Planning processes, policies and initiatives in ICTD education at institutions of higher learning in Asia and the Pacific:

Republic of Korea Country Paper

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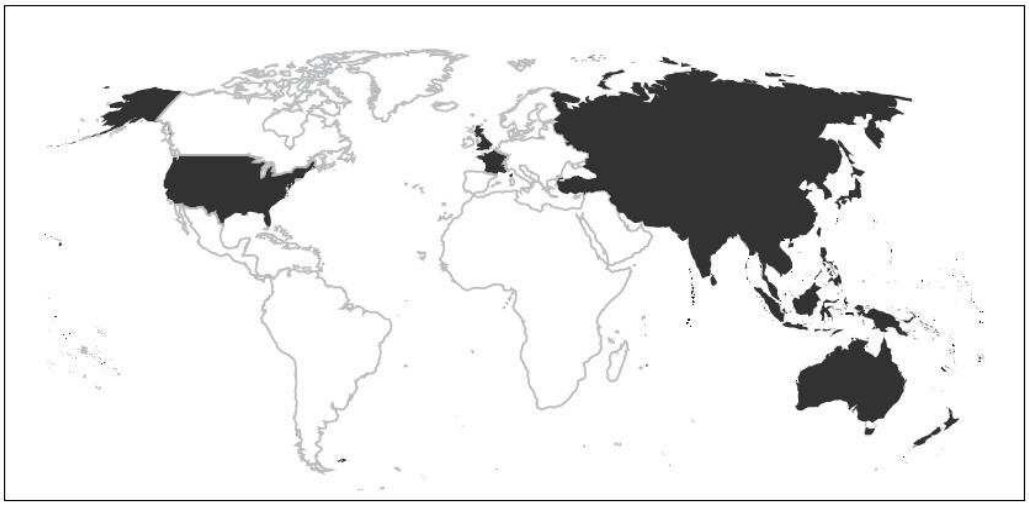

The shaded areas of the map indicate ESCAP members and associate members.

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Abbreviations and Acronyms

APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development (United Nations)
CS	Computer Science
CS&E	Computer Science and Engineering
e-TL	e-Teaching and Learning
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
Gbps	Gigabits per Second
ICT	Information and Communications Technology
ICTD	Information and Communications Technology for Development
IHL	Institution of Higher Learning
IT	Information Technology
ITU	International Telecommunication Union
KOCW	Korea Open Courseware
KREN	Korea Research and Education Network
KT	Korea Telecom Corporation
LAN	Local Area Network
Mbps	Megabits per Second
MIC	Ministry of Information and Communication
MOE	Ministry of Education
MOOC	Massive Open Online Course
MSIP	Ministry of Science, ICT and Future Planning
PC	Personal Computer
SARUA	South African Regional Universities Association
SKT	South Korean Telecom
SNU	Seoul National University
STEM	Science, Technology, Engineering and Mathematics
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. Introduction

This paper aims to provide a national-level gender-sensitive analysis of information and communications technology for development (ICTD) education in institutions of higher learning (IHLs) in the Republic of Korea. The paper analyses the planning processes, policies and initiatives in IHLs to prepare future ICTD leaders in the country. It includes an examination of information and communications technology (ICT) connectivity issues, and exploration of the partnerships between IHLs, policymakers, regulators and the private sector.

ICT holds the promise of improving the lives of people, and of disadvantaged people in particular. IHLs in developing countries, especially the public institutions, are continually reminded that they should prepare future leaders with the advanced knowledge and skills needed for the next stage of development in their countries, with the specific aim to achieve the Sustainable Development Goals.

The need for an orientation towards ICTD in academic curricula, whether in ICT or other disciplines, is recognized by the United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (APCICT) in its Turning Today's Youth into Tomorrow's Leaders' Programme, as pointed out in the following:[1]

> Recent research has indicated that universities and other higher-learning institutions in the region responsible for training the next generation of leaders lack adequate coverage of ICTD in their curricula. Programmes and courses that are best suited to provide training and impart knowledge about the use of ICT for socioeconomic development either do not cover ICTD or [do not] address it in a manner that sufficiently identifies the potential of ICTD.

Does the Republic of Korea have plans, policies and initiatives necessary to build tomorrow's ICT leaders with sensitivity to ICTD issues, at the national, institutional and programme levels? This country study attempts to answer this question through desk research, and a case study of a selected academic institution, which includes an in-depth study of its ICT programme. In the Republic of Korea, the Department of Computer Science and Engineering at the Seoul National University (SNU) has been selected for the case study.

An ICTD leader must be able to leverage the potential of ICT for development purposes. For the most part, this requires ICT competencies, although in some cases, business, public policy or domain expertise may suffice. The ICTD practice also requires working in remote, peripheral locations and with vulnerable people. ICT connectivity is likely to be problematic in such areas and for such people. IHLs that prepare ICT or ICTD leaders will be hindered if they lack good ICT connectivity and awareness on the conditions and requirements to implement ICTD initiatives. Therefore, it is necessary to examine the state of ICT connectivity at national, institutional and programme levels. It is hoped that the findings will then feed into the process of policymaking and programming at the IHLs, as well as at the national level, to encourage students and researchers to develop, implement and innovate ICTD initiatives for inclusive and sustainable development.

Additionally, analysis with gender dimensions is important because the low participation of women in computing is a worldwide phenomenon. For women to become ICTD leaders, IHLs

[1] APCICT, "Turning Today's Youth into Tomorrow's Leaders Programme". Available from http://www.unapcict.org/partners/aboutus/programmes/advisory/future-ict-leaders-programme.

should have a sufficient number of female graduates in ICT to start with and encourage their active participation in ICTD initiatives.

The study begins by defining ICTD in the context of this study.

1.1. Definitions of ICTD

There is no standard definition of ICTD, but three commonly-referenced sources—APCICT, Heeks and the World Bank[2]—provide sufficient guidance for compiling a definition. APCICT introduces ICTD broadly as the use of ICT to achieve socioeconomic development goals. Heeks who is reputed to have coined the term ICTD, uses ICT in the context of addressing pressing problems of the poor in developing countries. The 2012 World Bank Group Strategy includes the use of ICT to reduce poverty, increase productivity, boost economic growth, and improve accountability and governance. The following definition captures ICTD attributes highlighted in all three sources:

> ICTD is the use of ICT for inclusive and sustainable socioeconomic development.

Preliminary discussion with ICT educators at IHLs reveals that "ICTD" and "inclusive and sustainable socioeconomic development" are difficult concepts for educators and students to grasp, and it is necessary to elaborate on these concepts. Issue 1 of the APCICT Primer Series on ICTD for Youth[3] provides a set of case studies on ICT applications in different sectors and cross-cutting issues, including agriculture, climate change, cultural preservation, education, health, governance, poverty reduction, and the empowerment of marginalized groups. Based on these case studies, the following definition has been found to be useful in explaining ICTD to ICT faculty, students and alumni:

> ICTD is the use of ICT to address problems of a public interest nature that may not be addressed by the private sector without subsidies or other inducements. Examples include ICT applications that bring quality education to marginalized communities, the dissemination of agricultural information to rural communities, and the analysis of big data to better understand and manage public health issues, such as the spread of diseases.

1.2. ICT/ICTD in Higher Learning

Higher education policies and initiatives in a country are generally determined and implemented at three levels:

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[2] APCICT, *Primer Series on ICTD for Youth – Issue 1: An Introduction to ICT for Development* (Incheon, 2013). Available from http://www.unapcict.org/pr; Richard Heeks, "The ICTD 2.0 Manifesto: Where Next for ICTs and International Development?" Development Informatics Working Paper, No. 42 (Manchester: University of Manchester Global Development Institute, 2009). Available from http://www.gdi.manchester.ac.uk/research/publications/other-working-papers/di/di-wp42/; and World Bank, *ICT for Greater Development Impact: World Bank Group Strategy for Information and Communication Technology, 2012-2015* (Washington D.C.: World Bank, 2012). Available from https://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/WBG_ICT_Strategy-2012.pdf.

[3] APCICT, *Primer Series on ICTD for Youth – Issue 1: An Introduction to ICT for Development* (Incheon, 2013). Available from http://www.unapcict.org/pr.

1. The Ministry of Education (MOE) or Ministry of Higher Education;
2. The agency that liaises between IHLs and the ministry (e.g., a University Grants Commission); and
3. The accreditation authority

Typically, national policies are set by the MOE. The formulation and implementation of national and sector-specific policies are carried out by the relevant agencies. A separate accreditation agency may be given the responsibility to maintain standards.

IHLs generally operate with greater autonomy than other educational institutions offering primary, secondary, technical and vocational education.[4] This may be because IHLs are at the top of the credentialing hierarchy in a country, and are therefore expected to self-regulate through peer review and related mechanisms. As a result, IHLs usually formulate and implement policies on their own within the broad guidelines set by the relevant ministry or the responsible agency.

As ICT policies are equally relevant to the objectives of this study, the policies for both higher education and ICT in the Republic of Korea are examined.

1.3. ICT Connectivity

If IHLs are to produce future ICT or ICTD leaders, they need data and information on ICT connectivity and usage in teaching and learning processes, and related administration, for decision-making. While country data on general ICT connectivity are available from the International Telecommunication Union (ITU), there are no international surveys conducted on ICT issues in IHLs.

A study by the United Nations Educational, Scientific and Cultural Organization (UNESCO) identifies four critical issues related to the use of ICT in higher education as follows:[5]

1. Better access at lower costs
2. Access through mobile technology
3. Cloud computing
4. Open resources or digital content

However, country-level analyses are missing in the UNESCO study. Similarly, an Asian Development Bank study[6] discusses ICT strategies for universities, but national-level data are not provided in the report. Based on a literature review, only reports from the South African Regional Universities Association (SARUA) have been found to provide details on ICT connectivity at an institutional level. The 2006 SARUA study on ICT connectivity at IHLs reports

[4] Arthur L. Stinchcombe, *Information and Organizations* (Berkeley: University of California Press, 1990).
[5] UNESCO, *ICTs for Higher Education: Case Studies from Asia and the Pacific* (Bangkok, 2011). Available from http://unesdoc.unesco.org/images/0021/002141/214143E.pdf.
[6] Jouko Sarvi and Hitendra Pillay, *Integrated Information and Communication Technology Strategies for Competitive Higher Education in Asia and the Pacific* (Mandaluyong City: Asian Development Bank, 2015). Available from https://www.adb.org/publications/integrated-ict-strategies-competitive-higher-education.

on results from 54 institutions in 27 African countries.[7] SARUA summarizes the state of Internet connectivity at IHLs in Africa as too little, too expensive and poorly managed.

To provide an overview of ICT connectivity at IHLs in the Republic of Korea, the study looks at the national ICT polices and initiatives, and the national-level indicators relevant to ICT connectivity. Since institutional-level data on ICT connectivity at IHLs are not available in the Republic of Korea, the study examines in detail the ICT connectivity at SNU, the selected IHL. SNU is one of the three premier public IHLs in the country, with possibly the best connectivity in a public IHL in the Republic of Korea.

1.4. Gender Issues in ICT Education

This paper aims to integrate a gender perspective. The low participation of women in computer science and engineering programmes is a worldwide phenomenon.[8] Data on women's participation in computer science specifically, are not available in the Republic of Korea. However, data on science, technology, engineering and mathematics (STEM) related fields are available for the Republic of Korea from a survey of seven countries conducted on women in STEM. Other countries included in this survey are Cambodia and the United States of America.[9]

The participation of women in STEM degree programmes from Cambodia, Republic of Korea and the United States of America is estimated at 11 per cent, 19.5 per cent and 20 per cent, respectively.[10] It may be inferred that women's participation in computer science is also in these ranges. The reason for the low participation of women in STEM and computer science across the world is not understood too well. Social conditioning is thought to play a large role.[11] When women's participation in ICT education is small, their participation in ICTD may be assumed to be minuscule. Yet, women could be more enthusiastic about development-oriented applications than men. For instance, it is found that women entrepreneurs are more socially committed, irrespective of their businesses in developed or developing economies. Women are 1.17 times more likely than men to create social ventures rather than economic ventures, and 1.23 times more likely to pursue environmental ventures than economic ventures.[12]

The present study will focus on women's participation in ICT programmes in Korean IHLs.

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[7] SARUA, "ICT Infrastructure and Connectivity: New Capacity, New Opportunities", *SARUA Leadership Dialogue Series*, vol. 2, no. 3, p. 16 (2010). Available from http://ahero.uwc.ac.za/index.php?module=cshe&action=downloadfile&fileid=887110220129914168695 18.

[8] Wachira Kigotho, "Women enrol in sciences but not STEM", *University World News*, 20 February 2015. Available from http://www.universityworldnews.com/article.php?story=20150218131443779; and UNESCO, *A Complex Formula: Girls and Women in Science, Technology, Engineering and Mathematics in Asia* (Bangkok, 2015). Available from http://unesdoc.unesco.org/images/0023/002315/231519e.pdf.

[9] National Science Foundation, "Women, Minorities and Persons with Disabilities in Science and Engineering". Available from https://www.nsf.gov/statistics/2015/nsf15311/digest/theme2.cfm.

[10] Ibid.

[11] Eric S. Roberts, Marina Kassianidou and Lilly Irani, "Encouraging Women in Computer Science", Department of Computer Science, Stanford University (no date). Available from http://www-cs.stanford.edu/people/eroberts/papers/SIGCSE-Inroads/EncouragingWomenInCS.pdf.

[12] APCICT, *Women and ICT Frontier Initiative: Enabling Role of ICT for Women Entrepreneurs (Core Content, Module 2)* (Incheon, 2016). Available from http://www.unapcict.org/wifi.

2. Methodology

This country paper is part of a five-country study of ICTD education at IHLs in Asia and the Pacific. The other countries that the study covers include Cambodia, India, Sri Lanka and Thailand. These countries have been selected based on the following criteria: (1) there must be at least one country from each of the major sub-regions—South Asia, South-East Asia and East Asia; and (2) there must be at least one country from each of the World Bank Lending Groups–high income, upper-middle income, lower-middle income and low income.

The focus of the country study is on "building ICTD leaders with higher skills", and emphasis is placed on analysing the academic programmes that provide graduates with advanced skills in ICT at the bachelor's level, with some information collected on master's and doctoral degree programmes. Given the paucity of data on ICT or ICTD education at IHLs in general, the focus is on uncovering as many good practices as possible from a well-established ICT degree programme in one selected institution in each country, as identified by the Times Higher Education Ranking Survey[13] or by local recognition. The five selected ICT degree programmes are the top programmes from each of the five surveyed countries. Together, they offer a set of observations on good practices that may be used as reference points, and a basis for ICT and education policymakers to enhance the quality and relevance of policies and programmes in the coming years.

SNU is the top-ranked university and categorized as a world class university in the Republic of Korea. The data for the case study was collected by Dr. Jong Tae Lee of Seoul Women's University in consultation with Dr. Taekyoung Kwon, Vice Dean of Educational Affairs and Director of Information Affairs and Professor of Computer Engineering at SNU.

In this study, the national-level data on ICT connectivity at IHLs are limited to: (1) ICT policies, frameworks and initiatives; (2) ICT connectivity in general; (3) the national research and education networks; (4) open educational resources in the country; and (5) the situation and experience in the selected institution and ICT programme.

Related to ICTD education, information on national and institutional policies and initiatives, and general programme characteristics such as data on student enrolment, student-teacher ratios, uses of ICT in education, and innovations in ICT and ICTD education, have been documented.

Data on the percentage of women among the student body and the faculty have also been collected. Informants have been asked to report on any special initiatives to increase the participation of women, and provide country-specific reasons for low women's participation in ICT and ICTD. As a rule of thumb, participation is considered low if it is less than 33 per cent.

It should be noted that observations made regarding one ICT degree programme in the Republic of Korea, cannot be generalized for the country or for the Asia-pacific region, but it can be used as a benchmark or reference point. By selecting the top IHLs in five countries that are at different levels of development, this five-country study presents a range of benchmarks that IHLs in the region could aspire to reach. It is hoped that the examples and experiences documented in this paper and in the other papers of this study will be used by ICT and

[13] Times Higher Education, *The World University Rankings* (2016). Available from http://digital.timeshighereducation.com/THEREPRANKINGS2016/offline/download.pdf.

education policymakers to strengthen the linkage between the ICT academic programmes, faculty and graduates, and the society at large.

3. ICT Connectivity

In this section, the ICT environment and ICT connectivity at Korean IHLs are examined. This is followed by an analysis of the level of ICT connectivity and integration of ICT in education at SNU, the selected IHL for this study. The Republic of Korea's standard of ICT connectivity and integration of ICT in education can be considered a benchmark for the region, since the ITU ICT Development Index of 2016 ranks the Republic of Korea as the top economy in terms of overall ICT development.[14] Thus, ICT is expected to be well integrated into the lives of Korean graduates and citizens.

3.1. National Policies

To quote Larsen and Park:[15] "The Republic of Korea rose from being a country unable to provide even basic telephone service to many of its citizens in 1980, to become a 'fast follower' and then an innovator." Tracing the policymaking trajectory of the country would be useful for developing countries at various stages of their own development trajectory.

During the 1994 restructuring, the Ministry of Communications expanded in size and renamed the Ministry of Information and Communication (MIC). It was also given the sole responsibility for the ICT sector, and absorbed the industrial policy functions from the Ministry of Trade, Industry and Energy and the Ministry of Science and Technology.[16]

The 2008 reorganization relocated the major ICT policy functions of the government from the MIC into several new ministries. In the process, the institutional approach to ICT for development policy changed from an integrated model to a diffused one.[17] In 2013, a new Ministry of Science, ICT and Future Planning (MSIP) was established with the following mandates:[18]

- Set, manage, and evaluate science and technology policy.
- Support scientific research and development.
- Develop human resources.
- Conduct research and development leading to the production and consumption of atomic power.
- Plan national informatization and information protection strategies.
- Manage radio frequency bands.
- Oversee the ICT industry.

What is evident from these reorganizations is that ICT-related subjects may be concentrated

[14] ITU, "ICT Development Index 2016". Available from http://www.itu.int/net4/ITU-D/idi/2016/.
[15] James F. Larson and Jaemin Park, "Government restructuring and its impact on innovation capacity in Korea's ICT sector", in Proceedings of the Pacific Telecommunications Council Conference, 2013. Available from http://www.ptc.org/ptc13/images/papers/upload/PTC13_Larson_James_Paper.pdf.
[16] Ibid.
[17] Ibid.
[18] Government of the Republic of Korea, Ministry of Science, ICT and Future Planning website. Available from http://english.msip.go.kr/english/main/main.do.

in one ministry during the early stage of ICT development in a country, but they may later be distributed across several ministries as the ICT infrastructure and ecosystem become part of everyday life.

3.2. ICT Connectivity Indicators

As mentioned earlier, the Republic of Korea has the best ICT connectivity in the Asia-Pacific region, and is leading ICT development across the globe, as can be seen in Table 1.

Table 1: ICT and related indicators in the five surveyed countries, 2015

	Cambodia	India	Sri Lanka	Thailand	Republic of Korea
GDP per capita, 2015 (current USD)	1,159	1,582	3,926	5,816	27,222
Fixed-telephone subscriptions per 100 inhabitants	1.6	2.0	12.0	7.9	58.1
Fixed (wired) broadband subscriptions per 100 inhabitants	0.5	1.3	3.1	9.2	40.2
Mobile-cellular subscriptions per 100 inhabitants	133.0	78.8	112.8	125.8	118.5
Mobile-broadband subscriptions per 100 inhabitants	42.8	9.4	15.8	75.3	109.7
Households with a computer (%)	16.0	20.0	24.2	29.5	77.1
Households with Internet access at home (%)	21.0	14.1	18.1	52.2	98.8
Individuals using the Internet (%)	19.0	26.0	30.0	39.3	89.9

Sources: ITU, "Statistics". Available from http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx; and World Bank, "GDP per capita (current US$)". Available from http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?page=3.

A comparison of 2015 ICT connectivity data across all five surveyed countries is of interest here. Values of all indicators increase from Cambodia to India, Sri Lanka, Thailand and Republic of Korea in that order, except for mobile-cellular subscriptions, mobile broadband subscriptions and households with Internet access. In Cambodia, these three indicators are higher than those reported for India and Sri Lanka, which have higher GDP per capita than Cambodia.

3.3. National Research and Education Networks

IHL-related initiatives at the national level include the development of the higher education ICT infrastructure such as the Korean Research and Education Network (KREN) and the Korea Open Courseware (KOCW) development.

According to the 2013 White Paper on ICT in Education[19] of the MOE in the Republic of Korea:

> The MOE supports the expansion of next generation [information technology] infrastructure to … improve the quality of university education services, which includes operation of the Korean Research and Education Network, an educational computer network deployed for the basis of information utilization, content development for the national e-learning support centre, opening and making available good educational resources in universities better known as Korea Open Courseware (KOCW), university informatization promotion for said research, standard model establishment and its growth, etc.

To our knowledge there is no formal evaluation of the effectiveness of KREN and KOCW initiatives. These initiatives may not be critical for top universities, which have other means of connecting to the Internet and networks as explained below.

3.4. Connectivity at Institutional and Programme Levels

3.4.1 Local Area Networks and Internet Access

The ICT infrastructure at SNU is managed by its information technology (IT) service centre. SNU adopts a 10 Gbps intranet network to connect its entire research network. SNU's network system is also supported by three Korean network providers (KT, LGU+ and SK Broadband), as well as public network services—the Korea Advanced Research Network operated by the National Information Society Agency, and the Korea Research Environment Open Network operated by the Korea Institute of Science and Technology Information.

SNU is one of the earlier universities to establish broadband networks among universities in the country. The local area broadband network at SNU is connected to the Internet through the above-mentioned national networks. This is similar to the case study of IHLs in Thailand, but unlike the case study of IHLs in Sri Lanka, where the universities are connected to the Internet through the national research and education networks.

The Department of Computer Science and Engineering connects to the Internet through the campus local area network (LAN). A wireless LAN has been installed around campus for laptop users. Students can use the SNU Wi-Fi simply by logging on with their SNU ID, and visitors can also use the SNU Wi-Fi temporarily. Additionally, SKT, KT and LG Wi-Fi services are available at no charge.

3.4.2 Access to Computers

[19] Korea Education and Research Information Service, "White Paper on ICT in Education Korea", 2013. Available from http://english.keris.or.kr/whitepaper/WhitePaper_eng_2013.pdf.

The SNU Department of Computer Science and Engineering has many computer labs that can be freely used by SNU students. The department now manages three computer labs:

1. An open lab for undergraduate students with 30 personal computers (PCs) and 60 monitors (dual display). Students can use this lab at any time as it is not used for classes.
2. A lab for undergraduate classes with 30 PCs (with single display monitors but are wider and bigger in size than the ones in the open lab).
3. Another lab for undergraduate classes with 64 PCs (dual display). All the PCs provide high-speed Internet access through the Windows operating system.

Moreover, students can rent laptops, camcorders and DVD players from the University Computer Centre.

Computer labs and individual devices are both important. Students take most classes in the computer labs and it is up to them whether they use their own laptops during the classes or the lab computers. Around 60 per cent of the students use their own devices, which include PCs, laptops, smartphones and tablets. Others prefer to use the infrastructure and facilities in the university. Through students' personal devices, they can access class information and notices from the professors at any place. In the university, students use the single sign-on system to connect to Wi-Fi services.

The Centre for Teaching and Learning supports the production of teaching and learning materials. PowerPoint, Image, Flash and other multimedia techniques are used in the production of teaching and learning materials. There are various types of e-learning workshops for professors and teaching assistants on such subjects as e-teaching and learning, blended e-learning strategy development, digital media literacy, the use of Microsoft PowerPoint and other multimedia techniques, and the creation of videos and other digital products.

3.5. Integration of ICT in Education

The real test of ICT connectivity at an IHL is the extent to which ICT is integrated into student management systems, learning management systems, administrative management systems and any other aspects of the teaching-learning process.

3.5.1 Student Management Systems

Administrative services for students and faculty are provided via the SNU Portal—My SNU. The My SNU portal helps to simplify various administrative procedures, from issuing certificates of enrolment to extending the due date of a library book.

Online administrative services for students include course enrolment, course change, course withdrawal and course evaluation; application for leave of absence/return; application for scholarships; tuition fee statement print out; and classroom reservation for group studying.

Online administrative services for faculty include course management such as uploading syllabi, recording grades, research fund administration, and salary and allowance records.

3.5.2 Learning Management Systems

The e-Teaching and Learning service (e-TL) is an online support system created for cooperative online work at SNU. The e-TL includes an "Online Classroom" application, where students can directly communicate with the instructor and classmates, ask questions, post assignments or other information, and even have a real-time chat with group members. Notices and assignment information may be posted by the lecturer, which students will be notified about through the system. It is worth noting that although e-TL classrooms are automatically generated for each course, some lecturers may choose not to use this online classroom at all. On the other hand, there are lecturers that expect active online participation from the students.

Like in the case of Sri Lanka and Thailand, all lecturers are required to upload their class materials including syllabi and lecture notes via the e-TL, and students are expected to check the e-TL for notices and schedules, and download the notes. Every full-time lecturer would receive ICT devices such as PCs and printers, and it is officially required by the university to submit all assignments and term papers via the e-TL. In this regard, the use of the Internet for teaching is over 90 per cent in the department and in the university. Around ten years ago, the performance of e-TL was quite low, and many faculty members refused to use this system. But now, with upgraded performances and functions, the e-TL is quite popular.

Many students have established online groups to manage their class term projects. For instance, it is popular for Korean university students to use various commercial instant messaging applications such as Kakao Talk and Line, to build closed online communities or online chat rooms for their projects.

Compared to the learning management systems used in the programmes of the other four country studies, the system used at SNU seems all-encompassing, reflecting the overall performance of the ICT sector in the Republic of Korea and the importance of ICT in IHLs. However, it should be noted that the acceptance of integrating ICT in teaching and learning by faculty at SNU took over ten years, along with the improvements to the functionality of the learning management systems.

3.5.3 Other Applications

The "Seoul National University" application connects students to miscellaneous campus services. The application allows access to course timetable, cafeteria menus, campus services phone numbers, shuttle bus information, e-mail, notifications, and more than 100 other kinds of services. This application can be downloaded from the Google Playstore for Android phones and Apple Store for iPhones.

Another application is the "Seoul University Bus Information" in which users can check when the buses arrive at the station, and view real-time location information of the buses.

4. ICTD Planning, Polices and Initiatives

The expected role of IHLs in sustainable socioeconomic development, and the corresponding policy priorities in higher education vary with the state of the economy and context of each country. An examination of the policy priorities of the higher education sector in the Republic of Korea reveals the following: (1) concerns about declining student populations; (2) changing aspirations of the young people and their families with academic qualifications valued over

vocational qualifications, which are a national priority; and (3) concerns about the universities' responsibility to produce not only future leaders, but "good-willed" leaders.

4.1. National Level

The MOE is the overarching policymaking body for education in the Republic of Korea. Higher education administration is carried out through three bureaus devoted to policy, university support and academic affairs.[20]

Higher education policy priorities of the ministry are as follows:[21]

- Structural reforms in universities to respond to the rapid decrease in the population of school-aged children.
- Support to start-ups of university students in response to rising high unemployment rate of young adults/youth.
- The Work-Study Dual System and Employment First, Advancement to University Later policy to respond to national priorities in employment.

However, there are specialized colleges/universities under the administrative control of government ministries. For example, the Korea Advanced Institute of Science and Technology aims to train highly qualified scientific and engineering specialists required for developing industries. Funded by government, this institute is specialized in science and ICT-related engineering education (but also teaches other subjects) in undergraduate, postgraduate and doctoral courses. SNU is under the administrative control of MSIP. However, for the business plan and budget-related affairs, approval must be sought from MOE.

An example of a national-level initiative in the Republic of Korea is the promotion of software-oriented education at universities. The Korean government (MSIP, and former MIC) has been funding specialized ICT education programme in universities across the country to reduce the job-skill mismatch. These days, the Korean government sees software as the key technology and language of the 21st century, and is sponsoring software education at universities in order to cultivate high-level software personnel and diffuse software skills to all other subjects/sectors.

4.2. Institutional Level

SNU is one of the top-ranked universities in the world and the pressure to advance in its ranking is evident in the stated goal[22] of the university—to become one of the top ten universities of the world with top 50 academic fields during the 2015-2025 period. Being one of the top three universities in the Republic of Korea, SNU is not overly concerned about the future enrolment rate. Instead, the university appears to be focused on "equity" and "values" in the SNU system. Two relevant strategies are to: (1) open the university to students from

[20] Government of the Republic of Korea, MOE, "Organization". Available from http://english.moe.go.kr/sub/info.do?m=0105&s=english.
[21] Government of the Republic of Korea, MOE, "Policies and Programs". Available from http://english.moe.go.kr/sub/info.do?m=040101&s=english.
[22] Ideals and Goals of Seoul National University. Available from https://useoul.edu/upload/academics/I_Ideals.pdf.

diverse backgrounds; and (2) produce good-willed leaders. As the President of SNU stated in 2016:[23]

> In previous years, SNU had generally accepted only those with the highest academic scores in high school and on standardized tests, but I decided that we would recruit only 30 per cent through this conventional system. Entry for the majority of applicants is now decided through consideration of many other aspects, based on essays, bearing in mind the university's mission of achieving a diverse student body. Strong-minded young people who are not from privileged families or institutions and who have overcome adversity to achieve excellence can now gain a place at the best university in the Republic of Korea.
>
> It is very important for good-willed leaders to understand global concerns and to be engaged in developing solutions for international development crises. Last year, I visited a remote village in Nepal where a group of SNU students assisted in the creation of a sustainable, localized energy system that would provide electricity to power economic development. It was reassuring to see good-willed students from our institution applying their talents to serve global society. I resolved to continue the mission to produce more such individuals.

4.3. Programme Level

4.3.1 General Programme Characteristics

The Department of Computer Science and Engineering is the largest department in the College of Engineering at SNU. Of the 32 faculty members in this department, only one is female. There are about 400 students in the department including double major students. The student to faculty ratio is around 13:1.

Table 2: Student enrolment and full-time faculty headcount across five surveyed countries

	Cambodia	**Sri Lanka**	**India**	**Thailand**	**Republic of Korea**
	CS (Yr. 2-4)	**CS&E**	**CS&E**	**CS&E**	**CS&E**
No. of students	2000	500	400	304	400
% Female	~7-8%	20%	15%	-	~30%
No. of faculty members	45	20*	30	36	32
% Female	4%	35%	10%	28%	3%
Student-teacher ratio	44	25	13	9	13
No. of master's degree students	60	200	50	200	~140
No. of doctoral degree students	-	2-3[#]	50	36	~100

Notes: CS = Computer Science; and CS&E = Computer Science and Engineering.

[23] Times Higher Education, *The World University Rankings* (2016). Available at https://www.timeshighereducation.com/world-university-rankings/world-reputation-rankings-2016-seoul-national-university-creating-innovative-leaders.

* 28 if visiting faculty members and those on study leave are included.
# None graduated yet.
Sources: Desk research and interviews, July-August 2016.

4.3.2 ICTD Focus

ICTD leadership is the topic of interest in this country study. Being an ICTD leader requires the awareness of ICT applications of a public interest nature, which we defined earlier as applications that may not be produced by the private sector without subsidies or other inducements. The presence of such ICTD topics in research pursued by faculty, student projects, guest lectures, and extra-curricular activities available to students are good indications of the extent of ICTD exposure experienced by students. A listing of such activities from SNU's Department of Computer Science and Engineering is provided in the Appendix.

4.3.3 Employability of Graduates

As one of the top computer engineering schools since 1946, SNU's Department of Computer Science and Engineering has produced many ICT leaders in the country. According to employability statistics posted by the department, more students currently pursue non-ICT careers.[24] Therefore, the department is now focusing on building students' entrepreneurship abilities to create jobs in the ICT industry.

4.3.4 Gender Issues

In SNU's Department of Computer Science and Engineering, 30 per cent of the student body is female, but only one out of 33 members of faculty is female, which is the lowest among the five surveyed countries.

Similar to the selected ICT programmes in the other four countries, there are no planning polices or initiatives aimed at increasing the participation of woman at SNU. However, these figures would likely compel recruiters in universities to pay more attention to attracting more women to the student body and/or faculty of ICT programmes through appropriate planning policies or initiatives.

4.4. ICTD Alumni Perspectives

In order to obtain perspectives from an alumnus, this study conducted an interview with Mr. Young Lee, Chief Executive Officer of Grepp, Inc., and former Chief Technology Officer of Kakao Talk and Naver.com.

In 1994, when he was a master's degree student, the Internet backbone speed was about 100 Mbps. Now for his business, he is using a Giga-speed backbone and the Amazon Web Service hosting services with lower hosting cost. He is a professional Internet service developer and one of the early developers of Kakao Talk, which is the most popular messenger application

[24] Business - 36.17% (conglomerate - 25.53% and small business - 10.64%); Miscellaneous Non-Business - 44.68% (public institutions - 2.13%, administrative agencies - 2.13%, patent and law firm - 2.13%, and higher education - 38.30%); Other - 19.15%. Source: SNU College of Engineering, "Department of Computer Science and Engineering". Available from http://eng.snu.ac.kr/node/9289.

in the Republic of Korea and several foreign countries including Viet Nam. He is proficient in MySQL, Oracle, Java Platform and Ruby on the Rail.

4.4.1 Innovative Learning Experiences

According to his observations, there is a noticeable need to help students learn the programming concept of block-coding. With the concept of block-coding, computer language learning is changed from memorizing the essential commands to understanding the logical thinking. He believes that logical thinking can help the student recognize the essential idea of the programming and develop the programme faster.

4.4.2 Participation in Research and Community Engagement

Now he is working as the Chief Executive Officer of a start-up company to develop education toolkits for beginners to learn programming. He suggests that even though a person whose major is not in computer science or engineering, s/he should learn programming because s/he can understand how to identify a business problem and create a solution logically with the experience of IT and programming. Now his company supports teenagers to participate in a programming contest with its own toolkits, and the participants can have online competitions with these toolkits and online services.

4.4.3 Recommendations for ICTD

Young Lee believes that there are still diverse regulations and political issues that hinder industrial innovations in the Republic of Korea. It is critical that the Korean ICT industry seeks to reduce the regulatory barriers that discourage innovators, especially in software businesses.

He goes on to suggest that it can be meaningful to adopt the current ICT in education trends such as flipped learning and Massive Open Online Courses (MOOCs), which reduces the cost of learning. With lower costs, more people can learn and participate in ICT or converged businesses and social programmes. Most importantly, people should be supported to innovate, e.g., designing and developing real systems and services. Opportunities for students to experience and better understand these real systems and processes will help them create/design newer and better ones.

5. Summary of Observations and Conclusion

Of the five countries selected for the case study, the Republic of Korea is an outlier in many aspects. The inclusion of the Republic of Korea as one of the five countries was important because the IHL data serves as a benchmark for IHLs in the other four countries in the Asia-Pacific region. Furthermore, the historical development of planning policies and initiatives in the Republic of Korea offers insights on how other Asia-Pacific economies at various stages of ICT development could advance.

The MSIP is mandated to set, manage and evaluate science and technology policy; support scientific research and development; develop human resources, and oversee the ICT industry in the Republic of Korea. The Ministry's strong and active pursuance of its goals is a feature

that is unique among the five surveyed countries, and has helped IHLs realize their ICT education objectives.

The excellent connectivity at SNU and in the country as a whole, supported by well-equipped facilities and development of multimedia materials, is one of the outstanding features emanating from this country paper. The investment in ICT infrastructure for better connectivity benefited SNU, with more students accessing SNU online services. The integration of ICT into learning through various online systems and platforms was also important in allowing easy access to learning resources and enhancing collaboration in assignments and project work. Together with SNU's mandate to nurture "good-willed" leaders and promote entrepreneurship, these seem to be key ingredients to developing ICTD leaders.

Some other relevant observations on ICT connectivity and ICTD education in the Republic of Korea include the following:

- While the selected IHL, SNU's Department of Computer Science and Engineering is the largest department in the College of Engineering, participation of women is limited in both faculty and among the student body.

- The overall decline in students' enrolment in IHLs through demographic changes and lack of employment opportunities for university graduates may have been affecting the gender imbalance in IHLs in general. However, in top universities such as SNU, competition for entry would continue to be stiff and the limited number of women attending as students would consequently affect the chances of future ICT women leaders.

- Another critical higher education policy challenge identified at the national level includes the need for more vocational competencies and entrepreneurship among youth entering the job market.

- At a programme level, the need for increasing access to low-income students and preparing all students for entrepreneurship is a priority for SNU. The contribution of ICT graduates or any graduate to inclusive and sustainable development in the country is not on the institutional agenda. However, SNU is committed to nurturing "good-willed" leaders, which includes taking into consideration inclusive and sustainable development issues.

- As an SNU alumnus observes, universities can contribute to ICTD by widening the audience base and developing and applying ICT tools for flipped learning or MOOCs for use by a wider group of people. It is also important to promote innovation among students, support start-ups initiated by students, and expand students' exposure to socioeconomic development issues through conferences, student exchanges and other similar initiatives.

Appendix

The following briefly lists and describes various curricular, co-curricular and extra-curricular initiatives at SNU's Department of Computer Science and Engineering, with some commentaries from the country coordinator. These initiatives are not explicitly linked with ICTD education, given that the Republic of Korea is classified as a high-income economy. However, they highlight good practices that strengthen ICT education and its applications by students, which can potentially be used to nurture ICTD leaders.

Initiatives/New Modules Introduced to Reflect Emerging Technologies

SNU's Department of Electrical and Computer Engineering manages several programmes of integrated majors for its undergraduate students and major classes for the students from other departments and colleges. For instance:

- The department manages the Future Computer Engineer Camp to educate high school students that are recommended by their science teachers, about robot structure and programming. The camp is voluntarily taught by graduate school students from the Department of Computer Science and Engineering.[25]

- The department manages several integrated major programmes such as computational sciences (graduate course), information and culture technology studies (undergraduate course), business venture and entrepreneurship management (course programme), and technology management (undergraduate course). A major class entitled, "Challenge and Leadership of Engineering Department Students", focuses on interviewing or inviting new ICT leaders in the Republic of Korea.

- At the Practical Applications of Engineering Knowledge Internship Programme, students learn to apply the basic and advanced engineering skills that they have mastered in the classroom to the industry site. Prior to course registration, students must complete the summer/winter break internship programme at a corresponding corporation.[26]

Student Projects

All the undergraduate students can participate in special programmes such as the College of Engineering's Haedong Idea Factory. This is a start-up incubator programme for undergraduate and postgraduate students. The purpose of the programme is to provide space for students to share their ideas and actualize them into products.[27] This programme is targeted at students of computer science and technology, but the majority of start-ups are

[25] SNU, "2014 Future Computer Engineer Camp", 7 February 2014. Available from https://cse.snu.ac.kr/en/node/11294.
[26] SNU, "Industry Connection Program", 6 May 2013. Available from https://ee.snu.ac.kr/en/academics/services/industrial-educational-cooperation?bm=v&bbsidx=121.
[27] SNU, "SNU College of Engineering Launch 'Haedong Idea Factory'", 25 March 2015. Available from https://useoul.edu/notice?bm=v&bbsidx=122942.

initiated by undergraduate students from the computer science and engineering department. During the summer of 2016, the programme supported ten undergraduate start-ups.

Professor Kwon explains that a lot of classes can be described as "Practicum Courses" where the students are expected to manage their own term projects, including developing new software programmes. In this context, he believes that the integrated degree programmes, such as "Business Venture and Entrepreneurship Management" and "Technology Management" should be supported more than the current practicum courses in the department. With integrated degree programmes, students of the Department of Computer Science and Engineering will have an opportunity to better understand how to design and implement more practical and relevant projects.

International Programmes/International Affiliations

The Computer Science and Engineering Department has international exchange programmes in research and education with top universities in the United States of America, Europe, Japan and many other countries around the world. The exchange programme has been popular among students and faculties for many years.[28] In addition, students can benefit from international symposiums and joint lectures with other schools through international networks for academic exchange.[29]

Research Centres and Research Groups on Campus[30]

Specialized research centres, research groups and laboratories on SNU campus support a wide variety of specialized ICT-related research work that provides students with more in-depth expertise on a multitude of subjects. Following is a brief description about the various research centres and groups:

- **Big Data Institute** performs an integrated analysis of large datasets from multiple data sources through interdisciplinary approach to learning and research. Many of their research projects cross over disciplines, ranging from liberal arts, law and business management, to medical science and technology.[31]

- **Research on Software Analysis for Error-Free Computing** researches and develops software driven by (but not limited to) semantic-based static analysis, programming language theories, formal methods and corpus-based computation.[32]

- **Center for Manycore Programming** is dedicated to exploring technologies for high-performance multicore computing systems and embedded systems. In general, their

[28] SNU, "Greetings from the Head". Available from http://cse.snu.ac.kr/en/greetings.
[29] SNU, "VIII. Supporting Facilities". Available from http://www.useoul.edu/upload/academics/VIII_Supporting.pdf.
[30] For a full list of research centres, see https://cse.snu.ac.kr/en/research/centers; for a full list of research groups, see https://cse.snu.ac.kr/en/research/groups; and for a full list of laboratories, see https://cse.snu.ac.kr/en/research/labs.
[31] SNU, "Big Data Institute". Available from http://bdi.snu.ac.kr/eng.
[32] SNU, "Research on Software Analysis for Error-Free Computing". Available from http://rosaec.snu.ac.kr.

research focuses on compiler, architecture and operating system techniques at various levels taking a pragmatic approach.[33]

- **Center for Biointelligence Technology** develops core generic techniques in bioinformation technology, and performs research information services through the web. Through education and training, the centre aims to foster top-level biointelligence technology researchers. The centre also aims to promote interdisciplinary studies through seminars and workshops, and encourage technology transfer through industry-academia joint studies.[34]

- **Biological Motion Research Center** develops new ways of understanding, analysing and synthesizing the biological motion of humans and animals. The Centre aims to build a computer simulation model of biological brains and sensory-motor systems in order to understand how biological motions are generated and modulated. The centre applies their model of biological motion and its simulation method to biped/quadrupled robot control and clinical gait analysis.[35]

- **Artificial Intelligence Research Group** investigates powerful problem-solving methods inspired by human thinking, memory, learning and other cognitive processes. Their research focuses on cognitive systems that learn like humans and evolve to adapt to their environment. The research group conducts projects on computer vision, language learning, video analysis, recommendation agents, cognitive brain networks and ecological modelling.[36]

- **Communication Network Research Group** designs and develops the algorithms and protocols for all types of wireless and wired communication networks including Internet, wireless LAN, cellular networks and sensor networks. Their current research is focused on developing the core technology of future networks such as future Internet architecture, network virtualization, contents network, radio resource management, cognitive radio network and traffic engineering.[37]

- **Computer Graphics and HCI Research Group** develops human-centred computing technologies to solve complex problems through efficient visualizations using computer graphics and human-computer interaction techniques. Their current research topics include 3D modelling, 3D visualization, image processing/analysis, motion analysis and synthesis, motion capture, path tracking, interactive avatar control, intelligent virtual character, user interface design, and information visualization.[38]

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[33] SNU, “Center for Manycore Programming”. Available from http://aces.snu.ac.kr.
[34] SNU, “Center for Biointelligence Technology”. Available from https://cse.snu.ac.kr/en/research-center/center-for-biointelligence-technology.
[35] SNU, “Biological Motion Research Center”. Available from https://cse.snu.ac.kr/en/research-center/biological-motion-research-center.
[36] SNU, “Artificial Intelligence Research Group”. Available from https://cse.snu.ac.kr/en/research-group/artificial-intelligence-research-group.
[37] SNU, “Communication Network Research Group”. Available from https://cse.snu.ac.kr/en/research-group/communication-network-research-group.
[38] SNU, “Computer Graphics and HCI Research Group”. Available from https://cse.snu.ac.kr/en/research-group/computer-graphics-and-hci-research-group.

- **Computing Theory and Financial Engineering Research Group** studies algorithms and their optimizations. The research group is working on practical algorithms optimized for modern multicore and cache architecture, and genetic algorithms. Their applications, including malware detection and financial engineering, are also studied.[39]

- **Embedded Systems Research Group** researches smart embedded systems, where computers are embedded in buildings, highways, bridges, cars and cellular phones, enabling the living environment to have intelligence.[40]

- **Operating Systems and Distributed Systems Research Group** studies a broad spectrum of issues regarding building fast and reliable computer systems consisting of advanced software/hardware components. Their research topics include optimizing the software stack of commodity operating system, enhancing the security of system by using various protection mechanisms, and designing highly efficient distributed/parallel frameworks for processing large-scale data.[41]

- **Programming Principles and Software Engineering Research Group** researches on enabling technologies for the future where programming tools will use more and more sophisticated logics and highly engineered implementations. Such tools will eventually reach to a point where ordinary programmers can use them daily without much effort. Research topics include programming language theory, static analysis and verification, and software engineering applications and tools.[42]

Extracurricular Activities

Other interesting initiatives, much like in the studies of other IHLs, include participation in competitions, but also obtaining vendor certifications, student clubs and gaining memberships in professional societies. For example:

- **UPnL** is a computer software club where members work on various projects. The UPnL club participates in the SNU Computer Science and Engineering Exhibition every year and has developed many award-winning products.[43]

- **Waffle Studio** is a club for developing web-based and app-based application systems. Members not only learn computational skills, but also discuss how the web and application-based systems should be designed and developed in real world settings. The club serves SNU students online timetable service (SNUTT.kr) and SNU cafeteria menu application (SikSha).[44]

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[39] SNU, "Computing Theory and Financial Engineering Research Group". Available from https://cse.snu.ac.kr/en/research-group/computing-theory-and-financial-engineering-research-group.
[40] SNU, "Embedded System Research Group". Available from https://cse.snu.ac.kr/en/research-group/embedded-system-research-group.
[41] SNU, "Operating System and Distributed System Research Group". Available from https://cse.snu.ac.kr/en/research-group/operating-system-and-distributed-system-research-group.
[42] SNU, "Programming Principles and Software Engineering Research Group". Available from https://cse.snu.ac.kr/en/research-group/programming-principles-and-software-engineering-research-group.
[43] SNU, "UPnL". Available from https://cse.snu.ac.kr/en/student-club/upnl-0.
[44] SNU, "Waffle Studio". Available from https://cse.snu.ac.kr/en/student-club/waffle-studio.

- Weekly seminar series include a wide range of distinguished lectures, computer science and engineering industry seminars, and computer science and engineering lunch talks.[45]

Other events include professional get-togethers, camps and contest. A selection of these events is provided below:[46]

- **ComSee** is held annually in May at a holiday resort outside Seoul. In this event, professors, graduates and undergraduate students of the Department of Computer Science and Engineering gather to strengthen the department's spirit through fun team competitions and outdoor sports. The “Talk with the Professor" session during the event gives students the chance to have an open conversation with professors about campus life, selection of their major and career planning after graduation.

- **Future Computer Engineer Camp** is a three-day summer camp held annually for science high school students across the country. In the camp, high school students have the chance to meet with faculty members and outstanding students from the Department of Computer Science and Engineering, and learn the basics about computer science and computer programming. This experience aims to inform high school students about computer science and engineering degree programmes, and help students make a better choice about their future career.

- **Computer Science and Engineering for High School (CSE4HS)** is one of the projects initiated by the Department of Computer Science and Engineering to spark the interest of high school students in the challenges of computer science. The programme also helps high school computer science teachers design classes that are in line with the university's and the computer industry's needs.

- **SNU Mobile Service and Software Contest**, hosted by the SNU Mobile App Center, is a competition where teams design, programme and develop mobile applications. The best apps are selected and demonstrated in front of the public with prizes for the top three. Leading Korean companies such as SKT, Samsung Electronics and LG Electronics regularly attend the award ceremony. Talks on future mobile smartphone trends are given, and SNU computer science and engineering students can obtain information about the companies and their newest products.

- **SNU Computer Science and Engineering Exhibition** is held annually in September. At the exhibition, students present their team projects and competes for the best student project awards. The exhibition and competition stimulate students' critical and innovative thinking and improve their computer engineering skills.

[45] SNU, “Seminars”. Available from https://cse.snu.ac.kr/en/seminars.

[46] SNU, “About Events”. Available from https://cse.snu.ac.kr/en/about-events.