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

Cambodia Country Paper

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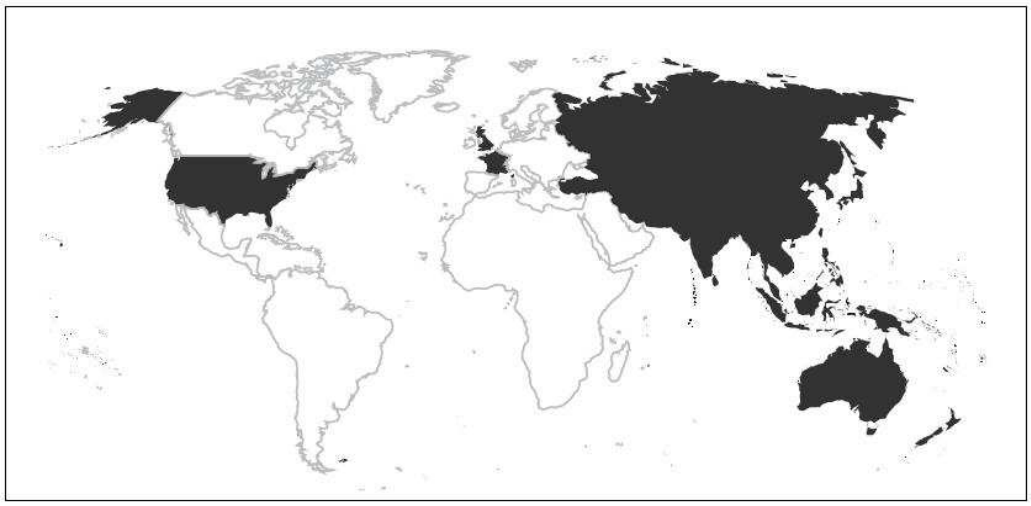

The shaded areas of the map indicate ESCAP members and associate members.

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Table of Contents

Abbreviations and Acronyms

ADB	Asian Development Bank
APCICT	Asian and Pacific Training Centre for Information and Communication Technology for Development (United Nations)
CamREN	Cambodia Research and Education Network
CE	Computer Engineering
CS	Computer Science
CS&E	Computer Science and Engineering
ESCAP	Economic and Social Commission for Asia and the Pacific (United Nations)
Gbps	Gigabits per Second
GDP	Gross Domestic Product
ICT	Information and Communications Technology
ICTD	Information and Communications Technology for Development
IDD	Information and Communications Technology and Disaster Risk Reduction Division
IDS	Information and Communications Technology and Development Section
IHL	Institution of Higher Learning
IT	Information Technology
ITC	Institute of Technology of Cambodia
ITU	International Telecommunication Union
JICA	Japan International Cooperation Agency
LAN	Local Area Network
LMS	Learning Management System
MB	Megabits
MoEYS	Ministry of Education, Youth and Sport (Cambodia)
MPT	Ministry of Posts and Telecommunications (Cambodia)
NGO	Non-Governmental Organization
NREN	National Research and Education Network
OER	Open Educational Resource
RUPP	Royal University of Phnom Penh
SARUA	South African Regional Universities Association
SDG	Sustainable Development Goal
SNU	Seoul National University
STEM	Science, Technology, Engineering and Mathematics
TEIN	Trans-Eurasia Information Network
TRC	Telecom Regulator of Cambodia
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America

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 Cambodia. The study 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 (SDG).

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 Cambodia 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 Cambodia, the Department of Computer Science at the Royal University of Phnom Penh (RUPP) 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 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 Ministry of Education. 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 Cambodia 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 (ADB) 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 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.

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[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.
[7] SARUA, "African Tertiary Institutions Connectivity Survey Report", 2006.

To provide an overview of ICT connectivity at IHLs in Cambodia, the study looks at the national ICT policies and initiatives, and the national-level indicators relevant to ICT connectivity. Since institutional-level data on ICT connectivity at IHLs are not available in Cambodia, the study examines in detail the ICT connectivity at RUPP, a premier public IHL in the country with possibly the best connectivity in a public IHL in Cambodia. RUPP is also the oldest and largest university in Cambodia.

1.4 Gender Issues in ICT Education

This report aims to integrate a gender perspective. The low participation of women in computer science and engineering programmes is a worldwide phenomenon.[8] Data on science, technology, engineering and mathematics (STEM) related fields are available for Cambodia from a survey of seven countries conducted on women in STEM.[9]

The participation of women in STEM degree programmes from Cambodia, Republic of Korea and United States of America (USA), 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 specifically on women's participation in ICT programmes in Cambodian IHLs.

2. Methodology

This country report is part of a five-country study of ICTD education at IHLs in Asia and the Pacific. The other countries that the study cover include India, Republic of Korea, 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

[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.

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.

Cambodian universities are not ranked by the Times survey, hence RUPP has been selected based on informed opinions from within the country. This report is based on data and information collected from desk research, a questionnaire survey to better understand RUPP and its academic programmes, and interviews with three ICTD leaders in the country, who are also RUPP alumni. Prof. Phal Des, Vice Rector for Academic Affairs and the former Head of the IT center of RUPP at RUPP is a key informant and has offered many insights.

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 (NRENs); (4) open educational resources (OERs) 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.

From an analysis of all the data and information, a set of challenges and opportunities to foster ICTD leaders in Cambodia is presented. It is hoped that the examples and experiences documented in this report will be used by ICT and education policymakers to strengthen the linkage between the ICT academic programmes, faculty and graduates, and the society at large.

3. ICT Connectivity

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

In this section, the ICT environment and characteristics associated with ICT connectivity at IHLs are examined. This will be followed by an analysis of the level of ICT connectivity and integration of ICT in education at RUPP, the selected IHL for this study.

3.1 National Policies

The country's ICT Development Policy 2020 was released in May 2016.[14] In addition, the Telecommunication Regulator of Cambodia (TRC) has developed a Master Plan 2020. Based on the English-language documents available,[15] the Master Plan 2020 includes four components:

- Empowering people
- Enriching e-services
- Ensuring connectivity
- Enhancing capability

Education services are included under "enriching e-services", but the proposed initiatives largely concern school education. The Ministry of Posts and Telecommunications (MPT) has under its charge, the major ICT agencies—i.e., the General Department of ICT; the National Institute of Posts, Telecommunications and Information Technology; and TRC. The policy framework and the implementing agencies in Cambodia do not appear to have a direct effect on ICT connectivity at IHLs. It is significant that the MPT and its agencies are not represented on the Board of Trustees of the Cambodia Research and Education Network (CamREN) (see section 3.3).

3.2 ICT Connectivity Indicators

Cambodia's Internet access indicators improved markedly from 2013 to 2015, according to ITU's ICT connectivity data:[16]

- The proportion of individuals using the Internet increased from 6 per cent in 2013 to 19 per cent in 2015.
- Fixed broadband subscriptions increased marginally from 0.2 per cent to 0.5 per cent.
- While mobile broadband subscriptions increased significantly from 9 per cent to 42.8 per cent.
- Internet access at home also saw a significant increase from 5 per cent to 21 per cent.
- Proportion of households with a computer increased from 9.2 to 16 per cent.
- Mobile cellular subscriptions stayed more or less the same at 133-134 per cent.
- Fixed telephone subscriptions decreased from 2.8 per cent to 1.6 per cent.

Although the proportion of individuals using the Internet and mobile broadband subscriptions have improved markedly, these gains in Internet connectivity at the national level are not reflected in Internet connectivity at RUPP (see section 3.4).

[14] Cambodia ICT Development Policy 2020. Available from http://www.mptc.gov.kh/files/2016/05/546/tictpolicy.pdf.
[15] Cambodian ICT Master Plan 2020. Available from http://www.trc.gov.kh/wp-content/uploads/2015/03/Cambodian-ICT-Masterplan-2020.pdf.
[16] ITU, "Statistics". Available from http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx.

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

NREN is a specialized Internet service dedicated to supporting the needs of the research and education communities within a country.[17] Building such networks for research and education is a priority in many countries. NRENs are expected to serve as platforms for collaborative research and education efforts by IHLs in a country.

In Cambodia, CamREN is the name given to the country's nascent NREN. The Network Operation Center of CamREN is located at the Institute of Technology of Cambodia (ITC), an independent institute governed by a board of trustees. Representatives from the Ministry of Culture and Fine Arts, Ministry of Education, Youth and Sport (MoEYS), Ministry of Finance

[17] For more information about NREN, see TERENA, "Research and Education Networking FAQ". Available from https://www.terena.org/activities/development-support/r+e-faq/.

and Ministry of Industry Mine and Energy are by law members of the board.[18] Interestingly, MPT is not represented in the ITC. This is in contrast to the situation in India where the ministry responsible for ICT works with the Ministry of Education on the ICT infrastructure aspects of NREN.

In Cambodia a functioning NREN is yet to emerge. According to Prof. Des, as of July 2016, the university has not been able to secure a connection. Given Cambodia's stage of economic development, its IHLs need the support of the government to establish a functioning NREN in the country. If the government's response is weak, a consortium of IHLs, like in Sri Lanka, may prove effective.

3.3.1 Open Educational Resources

In Cambodia there is no formal recognition of premier IHLs, like in India and the Republic of Korea. RUPP's vision is: "To become Cambodia's flagship[19] university in teaching, research and community services."[20] But generally, IHLs in Cambodia are poorly funded. Since the delivery, sharing and use of OERs require a good Internet connection, as well as the capacity to create OER content, it would be premature to consider OER initiatives in Cambodia until a functioning NREN is established.

3.4 Connectivity at Institutional and Programme Levels

One of the ten goals in RUPP's strategic plan is: "To provide free information technology support and Internet access to all students and staff."[21] However, the current state of ICT connectivity at the institution is inadequate.

According to Prof. Des, the university network at RUPP initially had broadband capacity of more than 50 MB with 18 Wi-Fi hotspots across the 25-hectare campus.[22] Much of the ICT infrastructure was built through an arrangement with the government of the Republic of Korea, but that project was terminated. Now RUPP works with a number of different private Internet service providers—there is no single university-designated Internet provider. Prof. Des estimates that there are six different providers operating across the campus. The Department of Computer Science, for example, uses EZECOM as the provider, while two big centres established with foreign technical cooperation—the Cambodia-Japan Cooperation Center and the Cambodia-Korea Cooperation Center—subscribe to Internet services from other providers.

Local Area Network (LAN) connections within the university have higher speeds—a connection from the payroll system to the central server of RUPP using fibre optic cables has a transfer rate of 10 Gbps. It has been noted that IHLs can economize on ICT connectivity if

[18] Institute of Technology of Cambodia, "Management Boards of Institute of Technology of Cambodia". Available from http://www.itc.edu.kh/en/index.php/about/direction-boards.html.
[19] As stated in the RUPP Strategic Plan 2014-2018, "a flagship university is one that has top class faculties with established centers of excellence. This type of university enrolls top students and receives government support. It is a prestigious institution that competes will with other private and public universities." See MEYS, *Royal University of Phnom Penh: Strategic Plan 2014-2018* (2014). Available from http://www.rupp.edu.kh/news/index.php?display=55.
[20] Royal University of Phnom Penh, "About RUPP". Available from http://www.rupp.edu.kh/content.php?page=about_rupp.
[21] Ibid.
[22] RUPP Campus 1 and 2.

they use LANs for internal management systems, including for the learning management systems (LMS).[23]

ICT access for students appears to be poor across the board. The facilitator who arranged for the interviews with the alumni, and a student that the facilitator interviewed, both said they use the coffee shop on campus to get better Internet access because the Wi-Fi hotspots on campus are not providing sufficient bandwidth.

Lack of support from relevant authorities seems to be a major reason for the current state of spotty connectivity at RUPP. According to Prof. Des, the university has initiated an action to join CamREN, as mentioned above, but it has yet to receive a response from the concerned authorities. The ITC web site informs that "CamREN is now connected to the Trans-Eurasia Information Network (TEIN)" but no further information is available. TEIN provides dedicated high-capacity Internet connectivity for research and education communities across Asia and the Pacific.[24]

Within the Computer Science Programme of RUPP, 3,700 students have access to 550 computers across the campus. Prof. Des estimates that about 30 per cent of the students have their own personal laptops (including the master's degree students, who are all required to have their own). RUPP does not have any agreements with vendors like Microsoft to provide access to software.

3.5 Integrating ICT in Education Management

The tools for administration and payroll are online at RUPP. Students in master's degree programmes use a Moodle-based system as the LMS. Students in undergraduate programmes do not have access to a student management system. Of the 36 master's degree programmes, four to five programmes actively use LMS, including programmes in computer science, social work and education. The Department of Computer Science is working with the Canadian International Development Agency to develop the infrastructure for its own LMS. Furthermore, an ICT policy for RUPP is being developed with support from the Swedish International Development Agency. RUPP intends to complete and implement the policy in 2017.

5. ICTD Planning, Policies and Initiatives

The MEYS, the Accreditation Committee of Cambodia and individual IHLs are the higher education implementing bodies in Cambodia.[25] Cambodia differs from the other four surveyed countries in that it does not have a separate agency for higher education regulation and administration. The Technical Working Group on Higher Education is entrusted with the task of coordinating external funding. According to the Higher Education Vision 2030 document, a secretariat for the group is to be established.

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[23] 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.

[24] For more information about TEIN, see http://www.tein.asia/tein4/index.do.

[25] MEYS, *Higher Education Vision 2030* (2014). Available from https://drive.google.com/file/d/0B1ekqZE5ZIUJSVhjN2E2UFJBQVU/view.

4.1 National Level

In Cambodia's National Strategic Development Plan 2014-2018,[26] one of the four priority areas is capacity and human resource development, particularly in the fields of science and technology, to enable the country to transition to an upper-middle income country by 2030. To implement the priorities set out in this strategic plan, MEYS has prepared the Education Strategic Plan 2014-2018. This plan's higher education development programme aims to "undertake systematic reform of the higher education system, … [and strengthen] teaching and research in science, technology, engineering, arts and mathematics subjects."[27] The Higher Education Vision 2030 document confirms this commitment to "expand programmes in science, technology, engineering, creative arts and mathematics to meet the national development strategy goals and objectives."[28] A policy document specific to ICT in education was developed in 2004, but has not been updated since.[29]

4.2 Institutional Level

The 2014-2018 strategic plan of RUPP[30] has three goals relevant to ICTD. Two of the goals focus on ICT—increasing STEM enrolments and being a centre of excellence for ICT. A third goal of "becoming a leading institution in providing research, consultancy and community services" is the development-related goal of the university. The strategic plans at both the national and institutional levels assume the linkage between technology education and development, but in concrete terms it is not clear how this linkage is to be implemented. The same situation is found in Sri Lanka. It is only in India that an effort has been made at the national as well as institutional levels to connect gains in ICT education to social and economic development.

Regional and international organizations, such as ADB and the World Bank, can introduce progressive policies through their lending programmes. The World Bank is particularly active in supporting higher education in developing countries. During the 2006-2015 period, the World Bank funded higher education projects in Afghanistan, Bangladesh, Cambodia, India, Indonesia, Nepal, Pakistan, Sri Lanka and Viet Nam.[31] These projects were to be implemented over 5 years or more, and ranged in value from USD 22 million in Cambodia to USD 430 million for a project in Madhya Pradesh in India. As noted by the World Bank in their project proposal for Cambodia, one of the four key challenges is the serious shortage of highly skilled local professionals to offer leadership in critical fields, such as the sciences, mathematics, technology-based disciplines, agriculture and education.

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[26] Royal Government of Cambodia, *National Strategic Development Plan 2014-2018* (2014). Available from http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---sro-bangkok/documents/genericdocument/wcms_364549.pdf.
[27] MEYS, *Education Strategic Plan 2014-2018* (2014). Available from http://www.moeys.gov.kh/images/moeys/policies-and-strategies/559-en.pdf.
[28] MEYS, *Higher Education Vision 2030* (2014). Available from https://drive.google.com/file/d/0B1ekqZE5ZIUJSVhjN2E2UFJBQVU/view.
[29] MEYS, *Policies and Strategies on Information and Communication Technology in Education in Cambodia* (2004). Available from https://drive.google.com/file/d/0B1ekqZE5ZIUJdDU1eFY0RExSbWc/view.
[30] MEYS, *Royal University of Phnom Penh: Strategic Plan 2014-2018* (2014). Available from http://www.rupp.edu.kh/news/index.php?display=55.
[31] World Bank, "Projects matching the search criteria - higher education". Available from http://projects.worldbank.org/search?lang=en&searchTerm=higher%20education.

4.3 Programme Level

RUPP offers two computer science undergraduate programmes:

- Bachelor of Science in Computer Science – a four-year programme, established since 1995 under the Department of Computer Science.
- Bachelor of Science in IT Engineering – a four-year programme, established since 2013 under the Department of Information Technology (IT) Engineering.

The department selected for the case study is the Department of Computer Science, since the IT Engineering Department was established only three years ago and has not awarded any degrees yet.

4.4 Programme Description

RUPP's Department of Computer Science was established in 1995 with support from the Japan International Cooperation Agency (JICA), to accelerate the progress of IT within Cambodia and other developing countries in the region. In accordance with this plan, the department aims to produce a cadre of skilled IT professionals in order to share the benefits of IT within a global network. Currently, JICA has no formal links with the department.

Since the beginning of 2016, the Department of Computer Science has started to reform the curriculum, but has found it difficult to gain consensus on the changes. The department is implementing the change gradually, starting with Year 1 students. One of the changes is to place more emphasis on mathematics as a core subject since incoming students' competency in this subject seems inadequate.

The undergraduate students in the Department of Computer Science have worked in groups on small projects as part of their assignments. They are related to game development, database management systems and web development for organizations. Other projects include a university guide app of RUPP for Android, obstacle avoidance with robot car, and analysis of survey data. But these opportunities are intermittent and participation is limited to a few selected students.

Master's degree students have worked on projects related to optical character recognition, cloud computing, high performance computing, traffic management systems, artificial intelligence, health care and access to emergency rooms, advertising, game development, virtual museum, and virtual RUPP, among others. All these activities develop skills essential for producing well-rounded ICT graduates. However, the high student-teacher ratio of 44:1 is an impediment to the offering of hands-on experience to all students.

The Department of Computer Science at RUPP does not require undergraduates to conduct research projects, and the department has difficulty finding internships and project placements for the 800 students in the final year. As a result, the department still depends on examinations for evaluations. RUPP has coordinated some competitions, such as a partnership with Microsoft and a health-care hackathon in 2013. Participation in hackathons is a practice in all programmes surveyed in the five different countries, with evidenced impact on the students.

In order to promote the use of skills in practical application, the Computer Science Faculty at RUPP engages in several outreach activities. Every year, the Computer Science Faculty assists in the Technovation Global Challenge,[32] which is a technology programme for secondary students. The Korean Center at RUPP offers short courses in application development and other topics. The IT center of RUPP has also worked with Microsoft on the Local Language Programme for Microsoft Windows 7 and Office 10. However, due to the high student-teacher ratio, most undergraduate students do not get an opportunity to participate in extra-curricular activities with the faculty.

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

4.4.1 Employability of Graduates

Based on an internal survey[33] it is reported that upon graduation, 91 per cent of the graduates get jobs, although many of them end up in other sectors such as banking and hotel management, as all businesses need some level of IT support. Around 8 per cent of the graduates claim to work in ICT-related start-ups. In another unpublished internal survey, Prof. Des estimates that about 4 per cent of the RUPP graduates join start-ups, with the majority coming from the Department of Computer Science at RUPP.

Employability numbers vary across academic programmes in different countries. The number of graduates that decide to pursue further studies increase along with the state of development of each surveyed university. In Seoul National University (SNU) in the Republic of Korea, about half of the computer science and engineering graduates have decided to pursue further studies. The higher research focus at SNU could be a reason.

Table 3: Percentage of computer science and engineering graduates that have pursued ICT and non-ICT careers among the five surveyed countries

[32] See http://technovationchallenge.org/.
[33] This is an annual survey that RUPP conducts before the graduation ceremony that is usually held in April. In 2015 there were 828 students who graduated with degrees in Computer Science and IT Engineering.

	Cambodia	Sri Lanka	India	Thailand[34]	Republic of Korea
Further study	6%	10%	10% (6% in management)	~33%	~50%
Employment in ICT sector	22%	85%	-	~33%	~50%
Employment outside of ICT sector	57%	5%	-	~33%	few

Sources: Desk research and interviews, July-August 2016.

In Cambodia, as many as 57 per cent of the graduates pursue non-ICT careers because jobs in the ICT sector are scarce, according to Prof. Des. In a paper that he wrote in 2008,[35] he concluded that a graduate with a degree in computer science makes less money than someone in another field of engineering, because computer science graduates are often recruited for relatively low-paying administrative jobs. ICT degrees have not been relevant to the job market in Cambodia, although opportunities for software developers have been improving in the last two to three years.

4.4.2 Building Future ICTD Leaders

ICTD applications can be distinguished from regular ICT applications by their applicability to those sectors that are particularly important for inclusive and sustainable development, or to segments of the population overlooked by exclusively market-oriented initiatives. As discussed, a major constraint at the Department of Computer Science at RUPP is the student-resources ratio, including teachers and ICT connectivity. This constraint limits RUPP's capacity to impart knowledge and skills related to ICTD.

The Department of Computer Science at RUPP has the highest student-teacher ratio among the programmes in the five surveyed countries. The number of students served by the department has increased from about 50 per class in 2006 to an intake of 1,200 first year students today. There are 45 faculty members in the department. They teach about 2,000 students in years 2-4, (in year 1, the students take more general subjects such as geography, mathematics and physics). This represents a student-teacher ratio of 44:1. Under such conditions, it is difficult to provide students with support for research projects and extra-curricular activities in ICTD.

This does not mean that ICTD efforts are non-existent at RUPP. Some initiatives have been possible due to the support of external agents, such as APCICT.[36] The Master's of IT Engineering Programme uses the aforementioned Primer developed by APCICT as a reference textbook, and so does the Department of Computer Engineering for their second-year students. A summer course for undergraduates entitled "ICTD for Youth" was conducted in 2013, using the APCICT Primer.

[34] These are estimates for CS&E Department of Chulalongkorn University in Thailand by Assistant Professor Natawut Nupairoj, Head, Department of Computer Engineering, Chulalongkorn University. The details can be found in the Thailand national report.

[35] Unpublished.

[36] APCICT, "Primer Partners Poster: Royal University of Phnom Penh", 2013. Available from http://www.unapcict.org/pr/primer-partners-poster/files/Cambodia_RUPP.pdf.

Although this study has not been able to directly link the success of ICTD leaders in Cambodia to any planning processes, policies and initiatives, RUPP graduates are active in the ICTD arena either as leaders or as partners or employees (see section 4.6).

4.5 Gender Issues

The Higher Education Vision 2030 document lists several strategies to improve gender equality in higher education. For example, one strategy is to "expand equitable access to higher education for qualified students, including … women." However, this study has not been able to identify any initiatives by MoEYS that have increased women's participation in ICT education. The MoEYS may be setting broad policy objectives and expecting the IHLs to put them into action.

But despite the promotion of gender equality in the Higher Education Vision 2030 document, gender considerations are absent in the RUPP's Strategic Plan 2014-2018. Of the 45 faculty members in the Department of Computer Science at RUPP, only four are women—that is less than 9%. This may be explained by the fact that there are few female students in the Department of Computer Science. Without any supportive measures, fewfemale students result in few women qualifying for faculty positions. Prof. Des estimates that about 7-8 per cent of the students are female. This is lower than the 15-30 per cent range in the other four surveyed countries.[37]

Systematic studies on the reason for low female enrolment in computer science courses have not been found. This study has also not found any initiatives that aim to increase female enrolment in computer science courses in Cambodia.

Women's participation in ICT education is low across the board in the surveyed countries, and indeed throughout the world. Cambodia has the lowest percentage of women in the student body at 7-8 per cent, and the Republic of Korea has the highest percentage at 30 per cent, as illustrated in Table 2. If the enrolment rate of female students is ordered along the GDP per capita trajectory of the countries, the percentage of females is at less than 7-8 per cent, 20 per cent, 15 per cent, and 30 per cent, respectively, for Cambodia, India, Sri Lanka and Republic of Korea. In addition to the general problem of low women's participation in ICT programmes, there may be context-specific factors in each country. Formulating strategies for improving women's participation in ICT education will require a variety of methods, including interventions at the secondary-school level.

The proportion of female faculty members in each institution also varies from 4 per cent in Cambodia, 35 per cent in Sri Lanka; 10 per cent in India; 38 per cent in Thailand; and 3 per cent in the Republic of Korea, with no apparent correlation with the income level of the country. The reasons here are likely to be highly context-specific. In Cambodia it could be due to low female enrolment in ICT degree programmes. In Cambodia, it could be a weakness in the pipeline in the IHL. In other words, if fewer women are taking subjects, the pool of female applicants as potential faculty is comparatively small.

[37] In the Engineering Programme, a newer programme that started in 2013, there are 100 students, 8 per cent of whom are female; and 10 faculty members, 3 of whom are female.

Lack of early orientation to mathematics is thought to be one of the reasons behind low participation of women in STEM, and in computer science or engineering, in particular.[38] As Prof Des notes, the level of competence in mathematics among students entering the computer science degree programme at RUPP has been weak. Perhaps RUPP could consider a separate stream for students with competence in subjects of an analytical nature – not from the STEM fields or specialized mathematics. As some studies have pointed out, it may not be critical to have advanced mathematics skills in order to be successful at ICT in its practical applications.[39]

Finally, other strategies to increase female participation may include:

- Increase in the number of scholarship grants for female students in the ICT field;
- Invite female ICT leaders to hold workshops for students and public to prove that women could be leaders and specialists in ICT like men;
- Recruit more female staff in the field of ICT;
- Regularly highlight projects that are initiated by female students and staff on social networks;
- Encourage female students to enjoy the ICT field and try to show them that software development or software engineering can be suitable for both men and women.

What can be seen in some developing countries is that sometimes non-gender conscious development priorities overshadow gender-conscious programmes. More could be done by the development agencies to mainstream gender in their programmes.. Funding agencies are in a position to highlight gender disparities and advocate for gender equality in ICT education, employment in the IT sector, and the use of ICT for development.

4.6 ICTD Alumni Perspectives

This section details the perspectives, experiences and aspirations of students and graduates, and reviews how policies, planning and programming have impacted on their career trajectory and contributions to ICTD and society at large.

The study team received names of four ICTD entrepreneurs, three of whom were interviewed. The three that were interviewed are graduates of RUPP, two of whom studied in the Department of Computer Science at RUPP.

- **Mr. Chhay Sokchanna**, IT Specialist, World Education
    - Educational background – BS in Computer Science, RUPP
- **Mr. Mak Puthea**, Freelancer
    - Educational background – BS in Computer Science, RUPP
- **Mr. Kagnarith Chea**, Co-founder and Managing Director, EDEMY
    - Educational background – B.Ed in Education, Institute of Foreign Languages at RUPP, and MA in English, Arizona State University, USA

[38] 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.

[39] See for example, Emma Mulqueeny, "Learning to code: Do I need to be good at maths?" *The Telegraph*, 6 December 2012. Available from http://www.telegraph.co.uk/education/educationadvice/9723375/Learning-to-code-do-I-need-to-be-good-at-maths.html.

The two alumni of the Department of Computer Science are working as IT specialists in the non-profit sector.

Chhay Sokchanna, IT specialist at World Education, began studying computer science at RUPP in 1999, when both the availability of ICT equipment and the quality of teaching were poor. He found that even though his graduating class in 2005 had studied ICT, the graduates could not work in the field because they were not properly qualified, and the economy did not offer sufficient opportunities. When he was studying, the students only had four hours per week to work on computers, and had no access to laptops, which is at least an option for students today. Many who graduated with him are working as taxi drivers, in motorcycle repair, and other small businesses. Out of his group of six close friends, only two are working in the ICT sector.

World Education is an American non-governmental organization (NGO) that started its operation in Cambodia in 1991. It provides support to MoEYS and builds capacity of local NGOs in ICT usage in various development sectors, including agriculture and education. At World Education, the teachers that are hired to teach ICT in school computer labs are not ICT graduates. They are mostly teachers from mathematics and literature who go through an orientation programme. World Education has been more successful connecting with ICT students from the university since the NGO began hiring undergraduate students as interns in 2014. World Education typically works with third-year students, and were able to hire five students in 2014, two in 2015, but only one in 2016 as their grant was ending. These students are all from provincial universities rather than urban universities like RUPP. Some of these interns continued to work full time at World Education, while others left to work in private companies, although they have all gained skills at World Education. In particular, they have learned the context and skills for working with a non-profit client, and would be more willing to work on projects sponsored by NGOs.

Having worked with undergraduate students, Chhay believes that computer science students are missing important practical skills. In his opinion, graduates have not learned to think about computer science as a problem solving field that must start from customer needs and the target audience, and evolve through critical thinking. They are instead working from a limited set of preconceived solutions. Ideally, students would not just be learning ICT in university, as is currently the case in Cambodia, but would be exposed to it earlier on in their K-12 education. He also sees a need for greater standardization in IT degrees. Currently, students from different universities with very different educational experience and course difficulty, receive the same degree. He has not pursued a master's degree in computer science because he has concerns about the quality of the programme at RUPP, and because the university does not offer a flexible programme for working professionals.

Mak Puthea graduated around the same time as Chhay Sokchanna. Mak began working during his final year at university and was interested in community issues. He has been involved with different non-profit organizations ever since. His most recent assignment is a Network Coordinator for the ICTD Cambodia Network, which is a collaborative network project with local and international NGOs to share experiences applying IT systems to their programmes. The assignment came to a close because of funding issues. He currently works for a private market research company as Sales Administration Manager, although he would prefer to work

in ICTD to integrate ICT into civil society organizations. However, he has seen that non-profits are not sustainable, and that the private sector is more stable.

Like Chhay Sokchanna, Mak estimates that only a small percentage of his classmates are working in the IT sectors. Others may be working as accountants or in NGOs, although he does think that there are more opportunities for the current class of computer science graduates, who are learning more soft skills and may have greater understanding of social issues. Students today are also involved in more internships and gaining more work experience.

Although he did not graduate from the Department of Computer Science, **Kagnarith Chea** is a RUPP alumnus who has been working in English education, and is the co-founder of EDEMY, an English education training programme. Kagnarith received a master's degree from USA through a Fulbright scholarship. He feels his success is largely due to the exposure he received in the USA and is constantly on the lookout for partners/employees with foreign exposure.

Kagnarith's team at EDEMY includes two computer science graduates from RUPP. They have developed an offline blended English learning product that combines online lessons from master's degree qualified teachers (50 per cent) and facilitated class time (50 per cent). Through an initial project that had explored online learning for rural students, the team realized the limitations of a programme that depended on a reliable and high-quality Internet connection, and had not included any in-person elements. Since that experiment, which he deemed a necessary failure, they have done a pilot test with the EDEMY model, now using Raspberry Pi devices that can create LANs at a low cost to take online learning experience offline. Always-on Internet is no longer needed. He is applying this system in two universities and three high schools. The LANs can cover about 30 computers or tablets. The material is provided to each centre through Raspberry Pi. Through their market research, Kagnarith's team found that about 80 per cent of the market in Cambodia can afford to pay USD 2-5 per month for their English courses. They can offer the course for free to those who cannot afford it, and still run a self-sustaining business. They originally intended to register the company as a social enterprise but such entity does not exist in the registration framework. Thus, their current company is registered as a private limited company. The company received initial funding from the American Embassy, as well as from their own equity. He also teaches part-time in the Master's Degree Programme at the Institute of Foreign Languages.

The company has benefited from Kagnarith's participation in international and regional conferences for education technology and social entrepreneurs. It has also gained from the experience of winning competitions like the 2016 Mekong Challenge, and from entering the semi-final round of the International Business Model Competition sponsored by Microsoft. Locally, Kagnarith's team receives support from IMPACT Hub Phnom Penh, a business incubator, in terms of access to a co-working space and help with entering competitions.

As far as what the university system could do to promote work like his, Kagnarith thinks it could support students who want to enter competitions, and use short courses to help generate interests in project-based work. The university could also promote internships that help students develop problem solving skills. He would welcome interns from Cambodia and abroad to work for three months on an open source project. He knows that many people might prefer a private sector salary, but the university could help steer interested students toward more social enterprise opportunities. Additionally, he sees opportunities for more cross-disciplinary projects at the university.

Kagnarith came to this business after substantive experience in the education field, including completing his master's degree through a Fulbright Scholarship in the USA. He feels that a project like EDEMY is more interesting than work in the private sector. Cambodia's major needs are in education, agriculture and health care, and he believes that upcoming social entrepreneurs can look beyond the existing market to change people's mindsets and create demand for their products in these key areas.

In his review of the report, Prof. Des notes two other alumni—Ms. Khoun Khemry and Ms. Plong Malypoeur—and the participation of RUPP staffs and students in the Khmer dictionary project funded by Electricite Du Cambodge, the state-run electric utility company in Cambodia. Ms. Khoun Khemry is now pursuing her doctoral degree at Waseda University, Japan through a Japanese government scholarship that RUPP has recommended. She and her team are developing an iOS app called Vcess.[40] Ms. Plong Malypoeur received her Master's degree in Belgium, also through RUPP's recommendation and is now developing a mobile app called Stops Near Me.[41]

5. Summary of Observations and Conclusion

Cambodian IHLs, in general, are constrained by insufficient resources, and the Computer Science Programme at RUPP selected in this study is no exception. This is evident in the unaffordable, unreliable and inadequate connectivity, the high student-teacher ratio, the lack of ICT equipment, and the high reliance on foreign technical assistance. In this context, it is difficult to provide students with support for research projects and extra-curricular activities in ICTD.

As this study notes, the organization of specialized ICTD short courses, similar to the one supported by APCICT, is a viable option to address curriculum shortfalls and high student-teacher ratios. Therefore, IHLs should consider integrating external resources into the curricula, to raise the profile of opportunities in ICTD, provided that adequate connectivity exists. This way, the use of available financial and other resources can be maximized by creating synergies between the ICT and education sectors.

Yet, the study found encouraging initiatives by graduates that focus on ICTD. Thus, coordinated policies, plans and initiatives at the national, institutional and programme levels should provide an enabling environment for students to innovate and develop creative ICTD solutions. Efforts also need to be made to raise the awareness of policymakers, and advocate for the effective use of ICT to achieve national development goals.

A number of points that the interviewees have made are worth noting, including the need to focus not only on the IT technical skills, but also emphasize problem solving and critical thinking skills in IHL curricula. Students and graduates should be encouraged to look beyond the markets and focus on Cambodia's priority sectors, including agriculture, education and

[40] Vcess is an app for finding food and drinks in Cambodia. See https://itunes.apple.com/us/app/vcess/id1093485967?mt=8.

[41] Stops Near Me is a free mobile application aimed at helping Cambodians use the public bus service in Phnom Penh. See Rattana Keo, "Startup Interview: Stops Near Me App", *Geeks in Cambodia*, Available from http://geeksincambodia.com/startup-interview-stops-near-me-app.

health care. In addition, opportunities that encourage innovation and creativity should be promoted, for example, through students' participation in competitions, internships and cross-disciplinary projects that can provide practical experience in applying ICT in different development sectors. Moreover, a flexible IT programme for working professionals and better standardization of IT programmes should be considered.

The alumni at RUPP have reported that they benefitted from competitions like the Mekong Challenge and the International Business Model Competition sponsored by Microsoft. There are other similar competitions available, such as from UNESCO[42] and ITU's World Summit on the Information Society stocktaking.[43] Participation in such competitions, particularly those related to ICTD, should be encouraged and mainstreamed into IHLs' policies and programmes.

Furthermore, the development of students' entrepreneurial skills should be incorporated in IHLs. Facilities and business incubators similar to IMPACT Hub Phnom Penh[44] could provide valuable learning experience, networking opportunities as well as an avenue for funding of ICTD initiatives. For example, the IMPACT Hub has compiled a list of funding available in Cambodia for initiatives that use ICT to achieve social goals.[45] Collaboration between IHLs, aid agencies and government authorities with this type of ICT hubs should be further explored.

The interviews with alumni reveal that ICTD initiatives do not necessarily come from ICT graduates. Further, as the Dean of Computer Science and Engineering Programme in Thailand observes, with increasing demand for additional subjects, as well as exposure to entrepreneurship, it is difficult to find space in the computer science and engineering curriculum to cover all the aspects. ICTD could be taught and researched in other faculties, and cross-disciplinary projects, and initiatives could be encouraged to address real life challenges and opportunities. As one interviewee suggests, social entrepreneurship could be an avenue for graduate students to initiate and sustain ICTD initiatives.

Adequate ICT infrastructure at the national and institutional levels is a necessary precondition for ICT and ICTD education. In addition, wider connectivity access is necessary for entrepreneurs, businesses, government agencies and NGOs to use ICT efficiently and effectively. Planning, policies and initiatives at MoEYS and MPT currently do not include ICT connectivity at IHLs.[46] At the institutional level, RUPP has yet to be linked to CamREN. This highlights a need for coordination between ministries and IHLs (and possibly funding and development agencies) on improving ICT connectivity at IHLs as a way forward to enhance the quality of ICT education.

Upgrading the ICT infrastructure of Cambodia will require the active engagement of MPT as well as the private sector. The appropriate competitive conditions, coupled with transparent and predictable regulations, and a stable policy environment, will encourage investments, which will in turn bring down prices and enhance the quality of broadband access. The Asia-

[42] UNESCO, "UNESCO King Hamad Bin Isa Al-Khalifa Prize for the Use of ICTs in Education". Available from http://www.unesco.org/new/en/unesco/themes/icts/ict-in-education-prize/.
[43] WSIS Stocktaking. Available from http://www.itu.int/net4/wsis/stocktakingp/en.
[44] Impact Hub Phnom Penh is a co-working space, a business incubator, a social enterprise builder and above all, a community of like-minded people who believe they can make the world a better place. See Impact Hub Phnom Penh, "What is Impact Hub Phnom Penh?" Available from http://phnompenh.impacthub.net/about-us/.
[45] Challenges – Grants – Programs for Entrepreneurs. Available from https://docs.google.com/spreadsheets/d/1vAbpK3rraMeCLJHrjKK5H1CUPeR2REn1A5sobjoGc9A/edit#gid=0.
[46] The current fibre broadband connectivity among universities was a 2010 initiative by EZECOM in collaboration with MEYS, which currently offers free high-speed access to 65,000+ students at the country's top universities.

Pacific Information Superhighway (AP-IS) initiative[47] of ESCAP will contribute to lower-cost and higher-quality broadband connectivity by addressing a critical link in the "chain" of elements that yield fast and affordable Internet connectivity, and by creating an enabling Internet ecosystem.

The reliance on external funding from development assistance and NGOs is particularly prominent in the case of Cambodia. Coordinated efforts to maximize the effectiveness of these funds, and the development of sustainable solutions to ICTD education will be key. RUPP, for example, received support from the Republic of Korea to develop its ICT infrastructure, but support has been discontinued. A more sustainable solution would be to develop the ICT industry so that IHLs can access the Internet at affordable rates and at levels of quality that are fit for purpose. In addition, external support has been received for teacher training, providing terminal access, and employing graduates. Cooperation with funding agencies is essential, and is an explicit policy of MoEYS.[48] The above-mentioned competitions, internship and cross-disciplinary projects could be considered for funding. In addition, technical cooperation and development assistance could highlight the need for increasing the enrolment of female students and promoting the active participation of women in ICTD initiatives.

There is a mismatch between the curricula taught in IHLs and the ICT skills demanded by the market. As one of the interviewed alumni notes, ICT degrees are not relevant to the job market in Cambodia, although this has started to change in recent years. This lack of relevant skills has been recognized by both graduates and employees. Promisingly, MEYS is planning to address this issue through surveys, consultation and the establishment of a Higher Education Technical Working Group.[49] At the institutional level, the faculty could cooperate with the private sector and NGOs to offer various experiential education learning programs, such as internships, mentoring and job shadowing, to bridge the skill/demand gap.

Women's participation, particularly within the examined computer science programme, is the lowest among the selected IHLs in the five surveyed countries. The MoEYS **lists several strategies to improve gender equality in higher education, but there seems to be a disconnect between policy and action.** It seems that MoEYS may be setting broad policy objectives and expecting the IHLs to put them into action. However, in pursuance of prestige and status, IHLs may be "muting" gender equality concerns. But without gender equality and increased women's participation in ICTD, the SDGs will not be achieved. Therefore, formulating strategies for improving women's participation in computer education will require a variety of methods, including intervention at the secondary-school level. Other initiatives could include scholarships for women in ICT fields; female guest speakers promoting the feel to other women; proactive recruitment of female staff in the fields of ICT; highlighting ICT projects by women; and engagement of women using social media.

[47] ESCAP, "Asia-Pacific Information Superhighway". Available from http://unescap.org/apis.
[48] The Joint Technical Working Group in Education is tasked to promote aid effectiveness and partnership in support of the Education Strategic Plan and the Annual Operation Plan of MEYS. See MEYS, *Education Strategic Plan 2014-2018* (2014). Available from http://www.moeys.gov.kh/images/moeys/policies-and-strategies/559-en.pdf.
[49] Ibid.

In conclusion, for a developing country such as Cambodia, where 41 per cent of the population still lives on less than USD 2 per day,[50] poverty alleviation needs to be on top of the agenda. This can be achieved through targeted policy interventions, and policies that incorporate ICT are able to assist in addressing many of the development initiatives. The preconditions for these policies to work are that: (1) there is wider ICT connectivity; (2) enabling policies and regulations are supported with adequate resources; and (3) there is enough human capacity to take advantage of ICT.

This report, through a case study analysis, has highlighted the challenges faced by IHLs in Cambodia, and provided examples of student-led ICTD initiatives. Policies at national, institutional and programme levels need to encourage such initiatives.

[50] As of 2011. See ADB, *Cambodia: Country Poverty Analysis 2014* (Mandaluyong City, 2014). Available from https://www.adb.org/sites/default/files/institutional-document/151706/cambodia-country-poverty-analysis-2014.pdf.