for each theme:

1. **Theme 1:** understanding of the eco-garden:
   - What do you know about the eco-garden?
   - Do you think it is valuable to set up an eco-garden in the University?

2. **Theme 2:** the roles of the eco-garden in sustainable environmental education:
   - What educational purpose would be achieved by the aid of the eco-garden?
   - What educational activities could be conducted in the eco-garden?
   - What are the roles of teachers and students in the educational activities in the eco-garden?
The interview protocol was used with slight changes to the wording considering the different interviewees. The interviews were conducted in the participants’ native language to avoid unnecessary misunderstanding and to save time. In particular, the designer group was interviewed in three meetings for the three different parties (initiator staff, designing and construction vendors) and so the designer group was regarded as three parties, instead of six people. Other participants were individually interviewed. All interviews were tape-recorded and lasted for approximately 0.5-1 h. All of the interview data were transcribed for later analysis.

Data analysis

The content analysis approach (Ellis and Barkhuizen, 2005) was adopted to analyze the interview data. The coding process went from initial coding to axial coding and focus coding (Strauss and Corbin, 1990). Each coding process started with initial coding, which produced a large number of codes such as knowledge of sustainability, knowledge of biodiversity, critical thinking skills, motivator, etc. These initial codes were then further condensed into broader categories. For example, the codes of critical thinking skills, managing skills, planting skills, scientific research skills, inquiry skills, observing skills and farming skills were combined into a broad category of the skills purpose of the eco-garden. Finally, focus coding was conducted to find the major themes which could account for most of the data.

To enhance the trustworthiness of the data analysis, peer examinations were conducted (Hitchcock and Hughes, 1995). Numerous discussions among authors who came from the same school of the University took place when any uncertainty in the coding and categorizing arose. Agreement was achieved based on the discussions and double checking of the matching between the themes and data extracts.

Results

Educational use of the eco-garden for cognitive learning of education for sustainability

A total of 30 specific educational purposes of the eco-garden were identified through data analysis. These purposes could be categorized into the domains of knowledge (11), attitudes (11) and skills (8) (Table I). The designers and educators suggested energy utilization, environmental pollution and biodiversity conservation for knowledge purposes of the eco-garden. These suggestions would form the basis of the knowledge and information required for the establishment of a successful PLE. One educator claimed that:

[…] As for knowledge, we can certainly understand more about ecology, what biodiversity is, how we conserve biodiversity, the importance of biodiversity to ecology, mankind and the community […].

One engineer stated that:

[…] The facility we saw is for renewable energy, things for environmental protection. This can allow the students to know that we can obtain our energy naturally. How can we use this energy more efficiently? How can we obtain this kind of natural energy more effectively? These questions are very important learning points for the students […].

The designers and educators’ acknowledgement of the knowledge purposes of the eco-garden were also echoed by the college students. One ENV student claimed that:

[…] I think the educational objective (of the eco-garden) may be very simple. What is renewable energy? How could electricity be generated? How can we observe the operation and cycling of the eco-pond […] the ecological cycling? […] Or on the farmland, how can we define an organic farm? Because I believe that many people do not know about this concept […] Or maybe for the butterfly garden, we can observe and learn about different species […] Or for the wetland, what is the structure of the wetland? How can we regard a place as a wetland? The function of a wetland […] Principally, it is the growth of my knowledge […].
<table>
<thead>
<tr>
<th>Category</th>
<th>Key education outcomes</th>
<th>DES (N = 3) (%)</th>
<th>EDU (N = 3) (%)</th>
<th>ENV (N = 7) (%)</th>
<th>NENV (N = 8) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge (cognitive)</td>
<td>Understand what is meant by sustainability</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Understand what ecology is</td>
<td>1 (33.3)</td>
<td>1 (33.3)</td>
<td>6 (85.7)</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Understand what biodiversity is</td>
<td>2 (66.7)</td>
<td>1 (33.3)</td>
<td>3 (42.9)</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Understand what the importance of biodiversity is</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Understand how to maintain/enhance biodiversity</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>1 (14.3)</td>
<td>1 (12.5)</td>
</tr>
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<td></td>
<td>Understand what kind of organisms (biodiversity) live in the Institute</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
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<tr>
<td></td>
<td>Understand underlying concepts of the technology introduced in the ecogarden</td>
<td>2 (66.7)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>1 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Understand what the problem of using fossil fuels is and why we should introduce renewable energy</td>
<td>2 (66.7)</td>
<td>0 (0)</td>
<td>3 (42.9)</td>
<td>5 (62.5)</td>
</tr>
<tr>
<td></td>
<td>Understand how to carry out organic farming</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>3 (42.9)</td>
<td>1 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Understand what pollution is</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Understand how to run an ecogarden</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Skill (psychomotor)</td>
<td>Be able to critically think of the dilemma between development and conservation</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Be able to observe the natural environment in detail</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
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<tr>
<td></td>
<td>Be able to adopt scientific inquiry</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
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<td></td>
<td>Be able to conduct scientific research</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
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<tr>
<td></td>
<td>Be able to manage an ecogarden</td>
<td>0 (0)</td>
<td>2 (66.7)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Be able to practice aquaponics</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Be able to practice organic farming</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>2 (28.6)</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Be able to plant trees</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
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<table>
<thead>
<tr>
<th>Category</th>
<th>Key education outcomes</th>
<th>DES ((N = 3)) (%)</th>
<th>EDU ((N = 3)) (%)</th>
<th>ENV ((N = 7)) (%)</th>
<th>NENV ((N = 8)) (%)</th>
</tr>
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<tbody>
<tr>
<td>Attitude (affective)</td>
<td>Be aware of the interrelationship between mankind and the environment, and realize the intangible advantages offered by nature</td>
<td>2 (66.7)</td>
<td>2 (66.7)</td>
<td>1 (14.3)</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Promote an appreciation of nature</td>
<td>0 (0)</td>
<td>2 (66.7)</td>
<td>2 (28.6)</td>
<td>2 (25.0)</td>
</tr>
<tr>
<td></td>
<td>Reflect on self-behavior regarding the environment</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>3 (42.9)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Enhance pro-environmental behavior</td>
<td>2 (66.7)</td>
<td>1 (33.3)</td>
<td>2 (28.6)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Promote a sense of responsibility for the environment</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Obtain satisfaction from organic farming</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Promote an appreciation for the efforts of farmers and thus treasure food</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (12.5)</td>
</tr>
<tr>
<td></td>
<td>Promote an appreciation of the traditional technology and wisdom</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Enjoy the learning process in the ecogarden</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Arouse students’ interest in learning interdisciplinary knowledge</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>1 (14.3)</td>
<td>0 (0)</td>
</tr>
<tr>
<td></td>
<td>Acquire the value that one should practice what one preaches</td>
<td>0 (0)</td>
<td>1 (33.3)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
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</table>
Educational use of the eco-garden for affective and behavior learning of EFS

Considerations of attitudinal change were revealed by various stakeholders (Table I). Most mentioned attitudinal changes are related to environmental sustainability. “Be aware of the interrelationship between humanity and the environment, and realize the intangible advantages offered by nature” was a common anticipated value gained, shared by all stakeholders. For example, one engineer mentioned that:

[...] Based on my knowledge, there are three “A”s, awareness, attitude and action. In fact, this is the objective of our education [...] widening their knowledge horizons [...] changing their attitudes [...] encouraging them to take respective actions [...].

Regarding attitude, the students can be motivated to appreciate nature, understand the natural wonders [...] and something like [...] it is not easy for human beings to change ourselves without any alteration to nature. That means [...] we did not realize what is going on [...] but if we can protect this balance, we shall have a lot of potential benefit. This may inspire them (the students) to (understand) the natural wonders and understand that living organisms are very complex and subtle things [...].

Although enhancement of pro-environmental behavior was anticipated by all stakeholders (except for NENV [Table I]), no specific behavioral changes in daily life (such as increasing recycling, changing diet to more sustainable food source, etc.) were mentioned by the interviewees. Most interviewees mentioned the acquisition of specific skills related to particular issues associated with EFS, for instance, aquaponics and organic farming (Table I). The purposes of developing skills in aquaponics, organic farming and scientific inquiry and the generic skills of observing and critical thinking were emphasized more by the educators compared with the other two stakeholder groups of designers and students. One educator claimed that:

[...] This (the eco-garden) can provide an authentic place to allow students to conduct experiential learning, because environmental education is not only related to the cognitive aspect [...] Through participation, the students can take action for environmental protection, and can change their daily habits. This is the ultimate goal. But if we lecture in the classroom, they (the students) may only understand cognitively. [...] Another possibility is skills, for example the skill of how to manage an eco-garden. They will have no idea. But [...] if they participate in the site environment, they will know how to maintain an eco-garden [...].

Plurality of stakeholders’ perspective for visualizing powerful learning environment

All three stakeholder groups had a higher number of expected educational outcomes for knowledge, followed by those for attitudes and finally skills (Table I). The educators were the only group that emphasized on education purposes in all three knowledge, skill and attitude (KSA) aspects. The educators suggested on average 2.33 ± 1.15 ideas regarding skills, whereas the designers mentioned a few (0.33 ± 0.58). The educators suggested on average 2.67 ± 1.53 ideas regarding attitudes compared to 0.63 ± 0.74 ideas suggested by the NENV students. The difference in the outcome attitudes of the designers (1.67 ± 1.15) and ENV students (1.71 ± 1.60) was very small, whereas the difference in the knowledge outcomes of the designers (2.33 ± 1.53) and ENV students (1.63 ± 1.06) was relatively large. The NENV students had the least number of expected outcomes for knowledge and attitudes.

To optimize the potential of eco-garden in EFS, all stakeholders were encouraged to give suggestions on how to make good educational use of the eco-garden. Diverse curricular and community activities recommended by all three stakeholder groups (Table II) fell into one major blueprints of a PLE – the way of knowledge delivery (Van Merrienboer and Paas, 2003). The suggested activities covered six of the eight learning environments suggested by
<table>
<thead>
<tr>
<th>Designer</th>
<th>Educator</th>
<th>ENV student</th>
<th>NENV student</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Curricular activities in the Institute</strong></td>
<td>Educators incorporate the ecogarden facilities into course curricula through conducting activities in the ecogarden</td>
<td>Course activities</td>
<td>Course activities</td>
</tr>
<tr>
<td>Students conduct self-directed projects/research in the ecogarden</td>
<td>Doing experiments</td>
<td>Monitoring the energy consumption of the ecogarden</td>
<td>Drawing and painting</td>
</tr>
<tr>
<td>Students are trained to become educators/tour guides in the ecogarden</td>
<td>Organic farming</td>
<td></td>
<td>Producing sculptures</td>
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<tr>
<td></td>
<td>Monitoring the energy consumption of the ecogarden</td>
<td></td>
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<td></td>
<td>Drawing and painting</td>
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<tr>
<td></td>
<td>Composing poems</td>
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<td></td>
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<tr>
<td></td>
<td>Designing and evaluating teaching modules for pre-service teachers</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Educational activities for the community</strong></td>
<td>The general public and secondary/primary/pre-school students are allowed to visit and take part in educational activities in the ecogarden</td>
<td>Leisure activities</td>
<td>Leisure activities</td>
</tr>
<tr>
<td>Students manage an area of the organic farm and grow their own crops</td>
<td>Drawing and painting</td>
<td>Drawing and painting</td>
<td>Drawing and painting</td>
</tr>
<tr>
<td>Students conduct the manual work of managing the ecogarden such as collecting garbage</td>
<td>Festival celebrating activities</td>
<td>Festival celebrating activities</td>
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<td></td>
<td>Competitions</td>
<td>Competitions</td>
<td>Competitions</td>
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<td></td>
<td>Proposal of ecogarden utilization</td>
<td>Photography</td>
<td>Photography</td>
</tr>
<tr>
<td></td>
<td>Website design</td>
<td>Farming</td>
<td>Compositions</td>
</tr>
<tr>
<td></td>
<td>Academic workshops or conferences are organized</td>
<td>Experts are invited to deliver relevant talks</td>
<td>Professional development for Early Childhood Education teachers</td>
</tr>
<tr>
<td></td>
<td>Day/night educational camps for local students are organized</td>
<td>Students manage an area of the organic farm and grow their own crops</td>
<td>Family visiting tours from local schools are welcome</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Students conduct the manual work of managing the ecogarden such as collecting garbage</td>
<td>Students manage an area of the organic farm and grow their own crops</td>
</tr>
</tbody>
</table>

*(continued)*
<table>
<thead>
<tr>
<th></th>
<th>Designer</th>
<th>Educator</th>
<th>ENV student</th>
<th>NENV student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Others</td>
<td>Educational panels with educational tools are installed for understanding the ecogarden and demonstrating the technology and biodiversity in the ecogarden</td>
<td>Educators apply teaching development funding based on the ecogarden facilities</td>
<td>Students engage in the consultation for the future improvement of the ecogarden</td>
<td>Camera renting service is provided</td>
</tr>
</tbody>
</table>
Vermunt (2003), namely, traditional teaching, assignment-based teaching, classical problem-based learning, project-centered learning, self-directed specialization learning and autodidactic learning. These are all individual-based rather than collaborative learning environments. Moreover, it was suggested that educators conduct field-based activities in the eco-garden during course time. University students could carry out self-directed learning projects or scientific research in the eco-garden. For example, one educator suggested:

[...] There is a place for practicing and a place for data collection; surely we can conduct laboratorial experiments in it (eco-garden). The eco-garden (team) can collaborate with the existing laboratory, because we have environmental and geological laboratories (in the Institute). After development, we could carry out a lot of laboratorial experiments and strengthen the scientific research of our Institute [...].

As part of the infrastructure and as a platform for experiential learning of EfS, all stakeholders advised establishing educational panels to provide introductory information for the different facilities of the eco-garden. In contrast to the passive demonstration function suggested by other stakeholder groups, the educators suggested the incorporation of teaching and learning activities on educational panels through the inquiry pedagogy.

The active roles of both teachers and students were highlighted, and interaction between teachers and students was emphasized. Most interviewees affirmed the role of educators as mentors, motivators and facilitators of the teaching and learning of EfS (Table III). They highlighted the importance of the educators motivating student self-directed learning on the basis of a life-long learning approach beyond the classroom and the curriculum. As for the students, in addition to their roles as self-directed learners and practitioners in the teaching and learning process, many interviewees emphasized on their role as trainers for educational activities. Students were expected to study in detail the natural environment; for example, conducting butterfly biodiversity surveys in the garden. One designer claimed:

[...] In fact, it will be an interactive approach. Although lecturers would be the principal people to lead or explain [...] Certainly in fact under such conditions, (the lecturer) should welcome the students’ observation and questions. Maybe through these questions, the lecturer would be inspired and have deeper thinking and generation of more knowledge [...].

One educator echoed these thoughts:

[...] The lecturer in the classroom demonstrates the leading role. But in the student association, the lecturer has no such role; the students will be the dominant people who proactively focus on their own issues of interest. In fact, we have some funding which students can apply for. Students can ask

<table>
<thead>
<tr>
<th>Educators' roles</th>
<th>University students' roles</th>
</tr>
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<tbody>
<tr>
<td>Mentor in the teaching and learning (38.1%)</td>
<td>Docent/teacher of the activities in the ecogarden (33.3%)</td>
</tr>
<tr>
<td>Facilitator of the constructivist learning process (23.8%)</td>
<td>Self-directed learner in education for sustainability (23.8%)</td>
</tr>
<tr>
<td>The one who mobilizes students to engage in extra-curricular self-learning (19.0%)</td>
<td>Learner in the teaching and learning (23.8%)</td>
</tr>
<tr>
<td>Motivator in the teaching and learning (19.0%)</td>
<td>Practitioner to apply the knowledge and skills learned (19.0%)</td>
</tr>
<tr>
<td>Guide for group activities in the ecogarden (14.3%)</td>
<td>Observer of the natural environment of the ecogarden (9.5%)</td>
</tr>
</tbody>
</table>

Table III. The top five roles of educators and university students suggested by all the interviewees in place-based learning in the ecogarden

Note: The values inside the brackets indicate the % of supporting interviewees regardless of their stakeholder group.
the lecturer to serve as an advisor and, based on the students’ own interest, organize some activities or advocate environmental protection. I think all of these are feasible [...].

Discussion
This section analyzes why the eco-garden triggered different stakeholder expectations of cognitive and affective learning of EFS but seemed less powerful in eliciting suggestions for psychomotor learning. It analyzes stakeholder visualization of PLE through integrating educational activities with the facilities in eco-garden and highlights the importance of using COOP to discover discrepancies in the expectations of different stakeholders. It also points out the future challenges to the eco-garden and finally provides practical implications and research limitations of this study.

The eco-garden as a tool for education for sustainability in tertiary education
There have been a few successful documented cases of programs to utilize campus infrastructure as a pedagogical tool for promoting EFS in higher institutions. Sukhontapatipak and Srikosamatara (2012) find that a curriculum-based education program associated with the campus wetlands in Mahidol University, Thailand, was able to alter undergraduate attitudes toward the valuing and the conservation of wetlands, and LaCharite (2014) finds that campus agriculture projects motivated undergraduate behavioral change regarding farming and cherishing food. These successful examples, however, require various prerequisites to support the program; the availability of natural landscape in the vicinity of the campus and a sufficient supply of land on campus. This hinders a wider application of these campus-based programs to other universities.

The case of Gaylie’s (2009) learning garden suggests the potential application of GBL in a higher education setting to alter student attitudes toward the environment. In Gaylie’s study, by addressing various practical problems and engaging in vigorous discussion with peers regarding the issues on EFS, students gradually acquired an eco-centric view through a series of in-depth reflections. Furthermore, a strong affective engagement in the garden helped to consolidate student attitudinal change. As for the eco-garden studied in the present study, introducing more specific knowledge and technology in the design stage of eco-garden would likely further aid the dissemination of up-to-date knowledge and technology to the students, which perhaps would encourage more students to participate in the programme.

The incorporation of Chinese traditional philosophy in the design of eco-garden and the views on the appreciation of the harmony of nature and humans revealed by the stakeholders highlights the importance of introducing cultural and philosophical components in any EFS programme to nurture pro-environmental attitudes. The significant resonance and alignment of the views on the appreciation of the harmony of nature and humanity between the designers and users is attributable to the shared ideology of local people who are deeply influenced by Confucianism (Ho, 2002). In Asia, the alignment of Confucian ideology, or other local schools of philosophy advocating the harmony of humans and nature, with the landscape design for EFS or even the EFS programs per se could be an effective approach to promote a pro-environmental attitude.

In contrast to attitudinal changes, anticipated changes to pro-environmental behavior were not stressed by stakeholders. This might imply neglect or the overlooking of a potential use of the eco-garden in enhancing pro-environmental behavior. Possible reasons could include the disassociation between the eco-garden and behavioral changes in daily life, the non-specificity of the behavioral change to be expected, etc. The function of the eco-garden on behavioral aspects and associated habit-improvement programs warrant further intervention studies.
Visualization of powerful learning environment through integrating educational activities with the facilities in eco-garden

The educational activities suggested by the stakeholders covered six types of learning environments and yet did not suggest a collaborative learning component, regarded as one very critical component in creating a PLE (Vermunt, 2003). The activities encompassed different levels of educational objectives, from simple skills training in organic farming practice to the cultivation of students’ high-end competence such as data-analyzing ability, evaluation ability and creativity through research projects and poem composition. The wide spectrum of the recommended activities suggests the potential of the eco-garden and the campus infrastructure, which provides an extensive repertoire of both traditional and current technologies of environmental sustainability, to facilitate the establishment of the PLE.

De Corte (2003) pointed out that a PLE is a learning atmosphere and a series of physical settings allowing students to complete numerous challenging and meaningful tasks. Problem-based learning, which was frequently proposed by the educators in this study, is a pedagogy which perfectly matches garden-based learning (Gaylie, 2009). The complex, state-of-the-art and all-in-one nature of the eco-garden enables it to serve as a useful tool for such a purpose. For example, students conducting research in the eco-garden, albeit studying and understanding the principles of organic farming in the garden, could also perform comparative studies with the aquaponics system, regarded as a new environmentally friendly version of the hydroponics system (a soilless planting method). Those investigating solar panels to generate electricity could also study the pros and cons of different types of solar panels, whereas others could compare the power generation rates of solar panels with different types of renewable energy, including wind turbines, in the eco-garden. These examples illustrate the importance of an eco-garden for providing plentiful resources to support the PLE.

Range of expected educational usages of eco-garden

Discrepancies among the expectations of the instructional designers, teachers and students regarding the learning context could hinder effective implementation of the teaching-learning process, which would subsequently adversely affect the learning outcomes (Könings et al., 2005). Könings et al.’s (2005) COOP model emphasizes on the role of students in the participatory process of building a PLE. However, the lack of empirical studies on understanding the perspectives of instructional designers hinders the further application of the COOP model (Könings et al., 2014b). The present study attempts to reveal the consistencies and differences in the expectations of the designers and the other two stakeholder groups, albeit with the further division of students with respect to their different academic backgrounds (ENV vs NENV students).

The current study provides a detailed account of the opinions of three stakeholder groups for the PLE features of a University campus eco-garden. All groups expected cognitive learning in the areas of energy utilization and biodiversity conservation and affective learning in cultivating environmental awareness and responsibility. Such matching helps maximize the positive effects of the eco-garden on learners (Brophy, 1987; Könings et al., 2014a) and subsequently contributes to EfS. However, the three stakeholder groups had differing expectations of the eco-garden, with a particular difference in the expectations of the designers and the other two stakeholder groups, attributable to their educational backgrounds. Except for the educators, none expected psychomotor learning from the eco-garden. It is reasonable to see that the educator group had the most extensive expectations regarding all three aspects. In contrast, the students, regardless of whether they
studied environment-related programs, had relatively low expectations regarding what they would learn from the eco-garden.

The background of the designer group and the educational knowledge they possess possibly contributed to the differences in expectation with the other stakeholders in terms of building the PLE of the eco-garden. The initiation of building the eco-garden from the administrative units resulted in a designer group composed mainly of engineers who might not have expertise in education, whereas the expectations proposed by the teachers placed more emphasis on psychomotor learning and highlighted the potential to acquire skills in the context of the eco-garden. Moreover, although the designer group expected students to have affective experiences while using the eco-garden, they did not know exactly how the eco-garden could be used to enhance student attitudes and values.

Könings et al. (2014a) established expectation inventories for both students and teachers, revealing how the friction (the mismatch of expectations) between students and teachers affects a PLE. The dynamics between the teaching approach of the teachers of this study, whether they focused on information-transmission or conceptual change, and the attributes of the students, whether their expectations remotely or closely matched teacher expectations, would determine whether the friction between students and teachers was beneficial or harmful. The teachers participating in the interview were generally those emphasizing on conceptual change. The communication between the students and the teachers regarding the learning outcomes would be crucial, as this kind of a teacher would face destructive friction when encountering students with distal expectations in relation to those of the teachers.

**Future challenges to the eco-garden**

As exemplified by the two NENV students holding relatively opposing views of the eco-garden, not all of the stakeholders agreed with the construction of a large-scale infrastructure for EfS in a university. The establishment of an eco-garden as such will undoubtedly have financial implications and educational benefits, introducing a certain degree of conflict, for example, regarding the responsibility for managing the garden, the priority of its usage, etc., among different stakeholders in the university. How to come up with a compromise among stakeholders is dependent upon sustainable and effective communication. The engagement of as many of the relevant stakeholders as possible, including the potential visitors, maintenance staff, etc., in the planning of the eco-garden and related education activities is of overriding significance (Brinkhurst et al., 2011; Disterheft et al., 2012). Determining the sources of conflict and addressing the common needs among stakeholders (Oviedo, 1999) would be a possible and constructive means of addressing any conflicts generated.

There is a growing initiative to “green” universities to promote campus environmental sustainability (Sharp, 2002). Sharp considers that the success of building a showcase green facility, such as the eco-garden in the current study, should be distinguished from institutionalizing the commitment to establishing an environmentally sustainable campus. However, it is argued that the integration of showcase facilities and an associated well-planned education program could effectively aid the institutionalization of the environmental sustainability concept. The convenience of accessing the eco-garden and the all-in-one setting of the garden, as mentioned by the majority of the different stakeholder groups, would create a convenient educational resource for the establishment of PLE for EfS in a university.

**Implications and limitations of the study**

This study reveals the discrepancy between expectations of different stakeholders, which may impair the functioning of the eco-garden. To overcome such a problem, effective
communication of expectations between different stakeholders is essential (Könings et al., 2014a). It would be desirable if seminars or focus groups could be carried out in the later development stage for a more interactive engagement of teachers and students in contributing their views regarding the utility of the eco-garden.

As a participatory process of designing the eco-garden teaching-learning activities, a comprehensive list of the suggested activities to be conducted in the eco-garden was collected (Table II). Based on the range of stakeholder perspectives, this data set forms a critical foundation for future course or program development, as well as the further improvement of the eco-garden facilities. It is believed that a thorough design of the eco-garden together with education activities is vital for successful planning and implementation of the eco-garden-based education activities.

However, the educational function of the eco-garden could not be achieved simply based on infrastructure or hardware. Among the four components set out by Van Merriënboer and Paas (2003), the eco-garden provides plenty of supportive information (theory) for both teachers and students in a field-based learning approach. There would likely be many questions, topics and tasks which could enrich the repertoire of the potential learning tasks. Yet, the procedural information and part-task practice rely heavily on the capacity of the teachers, as well as on student attributes. One of the prerequisites for students to complete the multiple questions or tasks in a PLE is the guidance and support of the teachers. Without the experience and the competence of the teachers, any well-designed educational tool would not be able to achieve its educational value. While no educator stakeholder groups solely mentioned the demonstration function of the eco-garden, it appears that all educator interviewees would like to more proactively engage the teaching resources of the eco-garden in their education activities, demonstrating high sensitivity to how the eco-garden could be used as a tool to enhance teaching and learning practice. What is more, both students and educators recognized the role of students and educators as active learners and facilitators, indicating that, perhaps, the educational function of the eco-garden in the cognitive and psychometric domains would be maximized for Efs, rather than just being a demonstration unit or a leisure spot.

The eco-garden aims to achieve the goal “nature and I as one” so that the harmony of nature can be pursued not only in environmental aspects but also among people. The communication of this philosophy to the students and the strengthening of their appreciation through educational activities in the eco-garden is crucial to establish pro-environmental attitudes through eco-garden-based learning. Those activities related to appreciation of the wonders of nature such as observations and data recording of biodiversity in the eco-garden are also important. These not only enhance student understanding of the eco-garden but also arouse reflection on and resonance with the appreciation of nature, which may in turn influence affective learning outcomes.

Despite the theoretical and practical significance of the study, it has some weaknesses which could lead to future studies. First, the participants may not fully represent the target population, because of the relatively small sample size for qualitative analysis. Therefore, we must be cautious in generalizing the findings. In future studies, a quantitative questionnaire could be designed to better understand teacher and student perspectives of the educational use of the campus eco-garden. Second, as stated in Könings et al. (2014b), despite the promising future of a participatory approach for designing the teaching-learning process, it would be worth understanding the implementation of a learning environment and what roles different stakeholders could play to help put this into practice. Further studies on the achievement of the student learning outcomes in such a PLE would be useful to ascertain the benefits of the participatory approach in designing education activities to be conducted in the eco-garden.
Conclusion
This study illustrates the expectations of stakeholders who emphasized on pro-environmental cognitive and affective change but not psychomotor changes. The introduction of traditional Chinese philosophy in designing the eco-garden that yielded a concerted pro-environmental view among stakeholders provides implications about the incorporation of cultural components in future EfS programs. The present study is also the first, if not the only, study to reveal the range of expectations of designers and the other stakeholder groups (teachers and students) in Konings et al.’s (2005) COOP model. Variances in the designers and the other groups’ expected educational purposes were identified for psychomotor aspects. Understanding the expectations of the different stakeholders sheds light on both the infrastructural design of the campus eco-garden and the development of a PLE for strengthening EfS. This has implications for the design of more effective eco-gardens and field-based courses or programs to achieve sustainability.

References
European higher education institutions–Top-down versus participatory approaches”, *Journal of Cleaner Production*, Vol. 31, pp. 80-90.


**Further reading**

Figure A1. Flow diagram of the operational systems of the sustainable eco-garden for the recycling of resources and energy conservation.

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Abstract

Purpose – This paper aims to suggest the structure of a platform for education and capacity building for Future Earth, which is an intensive program open to the eight stakeholders and which utilizes existing research programs/facilities associated with Future Earth. An intention of this paper is to facilitate a policy brief for projects associated with Future Earth.

Design/methodology/approach – This paper reviewed backgrounds and necessary items for education and capacity buildings in Future Earth projects by implementing three main priorities in Future Earth and current surrounding environments.

Findings – This paper then suggested a possible structure, competencies, contents and human resources for education and capacity building and education for Future Earth.

Originality/value – The suggestions can be implemented in capacity building and education programs associated with Future Earth.

Keywords Education, Sustainability, Capacity building, Future Earth, Human resource

Paper type Research paper

Introduction

This paper maps out an education and capacity building framework for implementing Future Earth in the Asia-Pacific Region. As a regional policy framework prospectus, this document outlines possible steps for success in the implementation of a long-run strategy that accomplishes continuously improving communications and decision-making systems.
Future Earth is a research initiative that will:

- develop our capacity for responding to the risks and opportunities raised by global environmental change; and
- transform our society toward global sustainability.

Future Earth is the flagship policy framework designed to replace prior incomplete and inadequate strategies for the future of the planet and the life that inhabits it. The core feature of Future Earth lies in its approach to involve stakeholders in the knowledge creation and systems transformation process toward sustainability. Human society and the ecosystem are both dynamic, and this means that the solutions too must be both immediate and continuous. To meet these needs requires a transdisciplinary approach, which in turn requires the establishment of an educational framework to give the current and a new generation of leaders competency and capacity building (Reid et al., 2010). Thus, education and capacity building are necessary and integral for the sustainability of Future Earth and the sustainable future it seeks (Future Earth, 2013).

Here, the central concern is the limited carrying capacity of the ecological services and natural resources the Earth provides, which cannot be overcome through economic growth (Arrow et al., 1995). This includes climate change, the need for alternative and renewable energy sources, loss of biodiversity, improvements of well-being poverty, dwindling natural resources and economic instability (UNESCO, 2014). Tackling these concerns requires seeing society and nature as a complex integrated system; one that is globally connected; one that links current and future generations. Over the past century, the global economy has grown by leaps and bounds, and the overall well-being of the Earth’s citizens has substantially improved with longer life expectancies, reduced hunger and less poverty in developed nations. Yet, this is not true for the entire world – particularly for developing nations, which hold most of the world’s population. In the next century, qualitative improvements through the cooperative efforts and achievements of both developed and developing nations, with explicit consideration given to the inequality of the North-South divide, must be sought.

From 2005 to 2014, the UN Decade of Education for Sustainable Development (ESD) promoted the mobilization of educational resources of the world to help create a more sustainable future (UNESCO, “ESD: Mission”). Yet, there is a critical need in Future Earth to take over their achievements in ESD and accelerate our efforts toward Global Sustainability to train eight stakeholders in Future Earth: research, science-policy interfaces, funders, governments, development organizations, business and industries, civil society (non-governmental organizations, etc.) and media (Future Earth, 2013).

The sustainability challenges facing the Asia-Pacific region are daunting in scale. The Asia-Pacific region has the majority of the world’s population, believers in all of the world’s major religions and a total regional economy larger than the USA or the European Union. Additionally, more than 20 countries and areas greatly vary from aging developed areas such as Hong Kong, Australia and Japan facing population decline to youthful middle-income and developing nations such as Malaysia, Indonesia and Cambodia with booming populations (Lee and Hong, 2012). As such, policies in the Asia-Pacific region must look not only at the eight stakeholders in Future Earth but also attend to the complex historical and political realities of the region and then navigate these toward international cooperative transnational policies and initiatives.

Policy recommendations
The education and capacity-building framework for Future Earth should focus on the following two areas for education and capacity building. First, there is a need for educational
reforms toward key sustainability competencies (Wiek et al., 2011) to grow the capacity of the Asia-Pacific as an innovator for progress toward Future Earth. Second, there is a need for a solutions-oriented project approach at the local, national and transnational levels. This includes transnational sustainability initiatives that have universities in various regions as a core, and many stakeholders from countries where the university is located will be necessary to accelerate the steps of transformation through capacity building.

It is our belief that to accomplish Future Earth, quantifiable change on each of the three central competencies, “critical thinking”, “normative dialogue” and “transformative leadership” proposed for educational reform, must be seen. Outcomes in each of these areas are measurable, and their accomplishment will have a substantial impact on Future Earth achievements. Critical thinking is indispensable as a tool to synthesize problems and their solutions reiteratively. Normative dialogue is important as the ability to understand and work with diverse opinions and ideas about values. Transformative leadership is the capacity to implement solutions in diverse stakeholder contexts. A common framework built on key competencies implemented through educational reforms and cultivated through shared projects will enable the realization of Future Earth for the diverse stakeholders involved.

For competency-based education, this would involve curriculum changes implemented by the ministries of education in the highly developed and middle-developed countries to require further coursework in critical thinking (an educational reform also sought by the Organisation for Economic Co-operation and Development (OECD); See Froese-Germain, 2010), intercultural understanding and transformative leadership.

For the solution-oriented projects, highly developed countries should lead by, for example, in Asia, taking responsibility for implementing trans-national initiatives. Middle-developed countries in turn should undertake trans-national initiatives and several domestic initiatives. Low development countries should work with nations of abundance on cooperative projects and have leadership responsibilities for the ones that occur in their own countries. Moreover, to enhance the capacity for sustainability in these countries, abundant opportunities should be available for students from less developed countries to study abroad in more developed countries. The envisioned transnational sustainability initiatives will create lots of interfaces between universities with resources in developed countries, universities with near-access to the sustainability issues and stakeholders of all kinds in partner countries. The idea here is not that the richer countries would colonize the poorer with sustainability but rather that they would enable the universities in the poorer countries to become independent leaders in sustainability and to serve as bases for further competency building in their own countries through cooperation. Such cooperation would also bring about crucial benefit to the universities in the developed countries by allowing closer attachment with the most challenging problems of the region.

Implementation priorities
Future Earth is designed to build on and transform existing projects and infrastructure, rather than reinventing everything de novo. What Future Earth adds is a holistic perspective incorporating all eight stakeholders and guidance from the conceptual research themes of Future Earth. By incorporating all stakeholders, Future Earth projects are more responsive to the needs of the societies they wish to transform, making the projects more autonomous and sustainable. Moreover, the projects are also capacity building and pedagogical in function, as they encourage co-design and co-production of knowledge and solutions utilizing the competencies of all stakeholders.

Future Earth sets out three priorities for education and capacity building as follows:
This policy paper sets out to examine how these priorities can be reasonably implemented in the Asia-Pacific region under the *Future Earth* initiative.

**Potential program structure in the Asia-Pacific policy framework**

Within the Asia-Pacific region, the researchers suggest that there are three main education and capacity building goals. First, there is the task of building relevant competencies in stakeholders. This supplies the necessary skills for multi-stakeholder collaborations to succeed. Second, there is a need to cultivate “bilateral translators”, those who can facilitate the accomplishment of important *Future Earth* sustainability projects by bridging the skills and needs of different stakeholders. Finally, there is the implementation of *Future Earth* projects, which can be built on existing programs and networks conducting the global environmental change research from their on-going achievements (*Future Earth*, 2013).

Every *Future Earth* Asia-Pacific education and capacity building project should have a focus issue. Moreover, the issue must be understood in such a way as to involve all eight stakeholders, match their capabilities and involve their concerns. Through the projects, stakeholders will use their expertise and competencies, learn from each other and work together to implement sustainability solutions through joint research, scaled demonstration and shared implementation (Lang *et al.*, 2012).

The achievement of both types of goals is essential to meet the challenges of the Asia-Pacific region and to help bridge the massive inequalities that exist within the sector to move toward a sustainable planet.

**Educational competency goals for Future earth**

The development of suitable education and capacity building programs for *Future Earth* that achieve global sustainability requires the establishment of a common platform for education and capacity buildings for *Future Earth*. This requires moving beyond a conventional model where universities exist to produce researchers with singular specializations. Instead, the education and capacity building for *Future Earth* commences with:

- building a common understanding of mechanisms, causes and solutions for the central challenges *Future Earth* addresses; and
- nurturing competencies to resolve *Future Earth* problems to lead to global sustainability.

At the heart of this is the need for transdisciplinary collaborative research and problem-solving that bridge disparate fields and incorporate “non-academic stakeholders from business, government, and the civil society” (Lang *et al.*, 2012, p. 26; Mauser *et al.*, 2013). To accomplish this, *Future Earth* builds on key competencies (Wiek *et al.*, 2011) that lead to a correspondence between our scientific understanding and the real world as it is. Global sustainability issues such as the resolution of environmental degradation, global warming, poverty reduction, improving well-being and the alleviation of global health problems require complex, interdisciplinary approaches with specific competencies. Eight stakeholders
armed with both cutting-edge technologies and knowledge from the outcomes of Future Earth, from diverse backgrounds (careers, academic training and motivation), are called upon to seek and execute alternative solutions to the challenges posed by a focal point issue.

Although the framework of competencies is helpful, Wiek et al. (2011, p. 212) points out that both the precise list of competencies and the production of “graduates [who] are skilled enough to tackle sustainability problems” remain elusive. Yarime et al. (2012) similarly points out the difficulty in finding an effective curriculum for the sort of integrative research that sustainability science demands.

Within the Asia-Pacific region, the authors highlight the following three competencies and their cultivation as central to solving challenging sustainability issues on both the local and global levels: critical (or logical) thinking that gives the ability to structure the issue explicitly, normative dialogue as the ability to engage profitably in discussions with stakeholders with diverse interests and backgrounds and still produces a common agenda on how to resolve the issue and transformative leadership to both formulate a vision and help activate the stakeholders to reach a dynamic solution to the problem.

**Competency I: critical thinking.** The first and keystone competency is critical thinking. Unfortunately, this, as with many terms in the competency literature (Wiek et al., 2011), is not sufficiently clear by itself. The OECD has recently emphasized on the importance of critical thinking and is in the process of adding conceptual problem-solving to its evaluative framework for education throughout the developed world (OECD, 2005; Froese-Germain, 2010).

Critical thinking has also appeared in various ways within sustainability science research as a competency. Thomas (2009) notes the need for “problem-solving skills in a nonreductionist manner for highly complex real-life problems” within the context of education for sustainability. Others also identify “reflexive competency” (Mochizuki and Fadeeva, 2010) or “reflectiveness”. This may be what Wiek et al. (2011) define as “problem-solving competence”.

The Delphi report produced under the aegis of the American Philosophical Association provides a helpful definition of critical thinking the authors will build on (Facione, 1990, p. 2):

> We understand critical thinking to be purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgment is based. Critical Thinking is essential as a tool of inquiry.

Within this definition, the core skills are those cognitive skills that enable “(1) interpretation, (2) analysis, (3) evaluation, (4) inference, (5) explanation and (6) self-regulation” (Facione, 1990, p. 4). Understood in this way, these skills form a keystone competency for sustainability science, which can itself be understood as excellence in correctly identifying the issues at hand, understanding how they and the stakeholders are related, outlining a solution that achieves the goals of Future Earth and finding the means of implementation.

Education that cultivates competency in critical thinking requires a multi-pronged approach. First, steps must be taken to develop the basic thinking skills of the eight stakeholders with basic informal logic and train them in the classroom to identify their solutions and discuss implementations. This, by itself, however, will only give a peripheral competency. Second, the curriculum should have students consider model problems that begin to mirror real-world complexity – not merely simulations that produce predictable results, but situations that require them to solve both resource management and human problems. Third, all eight stakeholders must be involved in the thought process that considers wickedly complex problems so that they will be able to tackle the more difficult
problems which remain unsolved and thus enable the sustainability scientists of the future make Future Earth a reality.

**Competency II: normative dialogue.** A second core competency is normative dialogue. This term is helpfully placed in the taxonomy of Wiek et al. (2011), but the reference there is as Wiek et al. (2011, p. 212) note in their own discussion ambiguous in an unfortunate and potential colonial way. To flesh out the problem, the use of normative competency insofar as it does not specify whether it means the ability to abstract from one’s own moral bearings or the ability to enforce one’s views onto others means that this could be a bludgeon to enforce ideological normativity. To avoid this, the authors elect to use the term “normative dialogue” and explain below that the capacity the authors maintain is needed for Future Earth progress toward sustainability in the Asia-Pacific context.

Future Earth research always faces moral thinking in the decision-making, because it concerns the trade-off between current human well-being and future ones, North-South dynamics and the rich and the poor in light of biased and intensive uses of environment and natural resources (WCED, 1987). In addition, global sustainability needs to consider the well-being not only of parties local to the problem but also of those more distant and prudently weigh these considerations appropriately. Much of the current ethics education in sustainability science is overly truncated with the assumption that a common view is the correct one or that there is only one side to each moral problem. This sort of thinking is especially problematic in Asia, which contains great diversity in terms of worldview and religion. Although all of these traditions do in their own ways value the Earth, their expressions and implementations of this care differ greatly. Lack of training for normative dialogue poorly equips future sustainability scientists for the humanistic angles of development problems, blinding them to the real moral concerns from other viewpoints. Competency in normative dialogue is both knowing what you think is right and wrong and knowing that this is what you think – the awareness that our own norms, values, attitudes, beliefs and assumptions are guiding our perception, our thinking, our decisions and actions within such sustainability issues. Through this, the eight stakeholders can reduce or avoid the danger of ethnocentrism in assuming that one’s moral framework is the only possible one. Moreover, translators who are conscious of this can work with the difficulty that broadly shared ideals can admit of various and incompatible interpretations (Hadorn et al., 2006). This is a competency precisely because it enables us to structure our Future Earth activities around self-reflective global consensus.

**Competency III: transformative leadership.** The third key competence is transformative leadership. Leadership is an interpersonal process whereby an individual (leader) influences a group of individuals (followers) to achieve a common goal (Yukl, 2010). A group is a collection of subsystems that operate together to achieve the goals by using socio-technical production processes (Katz and Kahn, 1978). To maintain this process, it is necessary for a team (or group) to extract resources from its surrounding environment and set a common goal that is likely to attract effort and investment by individual team members (Mumford et al., 2000). As a central point of interpersonal dynamics between leaders and followers, leadership is an indispensable part of this process.

Burns (1978) was the first to describe the theory of a transformational leader in leadership studies. A transformational leader performs leadership involving an interactive relationship with his or her followers using two elements; making followers more aware of the importance and value of task outcomes and transcending their own self-interests for the sake of the team. Through this process, both a transformational leader and his/her followers pursue self-actualization – a common goal of any team (Sun and Anderson, 2011). This
self-actualization process requires a transformational leader to be both visionary in introducing radical changes wherever necessary to achieve.

Within the sustainability literature, Wiek et al. (2011, p. 210) place the idea of effecting change under the title “strategic competence”. The component of leading that involves task of working with others is in turn placed under “interpersonal competence” (p. 211). This is joined with emerging consensus that leadership is of critical importance of leadership for sustainability (Akiyama et al., 2012; Metcalf and Benn, 2012).

One of the key skills in transformational leadership is the ability to formulate clear and appealing visions of what a team can accomplish and to provide the directions necessary for followers to understand the goals, objectives and priorities of the team. It is necessary to share a vision that illuminates the path to a better future by solving issues. A vision needs to be attractive enough for followers to justify devoting their efforts. Only by articulating a compelling vision can a transformational leader build an effective and well-performing team.

As the eight stakeholders tasked with problem-driven projects on a focal point issue in Future Earth are often required to bring about radical changes within limited time durations, transformational leadership is a necessary competency within the platform for education and capacity building for Future Earth.

Bilateral translators: human links between research, policy and implementation

Future Earth with the specific goal of closing the gap between environmental research and current policies and practices (Future Earth, 2013) needs human assets that can enable communication within/between the eight stakeholders. Moreover, stakeholder involvements in Future Earth should shift from mere consultation involving passively being consulted to full dialogue where all stakeholders are full agents working toward realizable solutions.

The Integrated Local Environmental Knowledge project for Research Institute of Humanity and Nature (Sato, 2014, p. 210) defines “bilateral translators” as individuals who stimulate the utilization and promote sharing of scientific knowledge among the stakeholders. In doing so, they evaluate and re-organize knowledge from the perspective of respective stakeholders and translate the diverse knowledge accumulated among stakeholders into more general conventional languages (ILEK project, 2016). These bilateral translators, such as Brundiers et al.’s (2013, p. 4615), “transacademic interface managers” or Williams ‘ (2002, p. 103) “boundary spanners”, seek to usher in a new era of cooperation in research. Bilateral translators who can “stitch” together common features out of different values and interests expressed by various stakeholders can be at the center of this communication.

To bring the stakeholder involvement up to the desired level, “bilateral translators” should stimulate the utilization and sharing of both general and specialized (scientific) knowledge; and facilitate co-design and co-production in research projects, and to co-deliver the results, supporting essential decisions should to be made to support for the transformation of the society. The bilateral translators are also expected to address current gaps in core competencies and gaps between researchers and other stakeholders. Therefore, during the transitional stage where the education platform has not yet integrated the three competencies, bilateral translators will have special importance.

There already are large amounts of knowledge, including scientific discoveries, humanistic knowledge and indigenous or local information, and new research is happening continuously. This growth will continue but does not by itself lead to a sustainable future. To transform society toward global sustainability, bilateral translators will need thorough knowledge of the key competencies identified above to bridge the:

[...] widely acknowledged challenges of collaborations across different communities of knowledge and values. Such collaborations demand bridging different worldviews, ways of knowing,
motivations, interests, and power positions, which often are incommensurable or even conflicting (Brundiers et al., 2013, pp. 4619-4626).

Moreover, working from Wiek et al. (2011), they should have both normative dialogue competence and “interpersonal competence” to play well with others, critical thinking skills to properly grasp problems and “strategic competence” to work toward solutions through transformational leadership (Brundiers et al., 2013, pp. 4620-4628). In other words, their job is to bring about the utilization of the cumulative wealth of the stakeholders for a solution-based approach to sustainability problems.

**Focal issue projects**

Focal issue projects can and should occur on multiple scales:

- short-term pilot exchange projects built around Future Earth’s core priorities;
- domestic university-led local transdisciplinary eight-stakeholder cooperative sustainability initiatives; and
- transnational cooperative sustainability initiatives (especially partnerships across of the economic development spectrum).

Framing rigid and artificial conceptual boundaries around either natural or social systems can hamper what might be termed as a more holistic understanding of the suppressed problems humanity and the planet as a whole are facing (Paula et al., 2010). Building on the eight-stakeholder model of Future Earth, the authors maintain that focal issues should be addressed in a transdisciplinary and solution-oriented manner. One major outcome of all of this is the production of “bilateral translators”.

**Pilot exchange projects**

Short-term pilot implementations could range from three days to two weeks. These are designed to provide all eight stakeholders an opportunity to contribute to the platform without overly interrupting their primary occupations. Such a program would lay the foundation for later, more intensive collaboration by training participant stakeholders in the Future Earth education and capacity building platform. These programs would be primarily local but could involve exchanges to involve and prepare others to host their own pilot programs.

One of pilot exchange programs is an intensive workshop to focus on the sustainable use of fishery resources, the International Education Program for Sustainable Fishery Resources. This project is developed and operated by the Graduate School of Fisheries Science and the Center for Sustainability Science at Hokkaido University (Japan).

This course is designed as an intensive program for sustainability science available for people with diverse backgrounds and interests using sustainable use of fishery resource as its local course. Training Ship (T/S) Oshoro Maru has been participating in ocean/fishery observations and research in the North Pacific over 100 years from the Oshoro Maru I (1909-1927) to current Oshoro Maru V (2014 onward) and has made significant contributions to fishery and ocean research in the North Pacific.

Participants attend ten days of interdisciplinary lectures focusing on sustainable fishery resource use, participate in a three-day cruise on-board the training ship Oshoro Maru (T/S Oshoro Maru), visit local fishing industry facilities and work together on group projects focusing on the global and local sustainable use of fishery resources.

This program consists of four components: lectures, site-visits, on-board training and group work for action proposals for the local community built on the sustainable use of
fishery resources. These activities aim to create a shared vision through a convergence of interests and concerns raised by diverse perspectives on the use of fishery resources by using Southern Hokkaido region as an example. In addition, at Hokkaido University, competency trainings for logical thinking, normative dialogue (as a part of environmental ethics) and leadership (as a part of environmental leadership) are provided as a part of sustainability science certificate program. Until now, over 50 participants (graduate students and governmental officers) from over 20 countries have participated in this program.

**Domestic-led local transdisciplinary projects**

These projects would be longer in term than pilot projects and involve sustained commitments from the stakeholders to make progress on Future Earth sustainability issues. These projects would take the form of “solution-oriented sustainable research”, which is applied to real-world sustainability goals (Miller et al., 2014, p. 240) and has been modeled at Arizona State (Wiek and Kay, 2015), and the kashiwa-no-ha collaborative initiative involving the University of Tokyo, Kashiwa city, Chiba University and others that focused on building a low-carbon city (Trencher et al., 2015).

One model of this in Asia is the Tanegashima hatsuga forum. Tanegashima is a remote southwestern Japanese island at the frontier of sustainability problems, such as aging, declining young population, job displacement and changes in climate, environment and natural assets. The forum provides a space for interaction between multiple stakeholders including industry, research, academia, government and corporations. Thus, the forum involves the co-creation of knowledge (Mauser et al., 2013).

One of the major accomplishments of the forum has been to integrate the energy resources of the self-sustaining sugar cane industry with the energy needs of other stakeholders on the island. What this has meant in practice is that the forum has sought to integrate resources from multiple disciplines to change cultivar and cropping methods of sugarcane grown on this island, implementing a new sugar extraction process (Ohara et al., 2012, 2013; Ouchida et al., 2016), making the sugar mill more efficient in terms of energy utilization (Ouchida et al., 2016) and establishing heat and power sharing among the industries and residents on this island (Kikuchi et al., 2016) for sustainability.

A key component has been the use of bilateral translators to bridge the disparate worlds of the stakeholders. As the forum’s efforts succeed, the island and its capacity will become an asset for capacity building, especially for similar science-based island revitalization projects. This project provides a capacity building platform for Future Earth through student mentoring and also allows for research and training related to all eight stakeholders in the Future Earth model.

These projects involve the cooperation of all stakeholders, and this changes the function from one that is researcher-led and focused to one where instructors and educational institutions could primarily undertake a feedback and a coaching role (Wiek and Kay, 2015). Instead, learners become the active agents and interact directly with stakeholders to produce solutions and gain practical experience with competencies and multi-stakeholder environments (Wiek and Kay, 2015).

As Wiek and Kay (2015, p. 29) note, traditional models of education “leave students ill-prepared”, and competencies are “best conveyed in real-world learning settings” (Brundiers and Wiek, 2013). For that reason, the authors maintain that it is vitally important to build on the key competencies of critical thinking, normative dialogue and transformational leadership. These competencies, which center on “how to think”, work in tandem with the domestic transdisciplinary projects, which will represent a core feature for
Multi-national mentoring projects

The purpose of these projects is both to find solutions for larger-scale sustainability and to empower stakeholders in less developed nations to approach and solve national problems in sustainability. Similar efforts are underway and being tracked through regional and international websites and networks such as the UN Sustainability Development Research Programme and the Latin America region Evidence and Lessons from Latin America platform[1].

As Future Earth progresses, the common platform of education and capacity building for Future Earth will increasingly interconnect the eight stakeholders in a cooperative framework for integrated Future Earth research. For researchers, this will provide a Future Earth stakeholder community that requests research, maintains dialogue during the project and reacts quickly to findings. For the other stakeholders, this framework provides outcomes-oriented research output; direct access to experts; research outcomes and innovations within the research framework; and dynamically responsive research teams.

Discussion and conclusions

The authors envision this platform having a role in resolving open natural resource problems, water shortages, lower-wetland management for carbon emissions and pollution-related issues at the local and regional level and issues of economic disparity within the Asian sector. Already established institutes and programs undertaking research associated with Future Earth will facilitate the opportunities for the common platform of education and capacity building for Future Earth. For example, Science and Technology Research Partnership for Sustainable Development (SATREPS) programs[2] initiated by Government of Japan that promote international joint research which targets global challenges and requires engagement by the international community can serve as candidates to facilitate a common platform for education and capacity building for Future Earth. A wide range of global/regional environmental issues (e.g. wild fire managements for carbon management and water resource management with sanitation system) has already been studied through the international networks developed by SATREPS. The initial design of Future Earth is committed to utilizing already established programs and networks for education and capacity building. Candidate programs for education and capacity to provide human assets for Future Earth should urgently be identified, consulted and prepared to incorporate and advance a common platform for education and capacity of Future Earth.

The competencies of critical thinking, normative dialogue and transformational leadership are not inherently controversial. In fact, global initiatives outside of Future Earth are already in motion to improve education in terms of critical thinking and transformational leadership (Froese-Germain, 2010). What our paper suggests is that the vocabulary gap between sustainability science’s “problem-solving competency” and “strategic competency” (Wiek et al., 2011, p. 205, p. 210) and the vocabulary used in educational contexts which calls them “critical thinking” and “transformational leadership” (Facione, 1990, p. 1; Burns, 1978, p. 36) must be bridged. As many of these initiatives are already under way, the main task is integrating Future Earth with this work. Progress in terms of normative dialogue may prove more difficult, but it is vitally important for Asia as a center of diversity. Some of the theoretical work is already being done (Kassiola, 2003; Peleg, 2010), but incorporation into education lags behind the other two key competencies.

The importance of “bilateral translators” in the proposed framework is high. However, the process for producing these valuable human assets is a subject for further research. One
assumption that needs to be validated through present and future examples is the role of outsiders as opposed to natural stakeholders. Although sometimes they would appear from within the stakeholders as natural members of a project, it is also quite likely that they will be brought in as relative outsiders. An outsider, by definition, has no particular stake in the region. For instance, they represent neither industry nor consumers. Ideally, what they can bring is high competency (especially in the competencies identified in this article) and direct experience in regional, solution-oriented projects.

Generally, being outsiders with high competency and no specific local stake may work as a plus for a bilateral translator, because they have advantages in winning the trust of the various and diverse stakeholders at the same time, and they consider their positions more calmly and carefully than an invested party. Participatory approaches in development projects facilitate process of local empowerment, allow the integration of local knowledge systems into local project planning and implementation, facilitate a two-way learning process between the local community and the project and build a common understanding between institutions and local groups (Oltheten, 1995, Chapter 1). The authors expect that bilateral translators will be able to catalyze implementation of this participatory approach but in the updated context of transdisciplinary process (co-design, co-production and co-delivery of knowledge) in Future Earth. Prior work has reviewed the framework of participation (Reed et al., 2013, Hassenforder et al., 2015) and has not contained descriptions of the capacities and characteristics of the human assets necessary to make such a framework successfully operate. The reason the authors recommend better highlighting solution-oriented projects in the context of capacity building is based on an assumption that this type of capacity is often identified through solution-oriented projects. Through successful examples of such projects, common features on emergence of bilateral translators should be studied more in detail. Similarly, further work should be done, based on successful projects, in identifying how outsiders can be accepted as partners in the process, as “development projects are by definition external interventions” (Oltheten, 1995, Chapter 1).

This paper presents an education and capacity-building framework for implementing Future Earth in the Asia-Pacific Region. The Future Earth education and capacity building priorities specify important education goals. They also provide a framework for cooperation among human assets in the form of the eight stakeholders. Bilateral translators supplement these individual stakeholders within this framework. From this, the authors identify two key policy recommendations. First, the paper calls for the implementation of educational reforms already, which are in-line with OECD expectations, to build capacity in three core competences.

Second, the paper calls for the implementation of transdisciplinary projects and promoting solution-oriented projects and capacity building projects. These projects can occur on three different scales, but all are directed toward the co-implementation of transformation and capacity building tasks. What remains is to further work out in detail how each country in the Asia-Pacific region can be involved to more precisely identify bilateral translators and their roles and to identify capacity and apply it to Future Earth related projects.

Acknowledgements
This research was partially funded by Grant-in-Aid for Specially promoted Research (26000001) from the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) and was supported by the Environment Research and Technology Development Fund (S-14), under the Japanese Ministry of the Environment.
This paper builds on research presented at the Science Council of Asia 14th Annual Conference 2014, Symposium: Towards Establishing a Common Nucleus Among Eight Stakeholder Groups: Education/Capacity Building for Future Earth. This panel brought together members from Japan, Taiwan and America, working at different universities throughout Asia and with diverse backgrounds in resource economics, engineering, human geography and philosophy. The paper was written collaboratively with each author contributing from his or her areas of specialization and in consultation with reviewers. Authors acknowledge the financial support of Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan.

Notes
1. Available at: http://ella.practicalaction.org/
2. Available at: www.jst.go.jp/global/english/kadai/index.html

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Further Reading


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Supplementary issue: sustainability in higher education: the Asia-Pacific region

Guest Editor: Tamara Savelyeva

165 Editorial boards

166 Editorial

171 Wheels of change in higher education: a collaborative, multi-stakeholder project as a vehicle for sustainability education
Kristin Warr Pedersen, Emma Pharo, Corey Peterson and Geoffrey Andrew Clark

185 Towards an engaged campus: measuring and comparing definitive stakeholders’ perceptions of university social engagement in South Korea
Young Ha Cho

203 Greening of a campus through waste management initiatives: experience from a higher education institution in Thailand
Siwaporn Tangwanichagapong, Vilas Nitivattananon, Brahmanand Mohanty and Chettiyappan Visvanathan

218 Global consciousness and pillars of sustainable development: a study on self-perceptions of the first-year university students
Tamara Savelyeva and William Douglas

242 Education for sustainability using a campus eco-garden as a learning environment
Chi Chiu Cheang, Wing-Mui Winnie So, Ying Zhan and Kwok Ho Tsoi

263 Education and capacity building with research: a possible case for Future Earth
Yasuhiro Fukushima, Gakushi Ishimura, Andrew James Komasinski, Reiko Omoto and Shunsuke Managi

ISBN 978-1-78714-349-4