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Digital Literacy for Employability and Entrepreneurship among Cambodian Youth

Assessment Report

Phnom Penh
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EXECUTIVE SUMMARY

Background and Objective: the emerging roles of digital technologies in sustaining economic growth result in pressing needs to address digital literacy among Cambodian citizens. However, many things remain unknown. To contribute to addressing this critical issue and promoting skill development among young Cambodians, UNDP, through this study, is collecting evidence to support policy interventions. Designed to contribute to the overall understanding of digital literacy levels and the development of a digital literacy framework that focuses on the advancement of employability and entrepreneurship among young men and women, this study aims to contribute to the overall skill development and employment of Cambodian youth by establishing evidence-based information and insight on how digitally literate young Cambodians are.

Method and Tools: This study is based exclusively on the definition of digital literacy pro- posed by the UNESCO which treats literacy as a combination of seven digital competence areas. The method employed is indicator-based and focuses on assessing four areas: the enabling infrastructure (i.e. existing hardware, software and public investment), the incubating platforms (curriculum quality, teacher capacity, sociocultural acceptance, and available quality learning resources), the digital behavior (learning appreciation and habits such as self-learning and private tutoring) and the actual literacy levels through the use of exam-like literacy tests. Although the primary data collection depended heavily on the use of web-based digital questionnaires and self-administered ICT tests, the rural youth were high school students who answered the survey questionnaire in their classroom with internet access. To a more limited extent, focused group discussions, either face- to-face or virtual-based, were also employed with community and out-of-school youth to fill in this information gap.

Samples: In total, a sample of 1,285 individuals was collected — 869 high school students, 284 undergraduate students, 80 working youths, 23 youth community members, nine factory workers, 12 high school teachers and eight university lecturers. Female participants account for 699 individuals or 54.4 percent of the sample. Students from 10 high schools in nine provinces were surveyed — two rural (Siem Reap and Preah Vihear), two semi-rural (Prey Veng and Svay Rieng), two semi-urban (Stueng Treng) and four urban (Battambang, Kampong Cham, Phnom Penh and Takeo). All university students, except for those coming from Chea Sim Kamchay Mear University, were sampled in Phnom Penh. Three face-to-face FGD sessions with community members and factory workers were conducted. High school and university teachers were sampled using virtual FGD.

Digital Landscape: The study found that on average, more than 90 percent of youth own at least a smartphone. This rate increases to 98 percent for urban youth and stays

above 75 percent for those living in rural areas. Computer ownership rate, however, is much lower with high school students owning the lowest at 35 percent while working youth owning the highest at 69 percent. Between 88 to 94 percent of youth have a social network account and 52 to 76 percent have email addresses. However, between 18 to 39 percent of these accounts were created by someone else on behalf of the account owners. Access to wired home internet ranges from 5 (rural areas) to 55 percent (highly urbanized areas). Youth use their smartphones mostly for media consumption purposes; such as social networking (83 to 86 percent), entertainment (76 to 79 percent) and news reading (65 to 70 percent). The main language used on digital devices is English (66 to 95 percent for smartphone and 75 to 92 percent for computer). In terms of financial technology, between 40 (university students) and 90 (working youth) percent of youth own a bank account. Youth who made payments through mobile phones account for 69 (university students) to 78 (working youth) percent. Those who made payments through computer, however, account for a much smaller proportion (8 and 23 for university students and working youth respectively).

Digital Education: Education, which is the main vehicle for digital literacy, was assessed in several ways. In general, high school curricula provide basic computer literacy through two government-sanctioned textbooks. At university level, basic digital literacy was provided as a one-semester subject covering mostly basic computer operations. The integration of ICT in other undergraduate subjects are unknown. In general, high school students are quite satisfied with their school ICT curricula (78 percent). Working youth and university students, however, are mostly critical of their ICT learning experience, with 68 percent feeling dissatisfied with their university curricula. The top three reasons for this dissatisfaction are limited class hours (81 percent), insufficient facilities (50 percent) and unsuitable curricula (37 percent). Teacher quality, however, was found to have received high approval rates (sitting at around 85 percent level) from either high school or university students. In terms of learning resources, most youth (61 to 72 percent) agreed that insufficient English capability is the top challenge to ICT learning since most ICT learning materials are available in English. Lack of internet connectivity and hardware facilities came as the second and third challenges to youth's digital literacy development respectively. Regarding ICT self-study, 39 (high school students) to 71 (working youth) percent of youth are regular self-learners. The most popular means of doing ICT self-study is the use of YouTube video tutorials (71 to 88 percent).

Youth Digital Literacy Level: The overall results from the ICT tests indicate a low to below average digital literacy level for all three youth groups, with an average between 47 to 51 percent points. Safety competence area receives the lowest scores (between 36 to 44 points) among the four tested areas. All three youth groups performed poorly in this competence area. The variations of the scores, however, are large. These indicate wide ranging digital literacy levels that are the results of several factors. Youth in highly urbanized areas have consistently higher literacy levels than rural individuals.

Generally, grade 12 students have a better digital literacy level than their grade 11 peers. This literacy difference is also statistically significant for rural or semi-rural high schools. Urban high school students did not demonstrate any significant difference in test scores between grade 11 and 12 students. The relationship between digital literacy and attained education level is more pronounced in working youths. Those with higher education performed consistently better than those at the lower education tiers — with an average score of 40.7, 52.8 and 58.3 for high school, university and working youths respectively. Device ownership also plays a role in determining digital proficiency. For example, high school students who own a smartphone or PC performed better (scoring 36 to 56 points) than those who own nothing (scoring 30 to 49 points). Those who own both smartphone and PC have the highest digital literacy level (scoring 37 to 63 points). Self-learning also contributes significantly to the youth's digital competence. Youth who practiced self-study scored higher on most competence areas than those who only depended on school curricula.

Gender gaps in digital literacy: Digital literacy level is also gender-related. Female youths were found to have consistently lower literacy levels than their male counterparts, particularly in the hardware, software and safety competence areas. There are still some competence areas that need further scrutiny before any statistically meaningful judgment can be made. Closing this gender gap is very important for the development of inclusive and non-discriminatory digital literacy.

Implications for Employability and Entrepreneurship: Generally, Cambodian youth's digital literacy levels measured by this study can be considered to float between low to average depending on their education levels. These literacy levels are considered unsuitable for work in information heavy sectors, but practically manageable in a working environment that demands intermediate office productivity (at least for post-high school young adults). For the employment sectors that demand specialized hardware and software operations, the current literacy level of the youth will require serious specialized training before they become efficient and productive. Although we did not investigate career-related digital competence, it is logical and rational to believe that people who scored relatively low in the administered tests which were designed to measure literacy at an intermediate level will not do well in advanced tests of specialized knowledge. In simple terms, one needs to be proficient at lower levels of literacy before becoming fluent at the higher levels.

Based on the test scores, Cambodian youth entrepreneurs are highly vulnerable. Their very low scores in the safety competence area (below 44 average points) and information literacy (below 54 average points) are the highly concerning indicators that youth entrepreneurs are not in a good position to defense themselves and their colleagues against digital adversaries. Low information literacy coupled with reliance on social media for news and entertainment has the high risk of facilitating the spread of fake news, unfounded rumors and sometimes the sharing of incriminating media.

In short, we can see that youth are really taking advantage of the entrepreneurial opportunities provided by the digital technology. Their preparedness for cybercrimes, however, is believed to be insufficient.

Implications on Digital Literacy Framework Development: This study suggests that future development of Cambodia's digital literacy framework should be model-based. Four literacy models: inclusive, communication centric, creation-oriented, and interdisciplinary— were provided as the foundation for the framework's development. Based on the advantages and shortcomings of the four models, the digital literacy framework we believe will serve the best interest of Cambodia is a cascading one, composed of the inclusive and creation-oriented models that are both encompassed by the communication-centric model. The foundation of this framework is the inclusive model where everyone is guaranteed equal and sufficient digital literacy competence meant for sustaining office productivity. With this framework, the digital literacy effort being currently implemented can continue because it is viewed as an inclusive model. This model, however, will be gradually replaced by the creation-oriented model when the youth has moved to the higher education level (such as the university). The two models must be accompanied by the communication-centric model at all educational levels to ensure that digital communication skills have been gradually integrated into the whole digital curriculum.

Suggested Policy Options: Digital literacy interventions center on two fronts. The first is the development of a digital literacy framework. Then comes the development of a strategy to operationalize the framework. To achieve these, the Cambodian government should consider:

1. Institutionalize digital literacy development by 1) formulating a flexible national digital literacy framework that consists of a cascade of at least inclusive model for high school, creation-oriented model for university and communication-centric model for all literacy levels, and 2) mandating the development of institutional frameworks that meet unique contextual demands and capacity of different educational institutions.

2. Reconsider infrastructure investments by 3) conducting cost-benefit analysis of state sponsored computer labs, 4) promoting societal contribution to boast device ownership ratio, 5) enhancing public-private partnership to attract private investments in the digital education sector, and 6) promoting the use of open-source technologies to curb piracy and increase copyright and intellectual property compliance.

3. Invest in open learning resources by 7) reimagining digital learning resources to increase multimedia-rich and highly interactive self-learning resources, and 8) standardizing digital terminology to increase ICT uptake among non-English speaking youth.

COVID-19

COVID-19 pandemic amplifies the importance of digital literacy as a bearer of socio-economic development.

This digital literacy assessment was framed prior to the onset of the COVID-19 epidemic and completed before the WHO declared it as a pandemic. The data collection and analysis approaches were thereby designed and implemented without any considerations on the implications of the pandemic on youth digital literacy, employment, and entrepreneurship. Although the digital literacy results reflect pre-pandemic situation, the overall findings are deemed truly relevant; and the suggested policy recommendations are considered even more urgent for the current situation and the post-pandemic socio-economic development.

The biggest implication of the pandemic on digital literacy is related to the nationwide closure of all educational institutions since March 16, forcing the biggest learning disruption since the collapse of the Khmer Rouge regime. The closure has forced schools and universities to scramble to put in place distance learning to provide students with some learning opportunities. This measure has three major implications on the students' learning outcome. First, virtually no institutions have been equipped with any suitable e-learning infrastructure and materials. This results in a very fragmented learning environment. Second, teachers who had no experience in producing e-learning materials were left with extremely limited options to fulfil their teaching responsibilities. Third, students who were not prepared for distance learning, especially those with low digital literacy and no ownership of computers, were left with highly restricted access to learning.

This learning disruption vindicates the necessity of investing in online learning which was put forwards by this study as one of the most urgent policy options towards leveraging digital literacy. Despite the easing of the closure and the limit reopening of some schools, it is undeniable that online learning is one of the most critical educational media to sustain Cambodia's education system should similar calamities happen in the future. The lack of online learning infrastructure also points to the needs to consider open-source technologies and the promotion of public-private partnership, which are two of this study's policy recommendations, to drive up self-learning practices through free or low-fee technologies. Furthermore, this study's policy recommendation of promoting societal contribution is crucial for sustaining the pandemic-stricken education system. Contributions such as investment in computers by parents will increase their children's access to online learning.

The most serious impact of the pandemic on youth employment in particular and the economy in general is the encouragement of the work-from-home practice. Although Cambodia has not implemented any full-scale lock-down measure, many institutions have allowed their staff to work from home which presented Cambodians with several challenges such as staying connected, owning computers, and knowing how to use different communication and productivity digital technologies. Although we do not know at this moment the impacts of working from home on the economy, it is undeniable that people with higher digital literacy are better positioned to contribute more to sustaining the economy than those with lower literacy.

On the other hand, the restriction of movement and the practice of social distancing also present some employment and entrepreneurial opportunities for the digitally literate individuals as witnessed by the fast expansion of the gig economy. Youth who are tech-savvy enough have a better employment security and capture more entrepreneurial opportunities due to their ability to stay productive and efficient despite working from home.

1. INTRODUCTION

This assessment report presents the results of the assignment titled "Assessment on Digital Literacy for Employability and Entrepreneurship among Cambodian Youth", which is a component of the Promoting Youth Employment in Cambodia project being implemented by UNDP Cambodia. The assignment took place between late November 2019 and early February 2020 and was carried out by a service contractor (the author of this report) on behalf of UNDP Cambodia. This assessment, which is believed to be the first of its kind, is intended to provide a broad baseline understanding of digital literacy levels among Cambodian youths, with a strong focus on determining the relationship between such literacy and their employability and entrepreneurship in an increasingly globalized and technology-dependent economy.

Cambodia's rapid transition toward a lower middle-income country can be attributed in a large part to its young and vibrant population. With a share of almost half of the working age population (UNDESA, 2019), Cambodia's youth has been perceived as the main driver of economic growth. However, with the country facing fast demographic changes and rapid influxes of digital technologies, an important question lingers around whether this youthful workforce can reap dividends from an increasingly integrated and connected digital economy.

Recognizing the emerging roles of digital technologies in sustaining economic growth, Cambodia is facing pressing needs to address digital literacy among Cambodian citizens. To contribute to addressing this critical issue and promoting skill development among young Cambodians, UNDP is implementing a project on Promoting Youth Employment in Cambodia. Under this project, it is collecting evidence to support policy interventions through two separate studies, one of which is carried out by this assignment and focuses on assessing digital literacy among Cambodian youths. This assignment is designed to contribute to the overall understanding of digital literacy level and the development of a digital literacy framework that focuses on the advancement of employability and entrepreneurship among young men and women.

2. OBJECTIVE

Aiming to contribute to the overall skill development and employment of Cambodian youth, the objective of this assignment is to establish evidence-based information and insights on digital literacy among young Cambodians. The specific objectives are:

1. Assess the digital literacy and related digital skills for employability and entrepreneurship of Cambodian youths aged between 15 and 30. Having virtually no information on the state of digital literacy of young Cambodians, development interventions aiming to promote digital economy are facing various uncertainties on whether their work is realistic, relevant and sustainable. Building a baseline understanding or insight into the status quo of the digital capability of Cambodian youth is increasingly viewed an urgent undertaking, underpinning the success of future development initiatives.

2. Based on the assessment findings mandated by the objective above, propose a digital skill framework and develop a responding policy brief. The results from the first objective are expected to provide needed inputs into the development of a framework and a policy brief that will be used to partially guide future digital development initiatives.

3. STATE OF CAMBODIA'S DIGITAL LANDSCAPE

The spread of digital technologies, such as smart devices, live communication, e-commerce, e- payment, e-banking, mobile computing, online news, geolocation, etc., in Cambodia is disrupting the traditional work environment and has altered the dynamic of the labor market. These technologies come with a promise of higher productivity, better efficiency and lower labor. From a consumer's point of view, this translates to higher quality of goods and services with lower prices. From a labor market standpoint, however, the spread of digital technologies presents a high risk of job cuts and unemployment, especially for an economy highly dependent on cheap and unskilled labor forces, as in the case of Cambodia. Over the past two decades, Cambodia's rapid and firm growth has been driven largely by the garment sector, tourism, agriculture and construction which are sustained by the abundance of low-skill, low-cost labor (Beschorner et al., 2018). However, with decreasing trade preferential and rising wages, such growth is increasingly untenable in the long run. Further exacerbating the situation is the higher expectation of Cambodia's young population as a result of better access to information brought about by the explosion of social media, mobile phones and the Internet. The dilemma surrounding the spread of the digital technologies for Cambodia centers around how well equipped its population is to embrace the changes, reap their benefits and tackle the risks associated with the digital employment landscape.

The question surrounding the readiness and preparedness of Cambodia to deal with an expanding digital economy is not new. Several studies have tried to shed some light on this issue and have led to a common understanding that the Cambodian population in general has a low rate of digital literacy and that its economy is being hampered by shortages in digital skills. Despite being ranked as the most competitive Internet and telephone market (and relatively high in cellular and Internet affordability, mobile network coverage and mobile phone subscription) Cambodia is consistently ranked very low in the "Skills" areas of the quality education system, particularly related to math and science, individual's use of Internet and the percentage of households with personal computer and Internet access (Baller et al., 2016). This ranking is consistent with the Global Digital Readiness Index which places Cambodia among countries with the lowest digital readiness with an overall score of 9.27 out of 25, well below the world's average of 11.96 (Cisco, 2020). With little fixed-line infrastructure left after years of civil conflicts, Cambodia has embarked on digital transformation through huge investments in telecommunication infrastructure. This is illustrated in the 2018 report by the International Telecommunication Union (ITU) which highlight a sharp increase in cellular subscription (less than 10 percent of the population to 116 percent) and active mobile broadband usage (below 1% to 66.9%) in the period between 2005 and 2017 compared with an increase of just 0.8% for fixed-broadband subscription over

the same period (ITU, 2017). This mobile- driven development is consistent with the low rates of households with a computer (12.5%) and households with Internet access (21.0%), according to the ITU study.

The sharp increase in mobile broadband penetration reflects a surge in digital adoption by the Cambodian population. Despite this significant progress, there is anecdotal evidence that mobile Internet is mainly used for media consumption such as Facebook and YouTube and for communication such as voice messages and video calls. This means the Cambodian population is yet to take full advantage of the potential of the World Wide Web. From the author's analysis of the World Bank's Enterprise Surveys database (World Bank, 2017), the adoption of digital technologies among Cambodian firms remain low compared to other countries in the region with firms having their own website account for only 24.2 percent in 2016, which is much lower than the Philippine (52.4%), Vietnam (48.6%) and Thailand (45.5%). Furthermore, Cambodia trails its neighbors in terms of providing secure Internet servers to its population, at a ratio of only 81.1 servers per one million persons in 2018, which is much lower than the average of 393.8 for lower middle income countries or Vietnam (1769.5) and Thailand (953.9) (World Bank, 2019). The uptake of digital technologies in the financial sector is even more bleak. From the analysis of the Global Findex Database (World Bank, 2018), only 22 percent of Cambodians aged above 15 owned a bank account in 2017. This rate drops to 15 percent when restricted to working age populations. The rate of digital transactions is also very low with roughly 16 percent of Cambodians making or receiving digital payments in 2017. This rate is interestingly lower than the 19 percent point scored in 2014. The rate of digital transactions can be directly linked to education level since almost 40 percent of all transactions were conducted by those with at least secondary education level.

The adoption of digital technologies in the government also remains fragmented. Without the presence of a unified national portal, the government of Cambodia instead depends on more than 50 websites independently developed by different government agencies to handle its digital affairs. The UN's E-Government Development Index (EGDI) contained in the 2018 United Nations E-Government Survey ranks Cambodia in the 145th place or in the Middle EGDI Tier (UNDESA, 2019). The index is a weighted composite of three normalized indices; the Online Service Index (OSI), the Human Capital Index (HCI) and the Telecommunication Infrastructure Index (TII). Despite this low rank, Cambodia made some progress by graduating from Low to Middle-OSI level. This survey, however, ranks Cambodia very low (171st place) for E-Participation Index, which is calculated based on the availability of online information, online public consultation, and the involvement of citizens in decision-making processes. This means the use of ICT by the Cambodian government in policy, decision-making, and service design and delivery to make citizen engagement participatory, inclusive and deliberative - is still very low.

When it comes to the readiness of its workforce to embark on digital revolution, Cambodia is facing a huge challenge in producing sufficient IT skills. Based on a 2016 study by

Markova and Wray (2016) Cambodia has a clear skills gap within its IT sector where the majority of businesses find it difficult to recruit competent IT staff. While there are plenty of applicants for low skill, entry level IT jobs, the study finds that for senior IT roles, the skills gap is huge and widespread, forcing employers to prioritize applicants with higher level of soft and language skills over those with technical abilities. Another interesting aspect revealed by the study is related to the very limited appreciation and simplistic view of the IT sector by the Cambodian students. Markova's study, however, only looks at the IT market and leaves out other sectors whose future competitiveness is heavily dependent on a workforce that is digitally literate but not at an IT professional level.

A more recent study that looks at the digital preparedness of Cambodia's workforce from a more diverse perspective was conducted by Pheakdey Heng in 2019. The top six skill gaps found in the study are: foreign language proficiency, technical skills, customer handling, oral communication, problem solving and teamwork. In terms of ICT skills, most employers identified managing online information and collaboration as their most important skill sets to look for in new recruits during the next 10 years, followed by analytic skills. Heng's study also finds that most employees surveyed are able to use basic digital technologies such as Internet search and download, emailing, Internet messaging and office productivity suites such as Microsoft Office. The current digital landscape of Cambodia discussed above is summarized in Table 1 below.

Table 1: Summary of Cambodia's digital landscape

Indicator/Challenge	Score	Comparison
Global Digital Readiness Index	8.6/25	11.93 (global average)
Company with website	24.2%	52.4% (PH), 48.6% (VN) 45.5% (TH)
Secure server per 1 million people	81.1	393.8 (mid income), 1769.5 (VN), 953.9 (TH)
Home with PC	12.5%	38.9% (Asia/Pacific) 47.1% (world)
Home with Internet	21.0%	49.0% (Asia/Pacific) 54.7% (world)
Bank account (aged 15+)	22%	
Bank account (working age)	15%	
Individuals conducting digital payment	16%	
E-Government Development Index	145th	
E-Participation Index	171th	
Lack of competent IT professionals		

4. ASSESSMENT METHOD

Although there probably is a general agreement that digital literacy in Cambodia is low among its general population (confirmed by the different studies presented in section 3 above), Cambodia still lacks a great deal of information on the nature and extent of digital literacy among its population, especially youths who will become its next economic bearers and propellers. The studies by renowned international organizations such as the World Bank and UN are generally large in scope and multifaceted. They rarely provide enough relationship between digital literacy and its confounding factors such as education, public investment and youth behavior. Because of their extended scope, these studies inherently have methodological limitations; the most common one being the composite index-based conundrum where the definition of importance or weight of each contributing variable is rarely subjective, unbiased and scientific. This means, in spite of their tremendous importance, assessing youth's digital literacy requires a more focused investigation whereby confounding variables that might have escaped the country-level studies can be captured. Another common problem with the previous studies is their heavy dependence on the "stated answers" provided by the survey respondents, which are mostly self-assessed in nature, as the basis for drawing conclusions. Although such methods are an important investigation tool, there are instances where self-assessment needs to be validated by actual capacity identifiable only by standard tests or exams. This is particularly relevant when it comes to literacy assessment. Old-fashioned, actual exams or tests must be administered in addition to other qualitative assessments to more accurately gauge one's literary competence.

4.1. Defining Digital Literacy

Traditionally, literacy refers to our ability or skills to read and write. This conventional definition expands to cover many more skills when the word "digital" is attached to it. Although reading and writing, particularly through the use of digital devices, remain at the core of the digital literacy domain, its fuzzy frontier has steadily moved outwards to encompass many new skills which are unfathomable based solely on our conventional understanding of literacy. Coupled with the ubiquitous influence of the Internet which further blurs the digital literacy boundary, our ability or the lack thereof to properly provide it with a universal or consistent definition has led to some experts avoiding defining it altogether and instead choosing to address more specifically the particular digital skills which are at the intersection of literacy and digital technology.

Regardless of these definition differences, it is unthinkable to conduct an assessment on digital literacy without providing a workable and proper semantic frame to its definition. In spite of the many acceptable yet differing definitions of digital literacy currently in use by various individuals or institutions, this study has chosen to adhere

to the UNESCO-proposed definition (quoted below in its entirety) which has been used for mapping ICT and digital literacy frameworks of more than 40 countries worldwide. Under the UNESCO framework (Law et al., 2018), digital literacy is defined as:

> *"...the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy."*

4.2. Approach

The definition provided above is further accompanied by seven areas of literacy competence which serve as the basis for the assessment of digital literacy level in this study. The summary of these competence areas is provided in Table 2.

Table 2: Competency areas defined in UNESCO-proposed digital literacy definition

Competence area	Competence description
1. Fundamentals of hardware and software	Basic knowledge of hardware and software operations such as turning on/o_ and charging, locking devices and doing privacy settings, etc.
2. Information and data literacy	Ability to browse, search, filter, and evaluate digital content
3. Communication and collaboration	Ability to interact, share, engage in citizenship, and collaborating through digital technologies and managing one's digital identity with sufficient netiquette
4. Digital content creation	Ability to develop, integrate and re-elaborate digital content with an understanding of copyright and licenses
5. Safety	Ability to protect devices, personal data, privacy, health, environment and well-being
6. Problem-solving	Ability to solve technical problem, identify needs and technological responses through the creative use of digital technologies and computational thinking
7. Career-related competences	Ability to operated specialized hardware/software for a particular field.

To assess one's digital literacy level, these competence areas must be further broken down into measurable indicators that can be either qualitatively or quantitatively captured by the employed assessment tools. The approach is grounded in an inherent assumption that literacy is the product of education, both formal and informal, and that assessing literacy level, particularly with youths, is incomplete without a thorough investigation of the education system. In principle this assessment approach consists of the following four components:

- **Assessment of enabling infrastructure:** Literacy, be it digital or otherwise, is always a result of learning and education whereby available infrastructures play a huge role. This assessment component responds partly to the second objective of this assignment where practical interventions to raise the digital literacy level are expected. Only by assessing whether existing infrastructures are acting as enablers or obstacles could we afford to provide intervention remedies. Three main indicator groups will be used for this assessment. First, hardware availability such as computer systems, network infrastructure and laboratories will be assessed. Second, the software side of the infrastructure is investigated. We will look at the availability of applications, how resource-intensive they are, and their overall popularity in the job market. Finally, we will look at public investments by the Cambodian government into improving digital literacy of its citizens.

- **Assessment of incubating platforms:** The availability of enabling infrastructure does not necessarily guarantee higher learning outcomes. We need to assess whether these infrastructures are further supported by an incubating environment. Four indicator groups will be used in this assessment. Curriculum quality, starting from the earliest stage of education at high school up to undergraduate level, is the first indicator group to be assessed. Teacher capacity will be next in the assessment stage. And because learning is highly influenced by cultural acceptance or appreciation, we must also look at how the Cambodian population perceives digital education. Finally, the incubating platform for learning must be accompanied by sufficient and quality learning resources such as books and audio-visual media.

- **Behavioral assessment:** Learning and student behavior are traditionally intertwined. How students appreciate their ICT learning program can affect their learning outcomes. How they see the role played by ICT in their career also impacts their knowledge reception and by extension, their literacy. Learning habits, both self-learning and instructor-led, will be investigated as well.

- **Literacy tests:** The previous three assessments evolve around identifying the conduciveness of learning. However, actual literacy level cannot be realistically captured without any tests. Two sets of tests will be used. The first one involves

surveying the youths using structured questionnaires where literacy level is self-declared. This approach isthen complemented by unguided voluntary digital tests performed independently by any person regardless of their age. Test results will be filtered to account for age variation. This fourth assessment directly responds to the first objective of the study.

4.3. Assessment Techniques and Tools

The four components discussed above will be operationalized by different assessment techniques and tools. Three different but complementing tools will be used to implement the four assessment components above to produce concrete and tangible outputs.

- **Desk review:** This assessment technique centers around building an overall understanding of existing enabling infrastructure and incubating platforms. It basically depends on reviewing existing materials such as published curricula of high schools, universities, and vocational training centers, relevant national development policies, strategies or plan. At high school level, the study depends exclusively on formal state curricula and government prescribed ICT textbooks as the main assessment indicators of incubating platforms. At university and vocational levels, things are much less unified. Each university or vocational training center is free to develop its own ICT curricula as long as they fulfill quality control requirements set forth by the government's ministries, which are not necessarily the Ministry of Education, Youth and Sport. Curriculum assessment, in this case, depends on published and readily accessible curriculum documents. The desk review also helps to identify important digital literacy areas that must be included in the subsequent data collection stages discussed below.

- **Focus group discussion:** Desk review depends exclusively on existing secondary data that in some instances can be outdated or irrelevant. To compensate for any potential shortcomings of the desk review, focus group discussions (FGD) were carried out with selected resource persons. Digital discussions were employed for this assessment technique. Using group chats on instant messaging platforms that support multimedia file sharing, the study conducted virtual FGD with high school teachers from different provinces. On-site FGD were also conducted with youth and community members. Discussion sessions with youth factory workers were also conducted. Although the assessment through the FGD is qualitative in nature, it provides important contextual understanding of digital literacy among the marginalized communities which contributes to the development of the more quantitative assessment tool discussed below. At university level, FGD could not be implemented due to the difficulty in arranging schedule for busy university teachers. Instead, virtual interviews (virtual FGD) were conducted.

- **Digital questionnaires:** Primary data for the four assessment components, especially the literacy tests, discussed in the approach above will be collected exclusively with digital questionnaires which are designed to be self-administered and unguided. They will also be cross-platform and device-independent. This means they can be used on a computer or a smartphone regardless of their operating systems. The use of digital questionnaires increases data reliability and quality and reduces cost and time. The collected data is digital and ready for analysis without the need for data encoding. These questionnaires and other survey tools are designed based on a modular approach. This means they are independent from, yet complementary, to each other. This approach ensures that any unforeseeable issues with one tool will not propagate to the others. It also allows for parallel data collection by different teams. The questionnaires primarily contain three sections and are highly structured. The first section covers general information of the respondent. The second section provides an opportunity for the survey participants to self-assess their ICT knowledge and skills through voluntary disclosure. These two sections are completely qualitative in nature. The third one, on the contrary, is exclusively quantitative and is designed as an actual knowledge test. Test scores that will be used partially for the assessment on literacy level are the products of this section and form the basis of the eventual statistical analyses. Between 43 to 45 test questions (depending on types of surveyed participants) which respond to the competence areas of the UNESCO-proposed digital literacy definition (Table 2) are contained within this section.

Apart from the three main approaches above, considerations on cross-cutting issues such as gender, geographic and economic variability of the surveyed respondents are embedded in every survey tool and questionnaire. This is done to ensure that this variability is methodically accounted for.

4.4. Sampling Method

The scope of the study called for a sample size that corresponds to a confidence level of 95% and a margin of error of 5% from a youth population of around 3.2 million (UNFPA, 2016). With a response distribution of 50 %, this translates to a sample size of 385. Due to the unguided and self-administered nature of the survey, the study ended up collecting as much as four times the computed sample size to account for potential negligence and responding errors or mistakes. The increased sample size also provides a much better confidence on the assessment results and allows for more significant segregated tests.

The data collection method employed in this study aims to reduce bias as much as possible and heighten the reliability of the collected data. To achieve this, the sampling approach strives to maintain geographic, social and economic balance of the surveyed

subjects. Geographically, the sampling of high school students was very diverse, ranging from the central plain to as far as Stueng Treng or Preah Vihear province. A cluster sampling approach was used to collect data on high school students. Among the population of high schools in Cambodia, ten schools from nine provinces have been chosen. To minimize bias, the study made sure that students from rural, semi-rural and urban high schools were sampled. Two high schools were chosen as bounding samples. One is from a very rural setting while another has been considered as the urban elite. The locations of these high schools are geographically distributed with all pairs of schools having an inter-school travel distance of more than 50 kilometers. Gender balance has also been strictly maintained. Ideally, the study wanted to focus its assessment on high school students attending Grade 11 or 12. However, a limited number of students from other grades might be accepted as well.

Sampling of university students is random. All sampled universities, except one, are located in Phnom Penh. Chea Sim Kamchay Mea University, which is located in Prey Veng province, was the only one located outside of the capital. Students from both private and public universities were sampled. Although this sampling choice is limited in geographic scope, it is believed to be still representative given that the majority of the universities are located in Phnom Penh. The survey of working youths is also random with respondents coming from various different skill backgrounds.

4.5. Methodological Limitations

The studies presented in section 3 and elsewhere have produced significant amount of useful data. This study does not intend to recollect this existing data. This was done to optimize the actual outputs of the study against its limited time window.

In relation to the seven competence areas dictated by the chosen literacy definition (Table 2, p. 6), this study was able to quantitatively assess only four of them. These include fundamentals of hardware and software, information and data literacy, digital content creation and safety. The communication and collaboration competence area was assessed qualitatively using the self-evaluation approach and focused group discussions. The sixth and seventh competence areas were not assessed. It is impossible for the study to conduct career-related competence assessment owing to the fact that different career-dependent skills require the ability to operate completely different specialized hardware and software tools. For example, a civil engineer must be able to use specialized structural analysis software; or an accountant must master the ability to use accounting software programs; or a healthcare professional is required to use complicated medical ICT systems to be considered digitally competent. Only ICT experts in each field will be able to conduct such assessments. The researcher of this study, despite his expertise in ICT field, does not possess enough suitable qualification to assess all career fields. The problem-solving competence was neither assessed owing to the fact that the tools used to collect the data are self-administered and unguided. It

is impractical to test for problem-solving skills without having the test takers physically present before the test administer. This study did not have the resources and time to conduct such assessments. However, several qualitative questions were embedded in the questionnaires to try to capture some forms of problem-solving skills of the survey's participants. This is, nonetheless, considered too limited to produce proper assessment conclusions.

It should also be noted that test questions administered through the third section of the questionnaires (discussed earlier on page 7) are not standardized. Cambodia has no standard test for digital literacy measurement. These questions were compiled from various standard tests used by different western institutions, notably the Microsoft Digital Literacy framework (Microsoft, 2019) and the Northstar Digital Literacy tests (Northstar, 2019). They are modified to fit with Cambodia's ICT context. In spite of careful research on their usability and two rounds of actual mock tests, these questions should be in no means considered standardized. Their total number is also low for testing the expansive digital literacy domain. There are roughly 10 to 15 questions in each of the four competence areas assessed in this study. For these reasons, the test scores generated by the questionnaires should be treated as probable indicators of literacy competence in some limited forms.

This study also attempts to investigate the relationships between digital literacy and three of its supposed direct contributors. Learning habit (in this case concentrating exclusively on self-learning), private ICT tutoring, and on-the-job ICT training are the three, non-curriculum parameters believed to yield significant influence on digital literacy of youths. To accurately measure the effects of these parameters will require the use of paired samples with pre- and post-intervention observations which are clearly outside the scope of this study. Without the luxury of paired samples, this work instead used hypothesis testing on independent samples to try to establish any relationship. In this case, the findings related to the impacts of self-learning, private tutoring and on-the-job training should be treated simply as probable indication of existence that will deserve a more careful future scrutiny.

Another important restriction that must be constantly adhered to is that the literacy test questions used in this study do not allow for inter-group comparison. That means results for high school students cannot be compared numerically with those of university students or working youths and vice versa. This restriction is necessary to ensure statistical sensitivity and separation. High school students are prescribed with questions that are thought to reflect their level of knowledge. These questions are less difficult than those administered to university students. Allowing for intergroup comparison will render the results of the youth groups practically insensitive which ultimately defeats the whole idea of knowledge measurement. In this manner, test results must always be interpreted based on the within-group frame of reference.

5. SURVEY RESULTS

Field surveys took place during the whole month of December of 2019. In total close to 1,000 students from 10 high schools took part in the survey. Sampling of university and vocational students returned more than 300 responses. A much smaller sample (almost 100 responses) was conducted on youth employed in various service and industry sectors. These samples, however, do not include youths and community members who took part in the FGDs.

5.1. Characteristic of Processed Data

After careful pre-processing to remove problematic data, the combined size of the sample dropped to 1,285 observations among which 699 are female, 584 male and two individuals with undisclosed sex. Table 3 breaks down the final number of high school students who took part in the survey. Except for Sisowath High School in Phnom Penh and Hun Sen Angkor Thom in Siem Reap, the majority of the students surveyed were at grade 11 and 12. At Sisowath, students from grade 10 and 11 were surveyed instead because Grade 12 students do not take ICT subject. We were able to only collect data from Grade 12 students at Siem Reap's Hun Sen Angkor Thom high school. Due to its rural and remote setting, only 3 students from grade 10 and 1 from grade 11 took part in the survey. The remaining 33 students were at grade 12. In Stueng Treng, the study was able to get 31 responses from Grade 10 students.

Table 3: Sample size of high school students based on grade, gender and location

Location	School type	Grade			Gender			Total
		10	11	12	👩	👨	na	
Battambang (BBang)	Urban	-	32	31	33	30	-	63
Kampong Cham (KCham)	Urban	-	29	22	23	28	-	51
Phnom Penh (PPenh)	Urban	168	134	3*	155	149	1	305
Preah Vihear (PVihear)	Rural	1*	66	22	64	25	-	89
Prey Veng (PVeng)	Semi-rural	-	20	24	23	21	-	44
Siem Reap (SReap)	Rural	3*	1*	33	21	16	-	37
Stueng Treng (STreng)	Semi-urban	31	44	86	100	61	-	161
Svay Rieng (SRieng)	Semi-rural	-	36	26	32	30	-	62
Takeo	Urban	-	27	30	38	18	1	57
Studywide		213	400	289	489	378	2	869

* *Excluded from future analyses due to small number*

Among the nine provinces where samples were taken, two high schools (one in Preah Vihear and another in Siem Reap) were classified as rural. Two other schools, one each from Prey Veng and Svay Rieng provinces, were rated as semi-rural. Two schools in Stueng Treng province were considered as semi-urban. The remaining four schools, each from Battambang, Kampong Cham, Phnom Penh and Takeo, were designated as urban schools. In total, 869 high school students, of which 489 were female and 378 male, considered as the elements of the first sample. Sisowath high school contributed 305 students to the whole study, making it the largest portion of the sample.

The number of university and vocational students collected for this study, which totals to only 284 individuals, is much smaller than that of high school students. These students, however, came from 32 different universities or institutes. Their fields of study are wide-ranging as well (Table 5). The students were also spread out relatively uniformly across different years of study (Table 4). Gender ratio is also quite balanced with 132 women to 152 men.

Table 4: Sample of university students based on gender and academic level

Level			Total
Year 1	27	37	64
Year 2	41	37	78
Year 3	35	31	66
Year 4	17	39	56
Year 5	12	8	20
Total	132	152	284

Table 5: Sample of university students based on gender and study major

Study major			Total
Agriculture (Agr)	8	12	20
Engineering (Eng)	22	59	81
ICT	1	15	16
Management & Business (Mgmt.Biz)	39	21	60
Medical Science (MedSci)	3	7	10
Natural Science (NatSci)	23	7	30
Social Science (SoSci)	36	31	67
Total	132	152	284

The smallest sample of the three youth groups is composed of those who are currently employed in various sectors. While we found it relatively easy to collect data about high school and university students because they can be conveniently located at their schools, collecting data on working youth was very challenging. The return rate of the survey was very low due to their limited time availability and our inability to conduct the survey in their offices. However, after a month of data collection, we were able to assess 80 working youths of which 46 are women and 34 are men (Table 6). Fortunately, the sample consisted of youths working in diverse industries. Youths who graduated from technical and vocational education and training (TVET) schools accounted for 11 individuals.

Table 6: Sample size of working youths based on skill and gender

Gender	Agr.	Eng.	ICT	Med Sci.	NatSci.	SoSci.	Mgmt. Biz	TVET	Total
👩	3	2	2	2	1	12	21	3	46
👨	1	7	1	0	3	7	7	8	34
Total	4	9	3	2	4	18	28	11	80

5.2. FGD Results

The surveyed samples conducted through web-based questionnaires were further aided by a few focused group discussions. Although the results from these discussions are not used for any statistical analyses, they are used to build situational and contextual understandings and serve as limited validations on some analysis results. In total we conducted three face-to-face and two virtual FGD sessions.

Face-to-face FGD: this type of FGD was conducted with community members and factory workers. Two sessions with members of the community were carried out, one in Samlaut district of Pailin province (December 25, 2019) and another in Svay Antor district of Prey Veng province (December 28, 2019). In total 23 people (18 females) joined the discussions. In Samlaut district, where eight people (five females) took part in the FGD, no one has home internet or PC. All but two, however, own at least a smartphone. In terms of digital literacy, they were all incapable of using a computer but expressed that they can use a smartphone for social networking, instant messaging and media consumption. In Svay Anthor, where 15 individuals (13 females) joined the discussion, the findings are consistent with what happened in Pailin. No one has home internet or PC, however, the ownership rate of smartphones is lower (only nine in 15 people) than that of Pailin. Again, the use of smartphones is consumption-oriented (social network, instant messages and media entertainment). Except for one female university student, no one can use a computer.

Due to the difficulties in arranging FGD with factory workers during their work hours, we conducted discussion sessions at their rental dwelling during the evening's off-hours. We were able to conduct only one session at the Tuol Sangke community in the eastern part of Phnom Penh and west of the Tonle Sap River. Nine married workers, all females, took part in the discussion. As expected, no one uses a computer and none have access to home internet, which is unsurprising because they live in cheap rental rooms. Only five people own a smartphone. The other four revealed, however, that their husbands own at least one smartphone. Smartphone usage, again, centers on media consumption and social networking.

Virtual FGD: due to geographic constraints, the study could not afford to hold FGD sessions with high school teachers. Instead we used virtual FGD through Telegram instant messaging app to facilitate the discussion. A total of 12 teachers took part. At university level, the same method was used and eight lecturers joined the discussion.

6. ANALYSIS AND FINDINGS

The biggest advantage of using digital questionnaires is that collected data is readily available in digital formats that can be easily pre-processed and analyzed. Collected data was first cleaned to remove inaccurate observations. There were several duplicates as a result of accidental double submissions. To ensure that one individual only submitted one response, anonymized unique device ID was collected for every single submission. Observations that shared one ID were removed, except for one which was kept based on several criteria such as data completeness and the length of time it took for the respondent to complete the questionnaire. Based on the results from our pre-tests, observations that had short and unrealistic completion time below a certain threshold would be taken out. Only submissions that had at least 10 minutes of completion time would be retained. The data pre-processing ensures that the samples used in the final analyses were realistic and representative of the reality and of the highest quality possible. The following sections describe the results from the analyses of the cleaned data.

6.1. Digital Landscape

The first information we got from the analyses of the collected data provides us some context on how Cambodian youths are using digital technology and how it is changing their daily routines. We found that Cambodian youths aged between 15 and 30 years old are highly connected and have a strong presence on the cyberspace. This is evidenced by a very high rate of smartphone ownership among them. On average more than 90 percent of the Cambodian youth own at least a smartphone (Table 7). This rate goes up to 98 percent for urban youth and stays above 75 percent for those living in rural areas. Computer ownership, however, is much smaller with high school students owning the least at 35 percent while working youths owning the most at 69 percent. Fueled by the rapid penetration of always-connected mobile devices, the youths also own email, instant messaging and social network accounts at an astonishingly high proportion. Close to 90 percent of high school students have at least one social network account. This number increases to over 90 percent as their age goes up (Table 8). Cambodian youth communicate extensively through instant messaging and live video calls. Email has become a communication backseat for younger youths (52 percent at high school level) but gradually increases its importance as these people become young professionals (76% for working youths).

Table 7: Types of devices owned by youths

Device	Hi.Sc	Univ	EMPL
Smartphone	91	91	95
PC	35	51	69
Smartphone & PC	31	44	64
No device	6	0	0

Table 8: Account types owned by youths

Account	Hi.Sc	Univ	EMPL
Social network	88	94	89
Instant messaging	77	87	91
Email	52	58	76

The low usage of email among youths, however, points to an inherent problem. Given that a smartphone always requires an email-based account for it to function optimally, it is surprising that the low rate of email ownership is out of sync with the very high rate of smartphone usage. The explanation to this inconsistency lies perhaps in how those accounts, be they social network or email, were created.

Table 9: Account creator within different youth groups

Creator	Hi.Sc	Univ	EMPL
Oneself	61	72	83
Other	39	28	18

Table 10: Top three reasons for having account created by other people

Reason	Hi.Sc	Univ	EMPL
Afraid of making mistake	64	56	64
The process is complicated	32	43	36
Insufficient English capability	19	18	7

Despite the prevalence of smartphones, the ability of the youth to take full control of the device as its legitimate digital owner was still inadequate. The study found that a large portion of the youth (39, 28 and 18 percent of high school and university students, and working youths respectively) had their accounts, especially email, created for them by someone else (Table 9). This special group might have lost access to the email accounts digitally attached to their mobile devices once they have been created for them. A comparison between Table 8 and Table 9 reveals a strong consistency between the low rate of email ownership and the high number of accounts created by somebody other

than the device's owner. Based on results from group discussions with factory workers, smartphones with unidentifiable account creators (mostly street phone sellers or device technicians) are rampant. One of the most common reasons for having accounts created by someone else is that the device's owner is afraid of making mistakes during the account's sign-up process (Table 10). A closer look at the data reveals that the rate of having an account created by another person is much lower among urban high school students, such as those from Sisowath or Kampong Cham high schools (at 18 and 25 percent respectively), compared to rural students (59 percent for Preah Vihear).

Table 11: Financial activities among youths

Financial activity	Univ	EMPL	Hi.Sc
Own a bank account	40	90	
Made/receive payment by phone	69	78	Not
Made/receive payment by PC	8	23	assessed
Payed for utility services	14	74	

Around 90 percent of working youth (university graduates only) have bank accounts under their own names (Table 11). This is unsurprising given the payroll process is most likely based on bank transaction. University students, on the other hand, own fewer bank accounts, at only around 40 percent. High school students were not assessed in this case because they are still mostly minors and Cambodia's regulation prevents underage individuals from openingpersonal bank accounts. Compared with the number reported in the Global Findex Database (p. 2 or Table 1), the finding show a much higher number of bank account among working youths (90% vs. 15%). However, one must note that a very large portion of Cambodian youths are still working in the garment and apparel industries. This youth group, according to our FGD results, does not depend on the banking system for their remuneration. Salary is almost always paid in cash, making it unnecessary for them to own a bank account.

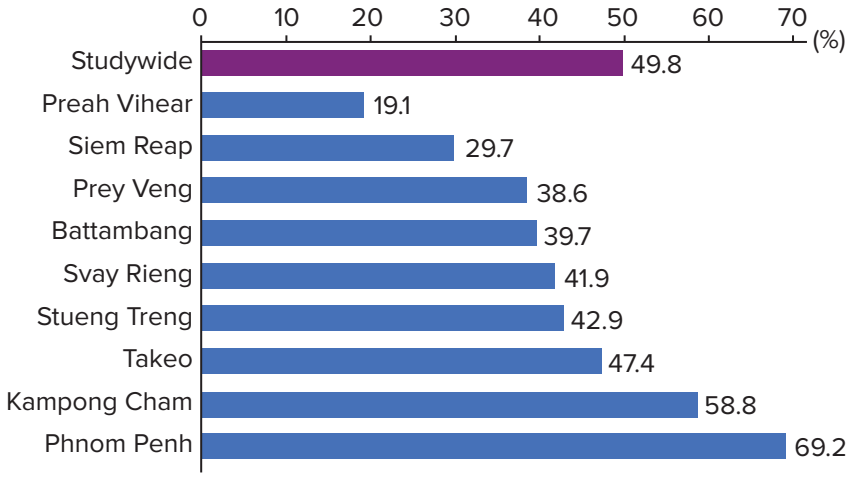
The rapid growth of mobile devices has shaped the financial sector as well. Electronic payment (E-payment), which is another component of digital financial technology, has seen a huge adoption among the working youths surveyed. Close to 80 of this youth group has used e-payment services through their mobile phones. The number of university students who have made or received payment through their mobile phone in the past year totals to 69 percent which is higher than the number of bank accounts owned (Table 11). This is made possible by the ability to conduct transactions without having a bank account, which is currently being offered by a plethora of money transfer agents. All of the factory workers interviewed for this study acknowledged that they sent money home to their family mostly through transaction services not requiring an account. E-payments using PC, however, are restricted to people who own a bank account, which explains their low usage among youth.

6.2. Enabling Infrastructures

As discussed in the methodology (section 4.2, p. 6), the first component of the literacy assessment in this study is the understanding of the enabling infrastructures that play a crucial role in shaping literacy. These infrastructure consist of both hardware and software components. They are sustained by both public and private investments.

Hardware: The first indicator that was used to assess the enabling infrastructure is the quality and availability of hardware. Table 7 (p. 15) indicates that the Cambodian youths are mobile-centric. The ownership of personal computers (PC) is much lower than the ownership of smartphones. This suggests that the existing enabling infrastructures are heavily consumption-oriented, which means youths are primarily digital consumers rather than producers or creators.

Figure 1: Availability of home Internet among high school students



Another important infrastructure is the availability of home Internet, either wired or wireless. This study found that on average almost 50 percent of the high school students surveyed have home Internet. This number, however, is quite skewed. Urban students such as those living in Phnom Penh or Kampong Cham have a higher rate of home Internet (Fig 1).

The rate for rural students falls to below 30 percent, which becomes skewed when cellular Internet connection is excluded. The number of rural students who have wired home Internet falls to below 5 percent, while the number of students from highly urbanized area remains between 40 to 55 percent. For university students and working youths, this study could not draw a definitive rate of home Internet. This is due in large part to the nature of the samples. The majority of university students surveyed have highly diverse accommodation types, with some living in dormitories while others living

in rental rooms. The number of students who own houses in Phnom Penh is too small to allow for a statistically plausible conclusion. This is similarly true for working youth. For these youth, Internet connectivity is almost always through mobile phones or mobile hotspots.

Software: From a software point of view, Cambodian youth do not see software availability as a problem to their ICT development. Only about 20 percent of high school students surveyed listed software availability as the challenge for their ICT study (Table 12). The number rises to 40 percent for university students before dropping back to 16 percent for working youths. These low numbers are probably due to three factors. First, the rampant availability of pirated software is believed to be the prime contributor. Second, working youth might have been provided with software access through their work. The third and smallest contributor might have been the adoption of open-source software by some public schools. For university students, access to software has become a much bigger problem due perhaps to the needs for more career specific and professional software programs which are harder to find in the pirated software market. Although this study cannot produce a concrete number on the level of software piracy in Cambodia, most university students interviewed revealed that various pirated software programs come preinstalled in their freshly bought computers.

Table 12: Challenges to learning ICT within youth groups

ICT learning challenges	Hi.Sc	Univ	EMPL
Insufficient English capability	72	64	61
Lack of Internet connectivity	51	43	45
Lack of hardware facility	47	50	48
Lack of study materials in Khmer	38	36	49
Lack of software availability	21	40	16
Unqualified teacher	15	14	–
Unsuitable ICT curriculum	10	37	–

Public investment: The third indicator used in this study is the level of public investments made by the Cambodian government in promoting digital literacy. When asked to pick the challenges they had in learning ICT at their schools or universities (or past universities in the case of working youths), the lack of hardware facilities such as computers and their necessary peripherals received an almost consensus result. Around 50 percent of youths identified access to hardware facilities as one of the challenges to their ICT development (Table 12). The Ministry of Education, Youth and Sport has made some public investments on ICT infrastructure, notably the provision of funds for public high schools to purchase desktop computers and their peripherals, through its New Generation School policy. This study, however, could not get any official data on the implementation, scale and achievements of the policy to date. Nonetheless,

we were able to indirectly assess, in some limited ways, the level of public investments by relying on the level of access to computer time provided to the surveyed students by their high schools. Study-wide, 73 percent of the students had access to computer time in their ICT subject. For rural high schools, this access level ranges from 52 to 54 percent. Urban elites such as Sisowath or Hun Sen Kampong Cham high schools were able to provide computer time to almost 90 of their students. The study, somehow, was not able to assess whether this time allowance is sufficient for the students.

The findings discussed in this section indicate that the existing enabling infrastructures necessary for ICT development among youths lean towards digital consumption. At the individual level, mobile devices, cellular Internet connectivity and software piracy have become huge infrastructures pivoting digital literacy among youths. At the collective level, on the other hand, the infrastructures needed to enable conducive ICT development remain both legally and financially uncertain.

6.3. Incubating Platforms

The availability of enabling infrastructures is only a portion of the whole literacy development continuum. These infrastructures must be accompanied by incubating platforms that further make use of them to create a conducive learning environment. Curricula, teacher's capacity, cultural acceptance and learning materials play a large part in turning available infrastructures into knowledge. This section discusses the study's findings concerning these four indicators.

High school ICT curriculum: ICT curriculum for high school has been formalized through two separate releases of Grade 11 and 12 classroom textbooks. They are simply titled "Information and Communication Technology for Grade 11" or "Grade 12". With content fully written in Khmer language, the Grade 11 textbook is composed of five chapters, for a total of 15 lessons. It focuses on building the student's ability in using computers through the understanding of their different hardware components and by performing software-based operations such as word processing, file management, spreadsheet or digital presentation. In relation to communication technology, two chapters on the working of the Internet and email are provided. Exercises and demonstrations of concepts are based on free and open-source software programs, notably the Ubuntu Linux operating system and the OpenOffice (currently known as LibreOffice) suite of applications used for office work. Analysis result on its content shows a high degree of technical coverage that encompasses the first five components of the UNESCO digital literacy framework (refer to section 4.2 and Table 2, p. 6). There are, however, several downsides in the book. Designed to be free from copyright and piracy issues, the use of open-source technologies in the book deserves praises. However, this approach goes head to head with the ICT market fully dominated by the Microsoft ecosystem. OpenOffice (or the eventual LibreOffice), Ubuntu Linux and other open-source software applications enjoy a very minimal use outside of the classroom. This means students

might find it challenging to have to tackle two software ecosystems at once. They most likely own a Microsoft Windows PC that runs Microsoft Office but must use an open-source system at school. Although this might sound beneficial to be able to use two systems, the reality is that it creates confusion for young and budding youth who lack technological experience. On the other hand, this textbook has become relatively dated as it was published in 2013 and has never been revised since. Given the rapid evolution of digital technology, the book is in need of urgent revision.

The Grade 12 textbook, which was published in 2016, is relatively more up-to-date. Consisting of five chapters that are further divided into ten lessons, the book is content-intensive. Using a completely different approach to the Grade 11 textbook, it abandons software-based exercises altogether and instead heavily embraces thought process exercises. The first part of the textbook gives an impression that its main focus is to prepare students for choosing future career paths. Given that Grade 12 students will soon graduate and move on to university education or jump right into the job market, providing students with a career roadmap in the textbook is highly sensible. Information literacy, netiquette, intellectual property, privacy, plagiarism and some other aspects of digital communication are provided in the first two chapters. The book starts to show incoherence from the beginning of Chapter 3. The flow of the content seems to lack logical consistency and drifts off the course set out by the first two chapters. For example, in a clear deviation from the previous chapters, web design suddenly appears and gives off an impression that a highly technical content normally found at university level in specialized IT courses will follow. Somehow, this impression turns out to be a false alarm as the content mainly provides an overview of what the students can expect in a web-based media industry. After a short break in content, however, web design reappears with content geared towards web development. The textbook wraps up with chapters on yet again various career paths and finally on how to choose universities. In short, the book mainly focuses on information intelligence and career paths, despite suffering from the lack of a clear and logical coherence.

University ICT curriculum: Things are different at university level where the ICT curriculum is not standardized. Each university has the freedom to develop their own curriculum as long as they fulfill the higher education requirements mandated by the government. With more than 50 higher education institutions in Cambodia, this study cannot assess all the separate curricula and make conclusions. However, based on the interviews with eight lecturers from four different universities (the Institute of Technology of Cambodia, Royal University of Phnom Penh, Royal University of Agriculture and Paññāsāstra University of Cambodia), this study found that the ICT curriculum at university level is normally provided as a two-credit introductory subject to computer science taught at foundation year (first year of university). The use of ICT in learning, however, extends beyond this introductory course. Students are normally expected to use computers for many academic activities such as writing assignment reports, producing digital presentations or conducting software-based laboratory exercises.

The lecturers interviewed stated that their students had no problem using computers for word processing or Internet-based academic activities such as web search, browsing, document download and online communication. The use of computers for specialized subjects, however, is fragmented.

To complement these limited interviews, the assessment on ICT curriculum was analyzed using student questionnaires. The study asked surveyed university students and working university graduates to rate their satisfaction on the experience they had with the ICT education provided to them by their respective university. The results are surprising. In terms of the availability of ICT subject at universities, 58 percent of the students surveyed said they were provided with the subject by their universities. However, among these students only 32 percent were satisfied with the subject (Table 13). Working youth, on the other hand, seemed to agree with the university students, since only 33 percent of them were satisfied with the ICT subject they were enrolled in during their university time. A closer look at the data revealed that the dissatisfaction comes primarily from those taking engineering (49 %), ICT (50%) or Management and Business (45%) study. The biggest reason for the dissatisfaction is related to the number of hours allocated for the ICT subject. Close to 81 percent of the student surveyed said their ICT subject did not have enough class hours (Table 14). The lack of hardware facility such as computers is another cause of dissatisfaction, racking up almost 50 percent of the students' censure. Unsuitable ICT curriculum comes out as the third contributor towards the students' low approval of the ICT subject, collecting 37 percent of the complaints. This sentiment is also shared by university graduates who are now working in their respective industries.

Table 13: Satisfaction on ICT experience offered by schools or universities

Satisfaction	Hi.Sc	Univ	EMPL
Satisfied	78	32	33
Dissatisfied	22	68	67

Table 14: Reason for ICT dissatisfaction among university students

Reason for dissatisfaction	Percent
Limited class hours	81
Insufficient facilities	50
Unsuitable curriculum	37
Unqualified teachers	14

In a similar fashion, high school students were also asked to express their approval on their ICT subject. At the high school level, the ICT subject has been provided although

still as an extra-curricular subject. In a huge contrast to the level of satisfaction by university students, 78 percent of the sampled high school students were satisfied with their ICT curriculum.

Digital entrepreneurship curricula: While ICT and entrepreneurship curricula are offered to university and vocational students, they are usually independent from one another. As digital technologies rapidly change how people conduct entrepreneurial activities, conventional entrepreneurship curricula being offered do not make use of how ICT affects or elevates the creation of products, services, or processes. Meanwhile, traditional ICT curricula fail to introduce how digital technologies can be integrated into economic activities to transform entrepreneurial efforts. The inexistence of a unified digital entrepreneurship curriculum means that students miss the opportunities to apply their ICT knowledge to enrich their technology-based learning of entrepreneurship.

Quality of teaching staff: Teachers play a huge role in building the literacy foundation. Having good infrastructures and highly thought curricula makes up a tremendous portion of the literacy development. However, these resources must be operationalized by qualified teaching staff before they can be truly beneficial. This study did not assess the quality of teaching staff directly. It depends instead on feedback provided by the students as a measure of assessment. From Table 12 and Table 14, we found that the rates of approval on teacher quality by either high school or university students are very similar, sitting at around 85 percent level. Students who saw their teachers as unqualified for delivering quality ICT-related subjects account for only 15 percent for high school or 14 percent for university students.

Cultural acceptance of digital technology: Based on the findings discussed in section 3 above, the Cambodian people have a high adoption rate of digital technologies. This study further validates this hypothesis by revealing that the high ownership rate of social network and instant messaging accounts points to an open culture that embraces new technologies. The low levels of wired Internet connectivity and computer ownership are most likely the result of economic rather than cultural obstacles.

Learning resources: The last indicator for the assessment of the incubating platform involves the availability of quality learning resources that support youth's knowledge development. At the public level, ICT learning materials have traditionally been released as textbook or technical documents with long revision or update cycle. This is starting to change with the role out of a multimedia-based electronic learning platform by the Ministry of Education, Youth and Sport. However, due to its infancy, this study does not have enough information to draw a definitive assessment on its outreach and effectiveness. At the private level, plenty of Khmer ICT textbooks, usually in the form of software manuals, are available on the market. These books have a much shorter revision or update cycle due to the fact that most are self-published without any proper editorial oversight. At the cyber level, ICT learning materials are readily available. The

problem is they mostly use foreign languages, particularly English. If we look back at Table 12 (p. 18), the biggest challenge for Cambodian youth in learning ICT is their lack of English proficiency, garnering more than 60 percent of votes from the surveyed youths. The number is even higher for high school students who are most likely less capable in English proficiency than their peers at the university level. This in part, implies the abundant availability of English-based materials suitable for ICT learning that are linguistically beyond the reach of the youth. The fourth challenge in learning ICT is directly related to the lack of study materials in Khmer (Table 12). High school and university students find the lack of Khmer study materials less challenging (at 38 and 36 percent respectively) than working youth (49 percent). This is unsurprising given that ICT materials for professional and specialized career-related learning become much more difficult to find than those intended for general ICT learning.

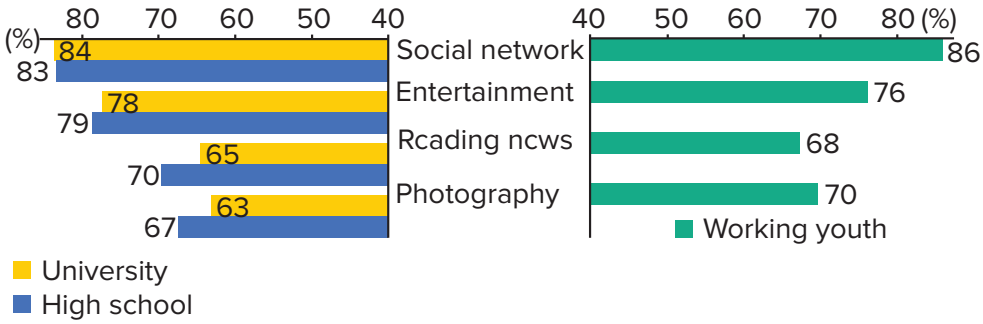
In general, the effectiveness of the incubating platforms for supporting digital literacy is somewhat mixed. Although we found no issues regarding teacher quality and cultural acceptance, curricula, particularly at university level, and learning materials remain the obstacles for literacy development.

6.4. Digital Behavior

The previous two assessments only consider external factors that affect literacy development. Youth, who are the recipients of these external interventions, react differently to the stimulus depending on their behavioral uptake. In this section we look at how youth react to the digital revolution around them as the indicators of how their digital literacy affects their work and living routines.

Use of digital devices: One of the most interesting questions related to the recent digital revolution is related to the connection between the ubiquity of mobile devices and their actual use in ordinary daily life. The high rate of smartphone ownership among youth (91 to 95 percent) as illustrated in Table 7 (p. 15) evokes our curiosity on how they are being used other than for making and receiving phone calls, which is the most basic function of a phone. When we asked the surveyed youths how they used their smartphones, some results came out as unsurprising. As discussed in section 3, there are anecdotal evidence that Internet-connected mobile devices are mainly used for media consumption and social networking. The results presented in Fig 2 confirm this sentiment. Among the top four uses of smartphones, social networking and media entertainment come out at the very top. Using smartphones for reading news and for photography are the third and fourth most used functions of the smartphones. This usage pattern is consistent within the three youth groups surveyed and has minimal geographic variation.

Figure 2: Purposes of smartphone usage among Cambodian youths



What is more interesting about the use of smartphone is the language preference among their owners. Figure 3 breaks down the degree of English usage on digital devices owned by the Cambodian youths. The figure seems to suggest that the use of English on devices increases as the education level of youths become higher. Furthermore, this usage pattern is consistent across the types of devices. The reasons for this language preference pattern are given in Table 15. As their education attainment rises, youth have become more accustomed to using English (from 47 percent at high school to 64 percent at university). Coupled with the lack of available software applications in Khmer, the limited number of Khmer terms to describe and explain digital functions, operations, and concepts further pushes the youth to adopt English as their digital language.

Figure 3: Languages used on smartphone and PC

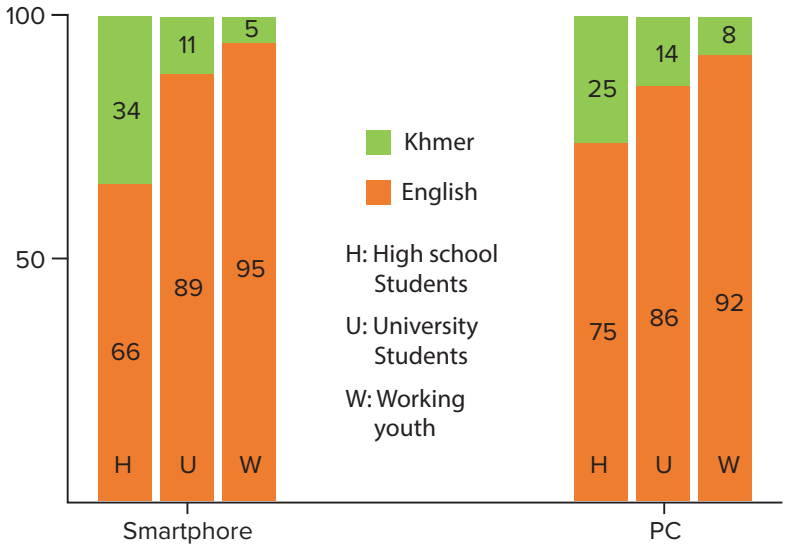


Table 15: Notable reasons for using English on devices

Reason	Hi.Sc	Univ	EMPL
Using English has become a habit	47	64	63
Most available applications are in English	54	53	49
Khmer ICT terms are limited	27	36	31

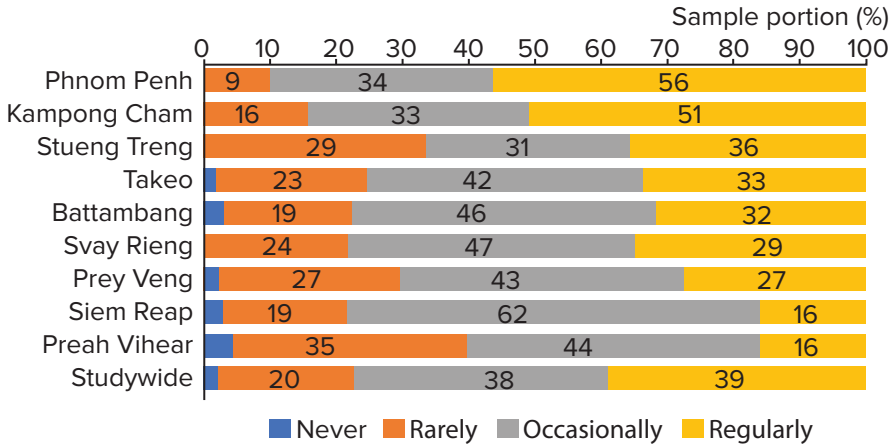
Self-learning: One of the most difficult aspects of embracing digital technology, especially for developing countries, is its breakneck evolution speed and changes. There are countless people who cannot keep up with the technology despite their ability to afford expensive and sophisticated devices. Undoubtedly, this phenomenon has a huge impact on digital literacy. Realizing the importance of the ability to keep up with technological changes, this study investigated youth's behavior towards self-development outside of their formal classroom. We looked at their self-learning habits and their appreciation of knowledge pursuance through other means of learning. We found that high school students have the lowest frequency of ICT self-study (Table 16) among the three youth groups. Regular self-learners account for around 39 percent compared with 58 for university students and 71 for working youths. These findings, however, are based completely on self-declaration and might be higher than what actually happened in reality.

Table 16: Frequency of ICT self-study among youths

Frequency	Hi.Sc	Univ	EMPL
Regularly	39	58	71
Occasionally	38	31	24
Rarely	20	11	5
Never	3	0	0

A deeper dig into the collected data reveals an interesting pattern related to self-learning among high school students. Youths from highly urbanized areas such as Phnom Penh and Kampong Cham have a much higher rate of regular self-learners among their ranks (Fig 4). This phenomenon is unsurprising largely because urban dwellers are afforded with much more opportunities in a wider learning spectrum. With better Internet connection, easier mobility and less restricted exposure to a larger pool of learning resources, these young individuals are better conditioned toward a self-learning mentality. Impoverished youths would find their self-learning opportunity quite restricted due to their inability to afford some important amenities necessary for building a conducive self-learning habit and their preoccupation with housework.

Figure 4: Frequency of ICT self-learning among high school students



The rate of self-learners among youth give us an important insight into the development of knowledge. However, the means or approaches used by the youths to pursue self-development are more important from an intervention point of view. This study uncovered that video tutorials, especially those found on YouTube, are the most sought-after resources used for self-study, consistently racking up more than 70 percent of the votes from the surveyed youths (Table 17). Self-learning through online reading comes as the very close second.

Table 17: Means by which Internet is used for self-study

Mean of learning	Studywide (%)			Regular learner (%)		
	Hi.Sc	Univ	EMPL	Hi.Sc	Univ	EMPL
Watching YouTube tutorial	75	71	84	80	76	88
Reading online	72	76	84	79	76	86
Web exploration	61	62	63	66	65	72
Sharing of documents	50	52	56	54	55	58

Private ICT tutoring: There is no denying that formal ICT education will not provide enough learning opportunity to some students. Highly ambitious youths with financial resources would have explored some other opportunities in their pursuance of knowledge. For some other individuals who are academically challenged, public school curriculum may be too difficult, thereby requiring complementary informal education. This is when private ICT tutoring comes into the fold.

Table 18: Percentage of youth taking private ICT tutoring

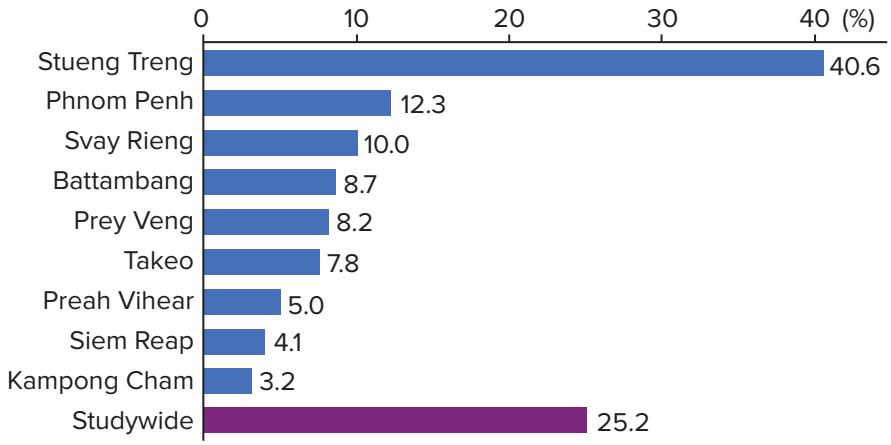
Youth group	Percent
Hi.Sc	25
Univ	61
Working	80

Table 19: Reasons for taking private ICT tutoring among youth groups

Reason	Hi.Sc	Univ	EMPL
Gain more advanced knowledge	76	76	81
Insufficient ICT class at school	25	51	41
Future ICT career	24	0	0

The study found that a huge proportion of working youths (80%) have undertaken private ICT tutoring (Table 18). University students also depend a great deal on this informal ICT education (61%). The rate drops significantly to 25 percent for high school students. When asked about the most important reason for enrolling in private ICT tutoring, the majority of youth gave a similar and consistent answer. They wanted to gain more advanced ICT knowledge (Table 19). The second reason, which varies greatly between the youth groups, is that ICT subject at school did not provide enough knowledge. High school students are less critical about this reason than the university students and working youth are.

Figure 5: Percentage of high school students taking private ICT tutoring



The 25 percent rate of ICT tutoring for high school students is very misleading due to an abnormal sampling case. Figure 5 illustrates this bias. This study-wide rate of 25

percent is largely skewed by the observations taken in Stueng Treng province. Due to difficulties in logistic arrangement, a portion of the high school students surveyed were interviewed and tested at two private evening tutoring sessions. If the students from Stueng Treng were excluded from the analysis, the eventual average rate would have fallen to below 10 percent. This is a very small number when compared with other types of private tutoring being offered for science subjects such as mathematics or physics.

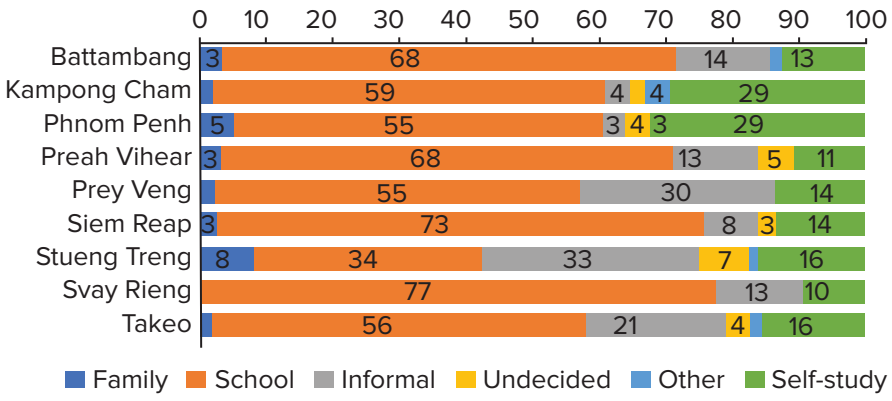
As a simple measure of cross-validation on learning habits, the study asked the youths to identify what they believe is the largest and most important source of their current ICT knowledge. The results turned out to be highly consistent with the stated self-learning habits of the university students and the working youths (Table 16, p. 24). The identification of self-learning as the most important source of the youth's ICT knowledge increases in correlation to their maturity and professionalism (Table 20).

Table 20: Main source of youth's ICT knowledge

Source of ICT knowledge	Hi.Sc	Univ	EMPL
Family	4	1	1
School	57	25	10
Informal study	14	25	30
Self-study	20	42	55
From work	–	–	3
Undecided	5	8	1

The results for high school students, however, are less consistent (Fig 6). Svay Rieng and Battambang, which boost a 29 and 32 percent rate of regular self-learner respectively, see a significant drop in the number of students whose ICT knowledge was proclaimed to be self-taught. The remaining provinces were found to be relatively consistent with the earlier findings.

Figure 6: Percentage of main source of ICT knowledge among high school students



6.5. Digital Literacy

The three assessment components discussed earlier were based on qualitative approaches drawn from self-stated or proclaimed assertions by the surveyed youths. Although they provide us with understanding on various factors that influence literacy, they do not give us a proper way to measure actual knowledge. This section, in contrast, discusses the findings on the four digital literacy competence areas dictated by the research method presented in section 4 (p. 5) in a more statistically sound way to realistically visualize the actual literacy situation.

6.5.1. Overall literacy

The youth who took part in this study were administered an exam-like knowledge test. Each individual received a personal set of test scores that reflected their true competence under the intrinsic assumption of the absence of cheating. Table 21 provides a summary of the test results. It should be noted that the test method used in this study does not allow for inter-group comparison. That means results for high school students cannot be compared numerically with those of university students or working youths and vice versa.

Table 21: Summary statistics of ICT scores for difference competence areas

Score type	Mean			St.Dev		
	Hi.Sch	Univ.	EMPL	Hi.Sch	Univ.	EMPL
Hardwar/Software	52.3	49.9	45.4	18.3	17.6	25.2
Information literacy	45.3	52.9	53.1	15.4	16.5	19.2
Content creation	50.0	48.0	62.8	22.8	16.9	30.8
Safety	36.8	38.1	43.2	21.0	19.7	19.5
Overall	47.3	47.9	50.6	15.3	13.0	17.1

The overall results indicate low digital literary scores (averaging between 47 to 51 points) in all of the four competence areas assessed and are consistent across the three youth groups. Safety area received the lowest scores (between 36 to 44 points) among the four tested areas, while all three groups performed poorly in this competence area. Figure 7 provides a more visual clarity to the literacy levels. To be considered digitally literate in a rapidly globalized and connected economy, this study expected the youth to emerge with an average overall score of 75 or higher with no competence area lower than 65.

Based on these results, our immediate attention went to the safety competence area, where youth's ability to safeguard themselves, their peers or colleagues against harmful digital adversaries such as scam, phishing or security breaches is questionable.

However, they performed better in the content creation and information literacy areas. To get a better understanding of the results, we looked at how high school students from different locations, and by extension economic statuses, performed in the test. The results, yet again, showed a very clear and consistent pattern, which is easily discernible by the box plot in Fig 8. For every high school, safety is the largest literacy issue. Urban high schools such as Sisowath and Kampong Cham performed consistently better than the rest in all four competence areas with students from Sisowath performing exceedingly well in content creation.

Figure 7: ICT literacy score by different youth groups

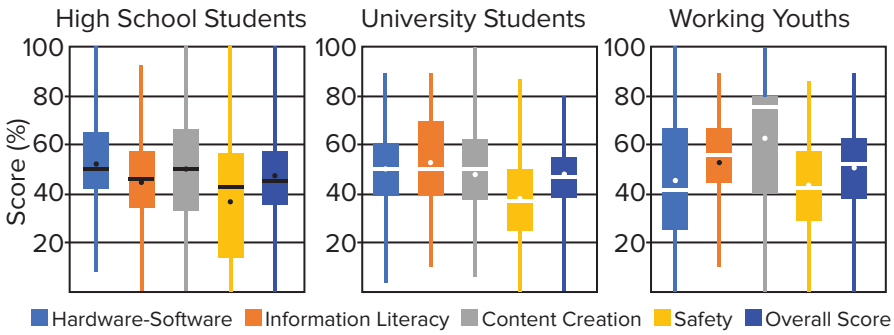
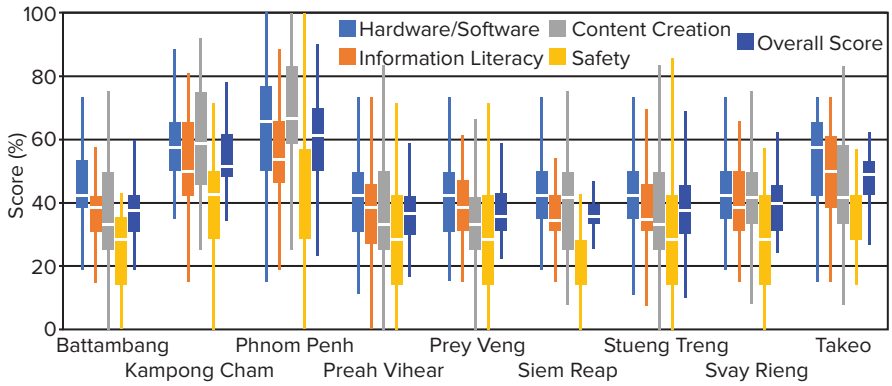


Figure 8: ICT literacy score of high school students based on location



The variation of scores for some areas also indicates wide ranging literacy levels. For example, content creation can have an interquartile range as large as 30 points. This means the literacy level of high school students can vary from a very low score to an exceptionally high one. The larger the variation in scores, the more contributing factors are involved in shaping the literacy.

6.5.2. Digital literacy and academic levels

The large variations in literacy scores of the four competence areas signal the need for a closer examination on potential relationships between the enabling infrastructure, the incubating platforms or youth's behaviors and the literacy performance. General assessments based on potentially dissimilar sets of observations can miss the important underlying interplay between different confounding parameters. To better understand such an interplay, we looked at the possibility that literacy is closely related to education levels. In this case, significance tests were performed to determine the difference in test scores among youths with the difference in education levels. From the test results summarized in Table 22, we are able to connect the relationship between grades and literacy level. Generally, grade 12 students have a better digital literacy level than their grade 11 peers. This literacy difference is also statistically significant (p- value <0.05) for rural or semi-rural high schools. Urban high school students did not demonstrate any significant difference in test scores between the Grade 11 and 12 students.

Table 22: Average ICT test score of high school students in relation to their Grade

Grade	BBang	KCham	PPenh	PVihear	PVeng	SReap	STreng	SRieng	Takeo
10			59.4	71.1*		34.4	33.4*		
11	33.2	53.4	60.6	36.5	31.9	38.9*	36.6	37.6	46.3
12	43.4	54.0	48.5*	37.9	41.3	37.1	41.7	42.7	47.3
p-value	0.000	0.852	0.426	0.720	0.001	N/A	0.028	0.027	0.698

**Number of students is too small*

The relationship between literacy and attained education level is more pronounced in working youth. Those with higher education performed consistently better than those at the lower education tiers—averaged score of 40.7, 52.8 and 58.3 for high school, university and working youths respectively (Table 23, p. 30). It should be noted that this difference is indicative only as there were too few observations at the MSc and Associate Degree level to draw a statistically meaningful conclusion.

The difference of scores based on year level for university students can be observed as well. On average, those coming closer to graduation perform better than freshmen. However, the differences are not statistically significant. Comparing score performance between study years can be misleading when study majors are not taken into account. When we looked at the differences between students who take the same study major but are at different year levels, we found that for Engineering, Management and Business and Social Science (the three study majors with enough sample sizes for hypothesis testing), on average, older students performed better than their younger peers. However, all t-test results returned insignificant differences with p-values consistently higher than 0.05.

Table 23: Average ICT score among working youth based on their education level

Education Level	Information literacy	Content creation	Safety	Overall
MSc	61.6	55.4	81.3	58.3
BSc	49.8	42.9	61.9	52.8
Assoc.	36.4	19.0	33.3	40.7
Studywide	50.5	43.2	62.8	52.9

In short, different grades do determine different ICT literacy levels for high school students. However, such differences cannot be statistically warranted for university students.

6.5.3. Digital literacy and gender

There is a long-held myth in Cambodia that women are not as good as men when it comes to digital technology proficiency. In this section we explore whether such a hypothesis is true. Table 24 provides a summary of the difference between gender and digital literacy levels.

Table 24: Average ICT test scores of youth based on gender

Score type	Hi.Sc		Univ		EMPL	
	👩	👨	👩	👨	👩	👨
Hardwar/Software	49.5	56.0	44.3	54.8	42.6	48.5
Information literacy	44.7	46.0	50.5	54.9	51.9	54.2
Content creation	49.1	51.2	46.3	49.6	63.1	61.8
Safety	35.4	38.6	34.4	41.4	43.5	41.6
Overall	45.8	49.2	44.6	50.8	49.7	51.1

A brief look seems to confirm the hypothesis that there are indeed differences in digital literacy between the two genders. However, when the data is segregated based on locations, the differences of literacy between female and male high school students disappear, except for Sisowath high school (Table 25) where the p-value is much lower than 0.05.

Table 25: Average ICT test scores of high school students based on gender and location

	BBang	KCham	PPenh	PVihear	PVeng	SReap	STreng	SRieng	Takeo
👩	38.3	55.2	58.0	36.2	37.4	37.3	38.0	41.4	47.3
👨	38.1	52.3	61.9	39.9	36.7	36.5	39.9	38.1	45.4
p-value	0.927	0.364	0.009	0.106	0.806	0.745	0.363	0.149	0.620

When further investigation on the difference between male and female scores was con- ducted based on grade separation, it was revealed that these gender differences only took place within Grade 11 of Sisowath (with a p-value of 0.0125). Students in grade 10 did not show any statistically significant differences. We do not have any idea why this happened.

For university students, gender differences become exceedingly confusing. Table 26 indicates that men, on average, scored higher than women in almost all study majors. However, hypothesis tests disproved this notion, except for those taking a Management and Business major (p-value = 0.002). For the ICT and medical science (MedSci) fields, the different scores between male and female students cannot be statistically tested due to the very limited number of observations available within the sample. We only received one female student doing ICT study (vs. 15 males) and three in the medical science field (vs. seven males) in our sample. These numbers are too small for any meaningful hypothesis testing.

Table 26: Average ICT test scores of university students in relation to their gender

	Major							
Gender	Agr.	Eng.	ICT	MedSci.	NatSci.	SoSci.	Mgmt.Biz	Studywide
👩	50.9	50.9	43.8	41.7	42.1	45.2	40.8	44.6
👨	43.8	53.0	56.0	42.4	52.4	47.5	50.7	50.6
p-value	0.317	0.522	N/A	N/A	0.134	0.458	0.002	

When competence areas are considered, things started to look different between female and male literacy levels. Female students in almost all study majors showed consistent and statistically significant lower literacy levels than their male counterparts' in the area of hardware and software. Safety is another area where female students in the Management and Business study major were found to lag behind their male peers.

The findings in this section, in short, cannot completely dispel the myth of gender gaps. There are still some competence areas that need further scrutiny before any statistically meaningful judgment can be made. Disproving this myth is very important for the development of inclusive and non-discriminatory digital literacy.

6.5.4. Digital literacy and device ownership

This study approached the assessment on digital literacy with a huge presumption that access to digital devices improves digital literacy of the individuals in question. This presumption forms the basis of the enabling infrastructure assessment and was found to hold firm. Based on Table 27 high school students who own either smartphones or PC performed generally better in the ICT tests (36 to 56 points) than those who own

nothing (30 to 49 points). And the best performers were those who could afford both PC and smartphones (37 to 63 points). This trend occurred everywhere regardless of the location (p-value below 0.05 or 0.1). Although the differences in some schools cannot be validated completely by the t-test (0.05 <p-value >0.1), the general trend is unmistakable. Access to devices indeed elevates one's digital literacy, with the differences more pronounced when the students own both smartphones and PCs.

Table 27: Average ICT test scores of high school students based on device ownership

Device	BBang	KCham	PPenh	PVihear	PVeng	SReap	STreng	SRieng	Takeo
None	34.4	48.9	30.0	37.3	32.2	40.0	37.2	36.4	35.6
PC	38.3	0.0	44.4	26.5	35.6	0.0	38.4	40.0	43.6
Phone	37.0	51.1	55.7	38.2	36.9	36.2	38.1	39.7	46.4
Phone & PC	45.6	58.0	62.4	37.8	46.1	48.9	46.2	43.0	49.8
p-value	0.083	0.034	0.000	*	*	*	0.093	0.258	0.204

**Not tested because the number of students with PC is too small*

This presumption manifested itself much clearer when tests were conducted on university students. As illustrated in Table 28, students who own both smartphones and PCs performed better in the ICT tests (48 to 65 points) than their peers who only owned smartphones (39 to 47 points), regardless of their study major. These results reaffirm the belief that enabling infrastructures play a huge role in advancing digital literacy.

Table 28: Average ICT scores of university students based on owned device and study major

Device	Agr.	Eng.	ICT	MedSci.	NatSci.	SoSci.	Mgmt.Biz	Total
Phone	42.6	45.1	46.7	40.6	39.4	40.8	39.7	41.8
Phone & PC	50.9	57.9	64.8	48.4	48.1	52.3	51.0	54.3

6.5.5. Digital literacy and private tutoring

Private tutoring has a long history in contributing to literacy in Cambodia. ICT private tutoring, although is not as widespread as other science subjects due to the high demand on hardware and software investments, is not uncommon. But how much it has contributed to digital literacy has never been studied. This study attempted to provide some insight on how private ICT tutoring affect literacy. However, one must carefully note that the number of youths who attended private tutoring in this study is limited.

Table 29: Average ICT test scores of high school students based on ICT tutoring

Tutoring	BBang	KCham	PPenh	PVihear	PVeng	SReap	STreng	SRieng	Takeo
Yes	39.2	57.9	62.4	35.1	36.7	33.7	37.9	38.6	43.4
No	37.8	53.0	59.6	37.6	37.3	38.0	39.8	40.4	48.3
p-value	0.590	0.450	0.313	0.402	0.865	0.221	0.366	0.426	0.100

Private tutoring among high school students does not seem to have any statistically significant impacts on the ICT test scores administered for this study (p-values are consistently higher than 0.05 in Table 29). In Battambang, Kampong Cham and Phnom Penh, the overall scores of those who took private ICT tutoring are higher (39.2, 57.9 and 62,4 average points respectively) than those who did not (37.8, 53.0 and 59.6 average points respectively). For the other six provinces, the reverse is true. Students who did not take private tutoring scored better (37 to 49 average points) than those who did (33 to 44 average points). A closer look at the differences in Battambang, Kampong Cham and Phnom Penh found that scores for hardware and software (50.4, 64.8 and 68.4 average points respectively) and content creation (41.2, 64.3 and 68.5 average points respectively) are the contributors towards higher overall scores for those who took private tutoring. This is in line with the finding from our limited virtual group discussions with the teachers. The focus of private ICT tutoring almost always concentrates on increasing the students' capability on using office productivity software programs. This area of knowledge is classified as content creation in this survey, which explains the better scores among the students of the three provinces. For the other six provinces, we could not draw a definitive explanation on why those who took extra private tutoring performed worse than those who did not. One possible explanation is that those who took part in the tutoring could not follow the formal ICT subject at school and thereby required some extra training to enable them to catch up with others in their classes. However, this explanation cannot be backed up by the data collected from the survey. It should be noted that the number of students who took private tutoring are less than the number of those who did not (at a ratio of one to four or 25 percent, Fig 5 on p. 26), thereby making it statistically difficult to draw a meaningful conclusion on whether private tutoring is advantageous.

The impacts of private tutoring on ICT test performance do not look encouraging at the university level either. Instead the numbers in Table 30 (column 2 and 3) suggest the contrary. Students who took private tutoring scored lower on average (47.7 points) than those who did not (48.1 points). The competence area that looked positive is the content creation area where students taking private tutoring outperformed their peers by a small margin (49.0 vs. 46.3 points). When analyses were done on students who shared the same study fields, a consistent pattern appeared. Students accessing private tutoring scored higher on the content creation area than those who did not take private tutoring, regardless of their study majors. This probably indicates that the private tutoring might have focused its attention on content creation training such as word processing or spreadsheets.

Table 30: Average ICT scores of youths based on private tutoring and work training

Score type	Tutoring				Training at work	
	Univ		EMPL			
	No	Yes	No*	Yes	No	Yes
Information literacy	52.4	48.3	50.0	53.8	53.7	52.4
Content creation	46.3	49.0	59.4	63.6	63.2	62.3
Safety	39.3	37.1	34.8	45.3	41.1	45.4
Overall	48.1	47.7	47.8	51.3	50.4	50.8

**Sample size is too small*

On the other hand, ICT training for working youth provided by their employers (column 6-7 of Table 30) does not seem to give the youth any edge (50.8 with tutoring vs. 50.4 without tutoring). Yet again, these results should be treated with serious care. On the statistical basis, the differences are not significant. In a similar trend to what happened with university students, when test scores were compared based on the skill of the working youths, the competence area that got better test scores are again, content creation. ICT training at workplace seems to indicate a lift of the test scores in the safety competence area.

6.5.6. Digital literacy and self-learning

The rapid changes that we witness in digital technology have prompted many discussions on how youth could keep up with the digital revolution. These changes have had serious impacts on the way we learn things. Traditional means of knowledge transfer such as those that occur in the classroom are no longer sufficient for our digital literacy development. One thing that is generally suggested for keeping up with the digital revolution is to embrace self-learning. In this light, we looked at the potential relationship between self-learning and the digital literacy level of Cambodian youths.

Table 31: Average ICT test scores of high school students for different sources of knowledge

Source	BBang	KCham	PPenh	PVihear	PVeng	SReap	STreng	SRieng	Takeo
School	38.3	53.2	58.2	37.8	35.7	35.6	35.8	39.7	47.5
Self-study	42.6	51.8	63.6	38.6	37.6	40.4	43.5	39.7	48.3

As indicated by Table 31, the relationship between self-learning and improved digital literacy among high school students seems to be true. Those who proclaimed to have gained their ICT knowledge primarily from self-learning were doing better (37 to 64 points vs. 35 to 59 points) within the administered tests. When literacy competence areas were considered, content creation appears to be the contributing factor for better performance.

Table 32: Average ICT test scores for different sources of knowledge

Competence area	Univ		EMPL	
	School	Self-study	School	Self-study
Hardware/Software	49.9	53.1	62.5	41.3
Information literacy	52.9	53.1	48.6	54.8
Content creation	49.7	49.4	61.3	69.5
Safety	37.3	42.7	35.7	44.5
Overall	48.4	50.1	50.7	51.9

The impacts of self-learning on test scores for university students indicate positive differences. Students who practiced self-study scored higher on most competence fronts (Univ part of Table 32). Although the differences are not statistically significant, they point to a recognizable trend. When these differences were checked against study majors, the impacts of self-learning become more visible and consistent.

The limited number of working youths surveyed does not allow for a statistically plausible analysis on the effect of self-learning on ICT literacy level, particularly when skill types are considered. Table 32 (the EMPL parts) provides a simplistic view of the overall performance of the working youths when self-learning is accounted for. The numbers appear to support the idea that people who take self-study seriously tend to have higher digital literacy. However, these numbers are the averages of youth with different professional skills. Comparing youth within the same skill group would have provided a better understanding., which is not the case here as the study did not have a large enough number of observations.

6.5.7. Digital literacy in other competence areas

To compensate for the lack of quantitative assessments on the other competence areas (refer to the discussion on the study's limitations on page 10), this study used self-declared assessment to capture some aspects of the missing literacy areas. The results from this qualitative assessment are presented in Table 33 and combined with our earlier findings, indicate that the youth's competence in the communication and collaboration area is generally quite satisfactory. The majority of youth knew how to share files, send messages, connect through social networks and communicate through email. They were also taking advantage of the cloud storage services. Based on the FGD with the university students, digital communication appeared to be less of a problem. High school students, however, may find it increasingly challenging to communicate through a more formal channel due to their lack of email usage. Informal communication through instant messages and social networks appeared to be adequate.

Table 33: Advanced ICT capabilities among Cambodian youths (value in %)

Task	Hi.Sc			Univ			EMPL		
	♀	♂	Both	♀	♂	Both	♀	♂	Both
Share files	74	79	76	83	88	86	88	89	88
Install mobile app	51	73	61	63	87	76	88	96	92
Install desktop program	59	66	62	63	67	65	76	81	78
Uninstall desktop program	28	44	35	28	56	43	55	81	66
Factory reset phone	22	51	35	22	51	38	31	69	47
Reinstall operating system	10	22	15	11	18	15	10	39	22
Use calendar app	76	80	78	28	36	32	41	62	49
Use cloud contact storage	11	18	14	15	12	13	17	19	18
Cloud storage	58	71	64	61	72	67	80	91	85
Use digital map	44	68	55	60	86	74	67	96	79
Share location	44	61	51	75	90	83	79	92	84

Some advanced aspects of the hardware and software competence area remained a challenge for the youths. Although most people can perform some higher-level hardware and software maintenance such as installing and uninstalling apps or resetting their devices, these capabilities are restricted to mobile devices only. Competence in PC maintenance is still relatively low, particularly among female youths (Table 33). The most disturbing aspect about the results in Table 33 is that female youths consistently have lower ICT skills than their male counterparts in each and every competence parameters listed. When combined with the findings in section 6.5.3 (p. 31), the whole gender issue in the ICT sector becomes problematic.

7. IMPLICATION ON EMPLOYABILITY AND ENTREPRENEURSHIP

This study has uncovered many interesting aspects of youth's involvements in digital literacy. Our findings, in general, indicate the complicated interlinks between literacy and enabling infrastructures, incubating platforms and youth behavior. There are, however, several questions related to how these complicated and sometimes delicate (such in the case of gender literacy imbalance) interrelationships affect youth's employability and entrepreneurship which represent two of the main pillars of digital economy. This section discusses some potential implications of these findings.

7.1. How employable is the youth?

In general, the findings indicate that the Cambodian youths have less problems in digital communication and collaboration at least from a technical and technological point of view which is very important for an economy that is becoming increasingly globalized and connected. But the linguistic barrier is restricting their potential. The heavy reliance on English is a testament to this chronic issue. As illustrated in Fig 3 on page 24, the Cambodian language has a very small footprint on the digital technology field (5 to 34 percent of devices use Khmer language). Most software programs, particularly the highly specialized applications, do not have Khmer locale support. This consequently places the youths who have low English proficiency in a disadvantaged employment position in any highly internationalized and tech-dependent job market.

The low test scores in all the competence areas, however, are the main concerns. While working youth, in general, showed a much-improved capacity in the content creation area, the range of variations is still large, which means picking out qualified future employees from the pool of available human resources can be tricky. Employers would most likely want to see the range of variation in competence in this domain decrease so that the recruiting process does not have to engage ICT knowledge testing.

Hardware and software competence areas are what makes youth's employability prospect more encouraging. From an employer's point of view, there is at least some small reassurance that any investments in hardware and software for their business is sensible because these infrastructures can be made useful by their young and growing workforce.

When it comes to the ability to search for, filter and evaluate digital content, which is very critical for a wide range of innovative businesses, the Cambodian youths will find it challenging, especially for those who lack English proficiency. Searchable and available content in Khmer is still very limited in all aspects. Jobs that depend heavily on reliable

information such as the broadcasting industry, journalism, or market research will want to recruit staff that are highly capable of judging and evaluating information. At the current level of literacy, the Cambodian youths can be expected to be capable of searching, identifying and retrieving information without much trouble. However, their ability to filter and evaluate information is still restricted.

For businesses that are security sensitive or that have valuable resources on the cyberspace, staff recruitment will be a huge challenge given the Cambodian youth's low safety literacy. The main concern for such businesses is not about dealing with a security breach that is destructive. Such level of safeguarding is normally left in the hand of highly skilled security experts that are most likely non-youths. The biggest concern is caused by minor but disruptive security issues such as viruses, spam, phishing, the intrusion into the digital infrastructure at the individual's level, privacy, netiquette and identity theft. These are issues with which the Cambodian youths might find it challenging to cope. And unfortunately, these are also the technological areas vital for entrepreneurship, especially for startups.

When it comes to the employability of very young individuals such as high school students, the prospect is less encouraging, particularly for rural youths. The very low ownership rate of PC and the heavy reliance on smartphones mean these youths cannot afford the opportunity to get familiarized with computer-based problem-solving skills. School computers are shared resources and will never provide enough computer time to each and every student to really learn and practice computer skills. The inability to own a PC also means that the youths miss important opportunities for self-learning, which was found to be an important contributor to improved digital literacy. While this youth group has high smartphone ownership, their uses are less for learning or skill building and more for media consumption and social networking. Although mobile devices have become very powerful, business productivity is still achievable mostly on PCs.

University students, with more advanced education, are better prepared for employment. Their ICT test scores prove, nonetheless, to be problematic, especially in terms of safeguarding themselves, and their colleagues and employers. The increased rate of PC ownership among this youth group signals a shift towards productivity applications. This upward trend continues into the working youth group. The test scores also reflect a better literacy in content creation, which is encouraging for employment in the digital productivity environment.

Generally, Cambodian youth's digital literacy levels measured by this study can be considered to float between low to average depending on their education levels. These literacy levels are considered unsuitable for work in information-heavy sectors, but practically manageable in a working environment that demands intermediate office productivity, at least for post-high school young adults. For the employment sectors that demand specialized hardware and software operations, the current literacy level of

the youth will require serious specialized training before they become efficient and productive. Although we did not investigate career-related digital competence, it is simply logical and rational to assume that people who scored relatively low in the administered tests which were designed to measure literacy at an intermediate level will not do well in advanced tests of specialized knowledge. In simple terms, you need to be proficient at the lower levels of literacy before you can become fluent at the higher levels.

7.2. How do youth find jobs?

Another important point other than working skills in securing employment is the youth's ability to locate jobs. When asked to identify the means by which the youth used or would have used to find jobs, dependence on social network groups (Table 34) came out as the most popular way of finding jobs among high school and university students (64 and 67 percent respectively) with job advertising websites being the first choice for working youths (75 percent). While job advertising sites were ranked as the second means of locating job announcements (Table 34) among high school (50 percent) and university student (61 percent), only a small portion of these youth groups was able to identify a legit job advertising website. Out of the 898 high school students surveyed only 14.2 percent (123 individuals) could name a job website they knew of. This number increases to 35.9 percent for university students. Working youth, however, knew a lot more about job websites (70 percent) than the other two groups. The general trend is that the older, and thereby more knowledgeable and experienced youth become, the more they turn to job websites for finding employment opportunities.

Table 34: Means of finding jobs (value in %)

Means used for job hunting	Hi.Sc	Univ	EMPL
Group on social networks	64	67	63
Job website	50	61	75
Group on instant message platforms	49	37	30
Newspapers	32	21	21
Other	8	3	4

From our observations, job advertising preferences in Cambodia are moving fast towards job websites (e.g bongthom.com, camhr.com, khmer24.com, pelprek.com). The traditional role of newspapers as the main source of employment advertisements has significantly given way to online advertisements. The low numbers of high school and university students who were able to identify a job website hint that they might be at higher risk of failing to locate potential jobs in the first place, let alone competing for one.

7.3. How digital is the current job market?

Employment is a supply and demand equation, and making it sustainable and productive requires harmony between the skills being supplied by the workforce and those demanded by the employers. The scope of this study covers only one side of the equation, the supply side, and leaves the demand portion aside. To properly assess whether the current digital literacy levels of youths make them employable will require a serious look at how digitally demanding the Cambodian job market is. In this sense, we cannot provide a reliable assessment based on any primary data, which this study did not collect. The assessment presented in this section is drawn extensively from the findings previously presented by other people's works.

Oftentimes, we hear about skill deficiency in the job market and the challenges faced by employers in recruiting the right staff. For example, from the National Employment Agency's 2018 skill shortages and skill gaps report (NEA, 2018b), accommodation, logistic, warehousing and transportation, and health are the three main establishments facing hard-to-fill vacancies, within which technical and associated professionals, managers and service and sales workers are the three occupations most difficult to recruit. The same report also revealed that low number of applicants with the required skills, competition from other employers, and lack of work experience are the top three causes of hard-to-fill vacancies.

But, rarely is the data on how high these establishments or occupations are digital dependent available. This makes it very difficult to gauge what levels of digital literacy are needed. However, when we look at the types of skills that make such vacancies hard to fill, digital literacy (at least if defined as basic computer literacy) ranges low at seventh place (NEA, 2018a). This implies that the digital dependency of the current job market is not too high. When the same report highlighted foreign language skills, technical skills, customer handling skills and oral communication skills as the top four skill shortages, one can comfort- ably infer that the Cambodian economy has barely entered the hi-tech, digital dependent stage worthy of digital panic.

Anyhow, the previous inference about the digital state of Cambodia's job market is clearly an understatement. Assuming the actuality of the findings in the two NEA reports, the biggest question about the digital well-being of the Cambodian job market, when it comes to youth employment, is not exactly how the deficiency of the digital literacy, as a standalone skill, is affecting the youth's employability. The question is rather how the lack of it, as a supporting skill, contributes to the shortages in other skills.

Although we do not have concrete data on the level of digital transformation of the job market, based on the share of employment by broad occupation group (NEA, 2018a), the top two high-skilled employments are found in the education and health sectors. Unless youth are exceptional, they most probably will not be recruited into these

sectors. Educators are rarely youthful in nature (except at the high school level, they are mostly aged above, or close to 30). These people have most likely earned at least a Master's degree. Their digital literacy, thereby, has reached the professional level. In the health sector, except for nurses and medical technicians, general practitioners or physicians are most likely older than 30 years old. In this case, youth will most likely find these high-skilled job sectors unattainable regardless of how high their digital literacy is. This issue simply rests on the definition of youth. Nurses and medical technicians are probably the type of workers that will be youth. In this situation, digital literacy matters. Youth whose highest level of education is high school will find it very difficult to be admitted. They must go through post-high school technical training to gain a proper qualification before they have any chance of landing the job.

Except for high-skilled occupations in the finance and insurance and ICT sectors, the youth's job prospect is in the skilled non-manual category. This is probably where digital technology is most prominently needed and where suitable skills are potentially lacking. For the ICT sector, high digital literacy is absolutely a prerequisite to landing the job. High school graduates will not qualify for this sector regardless of their digital literacy levels as they have not acquired proper qualification. University or TVET graduates are perhaps the only potential candidates.

The discussions above indicate that occupations most likely open to youth and affected by digital literacy are those that require non-manual skills. However, these types of occupations are potentially light in digital literacy requirements. People with intermediate knowledge of using office productivity tools and information literacy, combined with the ability to communicate through online channels, will most likely qualify for the jobs. Those who are less proficient such as high school students will require on-the-job training. Based on the analysis of required fields of expertise and level of experience contained in the two NEA reports, jobs above non-manual skills were mostly open to older adults who are no longer considered as youth. Jobs below non-manual skills usually do not require much digital literacy other than basic digital communication skills such as messaging.

7.4. Entrepreneurship and youth digital literacy

The digital revolution has brought immense power to the hand of entrepreneurs making many entrepreneurial things possible at less cost and higher efficiency. From a farmer accessing market information through her smartphone to a business owner arranging virtual video conferences, things are moved by digital information and communication technology. Entrepreneurship is where the growth of youth's digital literacy really makes a huge impact on the economy. As evidenced by the findings in this study, youth spent a lot of time accessing information (72 to 88 percent of the youth reads news online), self-entertaining (71 to 86 percent of youth watches YouTube) and doing business

through their mobile devices. Although we do not currently have enough data on how technology has changed the way young people do business, the explosion of online businesses, such as sales and advertisement, is undeniable. Simple advertisements can be easily done on social networks and can potentially have a far better outreach than the traditional non-cyber means.

From our observations on youth's activities on Facebook and Instagram, a small portion of youth really take digital-enabled entrepreneurial opportunities seriously and have carved out a new and exciting market for products and services. With mobile-enabled access to market information, better virtual business coordination and collaboration, fast and cheap online advertisement, cost-saving through the reduction of hiring showrooms for products and services, unlimited customer outreach and fast digital payments, a noticeable youth population is running online businesses such as product sales and delivery services. Because of this digital revolution, creative businesses such as self-sponsored multimedia productions are rising. Using the sharing capability of documents, photos and videos, and real-time media streaming, we are now living in a world deeply encroached by the never-ending digital marketing.

An important aspect of youth entrepreneurship being heavily digital-dependent is related to the expansion of the gig economy fueled by the rise of independent contractors, on-call workers and temporary service providers. The best example of this gig economy is the rapid growth of ride-hailing services such as PassApp Taxi or Grab, on-demand delivery services, and online sales by individual entrepreneurs. This entrepreneurial activities require the entrepreneurs to have a commanding knowledge of using online platforms such as digital navigation or booking apps, internet banking and the social networks. The ride-hailing and delivery services have transformed many youths, predominantly male, into micro-entrepreneurs. Female youths, however, are more principally involved in the online sale businesses. They typically use social networks to advertise their products, such as cosmetics, clothing, baby cares, jewelry, etc., on-call workers or firms to handle delivery services, and e-banking apps to facilitate payments.

> *"I design clothing items and post their pictures on my Facebook page. With more than 2,000 likes on my page, my products attract a lot of attentions quickly. It is very convenient for potential buyers to inquire about my products by using the comment function on my page. Serious buyers, however, normally make phone call inquiries. I use ABA and ToanChet banking services to receive payments from buyers and outsource the delivery to several on-call deliverymen."* – Sophany, 24-year old self-employed fashion designer and tailor based in Beng Tumpon, Phnom Penh.

Although the examples above provide some snapshots of youth entrepreneurial activities that were observed by the study, how the Cambodian youth, in general, are taking advantage of, or prepared for, these digitally-enabled entrepreneurial opportunities remains largely unknown. Despite anecdotal evidence, no concrete data on this matter exists.

Nonetheless, based on what this study found; these exciting entrepreneurial opportunities come at a cost. Internet scams and phishing are some of the emerging threats to young entrepreneurs. Cyber-bullying on social networks is becoming more common and the breaches of privacy such as the releases of compromising photos or videos and private communication records such as instant messages are threatening to create distrusting entrepreneurial environment.

Despite encouraging examples of youth entrepreneurship that is the fabric of the gig economy, there are also concerns on the increasingly blurry distinctions between unemployment, employment, and self-employment within the youth population. The biggest concern, however, centers on the precarious nature of work in the gig economy. Micro-entrepreneurs, such as ride-hailing drivers and deliverymen generally have low earning, and little chance of making career progress. The lure and the ease of becoming a digital or cyber entrepreneur is also distracting the youths from some important self-developments such as higher education.

From the test scores discussed in section 6.5.1 (p. 28), Cambodian youth entrepreneurs, and the overall youth population in general, are highly vulnerable. Their low scores in the safety competence (below 44 average points) and information literacy areas (below 54 average points) are highly concerning indicators that youth entrepreneurs are not in a good position to defend themselves and their colleagues against digital adversaries. Low information literacy coupled with the reliance on social media for news and entertainment has the high risk of facilitating the spread of fake news, unfounded rumors and sometimes the sharing of incriminating media. In short, we can see that the youth is taking advantage of the entrepreneurial opportunities provided by the digital technology, however, their preparedness for cybercrimes, is believed to be insufficient.

8. IMPLICATIONS ON DIGITAL LITERACY FRAMEWORK DEVELOPMENT

At the time of this writing, to the best of the author's knowledge, Cambodia has not developed a countrywide digital literacy framework. The second objective of this study is to provide input for the eventual development of the framework. The following discussions intend to fulfill this objective. Any suggestions, inputs or interpretations of facts that are related to the development of the framework are the culmination of all the findings presented so far and the experience of the author as an educator, an information technology practitioner and a former student.

8.1. Finding a common ground

We have seen in this report that youth in particular and the Cambodian population in general are afforded technologies and tools that have never been this prevalent before. This growth, however, does not necessarily mean we are able to harness them effectively. Instead, this technology explosion has the potential to enlarge the digital divide in Cambodia. This increased device ownership, particularly smartphones, also means that the divide is no longer just about access to technology but rather about our fluency in using it.

Unfortunately, the disagreements on what institutes digital literacy among academic community and policy makers are impeding the efforts in formulating sound intervention policies and programs. In this sense, any effort to prepare a digital literacy framework for Cambodia must begin with establishing a commonly accepted definition of what digital literacy is. Past efforts in defining digital literacy center around two concepts: the first one equates literacy to competence in using a wide range of digital tools, be they hardware or software based, with the second simply treating literacy as indicators of having the ability to filter and evaluate digital resources critically and efficiently. If we take a closer look at how we use digital devices and technology every day, we would realize that the two types of definitions are complementing each other. We are using a wide range of digital tools to filter and evaluate digital resources in way that is efficient and critical. This indicates that from a practical point of view, digital literacy encompasses our ability to use digital tools to critically evaluate digital resources that will result in us making and taking a better decision or course of action.

The practicality of the definition above is what leads this study to use the UNESCO-proposed definition of digital literacy discussed in section 4.1 and 4.2 as the guiding principle of the assessment. Despite its heavy focus on employment and entrepreneurship, the author believes it serves the purpose of creating a digital-economy oriented framework. This definition, however, should serve as a good starting

point for Cambodia to establish its own interpretation of digital literacy that fits a broader social, cultural, economic and environmental context.

8.2. Model-based framework

The difficulties in devising a common definition of digital literacy should not be understated. Literacy, as in any other forms of human endeavor, evolves and sticking to one definition as a one-fixes-all solution must be avoided. This, however, does not mean the previous argument on finding a common ground should be tossed away. Instead, formulating a common definition under a sound frame of reference is what the Cambodian government should strive for. In this regard, the best way to approach the development of the digital framework is to use models, each with its own mandate and implementation frame.

Due to limited data, this study cannot propose a universal model that will address the whole spectrum of digital literacy development in Cambodia. Although it strove to capture as many literacy-influencing parameters as possible (as evidenced by the many aspects of literacy such as enabling infrastructure, incubating platform and behaviors), the focus has always been about youth and employment and entrepreneurship. In spite of this limitation, the models suggested in this report should provide sufficient inputs for the Cambodian government to formulate (a) suitable national framework(s).

8.3. Inclusive literacy model

The main idea behind the inclusive model is that literacy should be universal or as wide-ranging as possible. This concept has its root in providing equal literacy opportunities to everyone regardless of their social, cultural and economic backgrounds. Under this model, the resulting framework aims to provide the Cambodian people with a workplace skill needed to firstly get employed, retain the job and then obtain promotion. The inclusive model is based heavily on the information literacy, which focuses on building the people's competence in finding, searching or browsing for digital content, then in filtering and evaluating it, all being done in a networked environment or on the Internet. This model also lends itself to media literacy, which essentially positions users as part-time creators.

The expected reach of this model is the universal digital literacy where everyone is familiar with and capable of using basic digital tools and technologies such as desktop office productivity software (for example the Microsoft Office suite of applications), cloud-based applications and, to a more limited extent, web content production tools such as Google Doc or Sheet. In this sense, the model aims to largely transform people to become well-informed and critical digital content consumers, with an extra capability in handling office productivity work such as word processing, creating and delivering presentation and spreadsheets. The ultimate digital competence of this model is the literacy at the individual level.

Figure 9: Inclusive digital literacy model

INCLUSIVE LITERCY MODEL

Goal
Basic digital literay for all

Audience
Everyone, but generally targeting high-school students.

Skills
Basic digital operating skills such as office software, web applications, and information literacy

Under the UNESCO-proposed global framework discussed in section 4.1, to reach the inclusive level of digital literacy, the people must at least master the first two competence areas presented in Table 2 (p. 6). The government approved ICT textbook for Grade 11 of high school falls within the realm of this model. And from our survey results (section 5.1 to 6.5.1) the youth's digital literacy indicate a conforming pattern to this model. The youth has become heavy digital consumers with some capability in office productivity, and web and cloud technology. A summary of the model is presented in Fig 9.

8.4. Communication-centric literacy model

The inclusive model has become more and more insufficient in a world increasingly connected. The social network craze and mobile Internet explosion further push the inclusive model increasingly closer to irrelevance. Being able to critically evaluate information has proved insufficient, especially in the employment and entrepreneurship perspective. Traditional office productivity such as word processing, spreadsheets and emailing will not serve the long-term success of any company aiming to thrive in an increasingly globalized economy. Effective communication and collaboration that defy geographic and demographic restrictions have become the backbone of the modern business ecosystem. This revolution demands for a more expanding digital literacy framework. This is where the communication-centric literacy model fits in.

With all the attributes of the inclusive model built in, the communication-centric model pushes the competence areas further to include the communication and collaboration area of Table 2 (p. 6). With a focus on giving people an ability to interact, share, and collaborate using digital technologies, the model layers this core competence with sufficient understanding of netiquette, or etiquette governing communication on the Internet and safeguarding.

The inclusive literacy and the accessibility to connected devices have provided the people with digital highways that they can use to drive themselves to any digital destinations. However, having the ability to drive on a highway is not enough. Drivers will need to

drive carefully, responsibly and respectfully under a set of laws or regulations because the highways are shared by other travelers as well. In this sense, the competence-centric model wants to ensure that digital communication and collaboration will be conducted safely, responsibly, respectfully and lawfully. Using this model as a reference, netiquette and safeguard are where Cambodia's existing curriculum is insufficient. In the official textbook for Grade 12, a very short section was devoted to teaching students on some aspects of netiquette and safety. However, the content lacks depth and is large in scope, but superficial. Figure 10 provides a summary of this model.

Figure 10: Communication-centric digital literacy model

COMMUNICATION-CENTRIC LITERCY MODEL

Goal
Safe digital communication

Audience
Everyone, but generally targeting communication-heavy professionals

Skills
Inclusive skills + ability to interact, share and collaborate digitally.
Understanding of netiquette and safeguarding.

8.5. Creation-oriented literacy model

The inclusive literacy model which basically enables people to consume information has its mandate at high school or junior university levels. This competence level sufficiently enables students to fulfill their academic responsibilities such as doing research for assignments or, for working people, to keep their office productivity going. However, this model is consumption-centric and from an economic point of view, is not sustainable. A different and more challenging literacy model that elevates the inclusive literacy competence toward the producer side of the consumer-producer continuum is clearly needed as a counterweight to balance and sustain the digital economy. Here it comes the creation-oriented literacy model.

The creation-oriented literacy assumes all competence areas of the inclusive model and then adds some more advanced capabilities to it. Skills acquired in the creation-oriented literacy domain are higher level and challenging. They enable people to create richer digital content such as video, audio or animation. This model also requires the competence in advanced computational hardware and programming. On the social and cultural front, the model's competence areas expand to cover copyright and intellectual property knowledge which are the building blocks for creating or remixing digital products or services. The creation-oriented literacy, in short, can be viewed as a package or bundle of digital attributes that surpasses the proficiency of a single skill.

Under this model, creative literacy logically requires the competence in problem solving and the mastery of specialized hardware and software for a particular field of occupation. For example, a digital artist must be able to use drawing apps or graphic edit programs, or an architect must master the use of computer aided drawing or design (CAD) programs to be able to create digital products. The creation-oriented literacy is what universities are expected to provide to their students. The levels of literacy in this sense, however, vary according to the disciplines and the level of specialty. A summary of this model is given in Fig 11.

Figure 11: Creation-oriented digital literacy model

CREATION-ORIENTED LITERCY MODEL

Goal
Advanced skills for digital creation

Audience
Skilled proffesionals in all fields, particularly problem solvers

Skills
Inclusive skills + digital problem-solving skills.
E.g. digital artistry, discipline-based digital skills, programming

8.6. Inter-disciplinary literacy model

The prevalence of digital technology in our everyday life has raised the question on whether we should explore the possibility of infusing digital literacy into all aspects of our learning. Contrary to what is being currently implemented at high school and some university levels where digital literacy is being delivered as a standalone subject, the inter-disciplinary model calls for the infusion of digital literacy directly into the curriculum of every appropriate subject according to its unique learning context and demand. For example, the high school geography curriculum can include digital map reading or virtual geographic exploration as parts of its teaching contend. Another example is that spreadsheet-based problem solving can be integrated directly into the statistics subject.

At the university level, infusion of digital literacy into individual subjects provides many opportunities to students to become digital creators. For example, a biology or medicine class can take advantage of virtual anatomy to study the functions of different organs. Such direct integration of technology into individual subject raises the prospect of students gaining career-related digital competence at an early stage of their education. Figure 12 depicts a summary of this model.

Figure 12: Inter-disciplinary digital literacy model

INTER-DISCIPLINARY LITECY MODEL
Goal Digital skills infused in all learning aspects **Audience** Everyone: towards digital nativeness **Skills** Digital skills infused to all learning subjects at all levels. Pyramid of skills, from basic to professional

8.7. Choosing the right model

The discussions about the different literacy models above eventually lead to the question of which model is best suited for the Cambodian context. This is, indeed, a very hard decision to make, especially when infrastructural needs, human resource requirements and socio-cultural acceptance are taken into account.

The inclusive model, whether we know it or call it this way, has been implemented in Cambodia for quite a while. It is the most fundamental model that aims to bring digital literacy to the masses. It has its limitations and some of them were illustrated by the results of this study. This model will not create sufficient literacy level to satisfy the demand of the digital economy and thereby requires a serious reconsideration on its mandate and implementation frame.

In spite of these limitations, graduating from this model will requires serious changes to many existing strategies, policies and plans, all of which carry various potential disruptions to the economy. But sticking with the model for too long might weaken the competitiveness of the Cambodian population in general and youth in particular. The decision whether to change or to continue course will be very delicate.

The creation-oriented model, with all its appeals, will require a huge investment in both hardware and software. Career-related hardware and software infrastructures are normally expensive, both in terms of acquisition and maintenance. Teaching resources such as teacher's capacity and learning materials will be stretched as well. However, the consumer-heavy literacy level we are currently witnessing among youths screams for immediate interventions to return the consumer-producer balance to a more sustainable development course.

Among these models, interdisciplinary literacy is probably the sexiest and most ambitious of all, with promises to bring digital wonders to all aspects of our learning experience. But it is the most resource-intensive model that requires unwavering

commitments from the government, the private sector and the public. Cambodia might not be ready to embrace this model in its entirety.

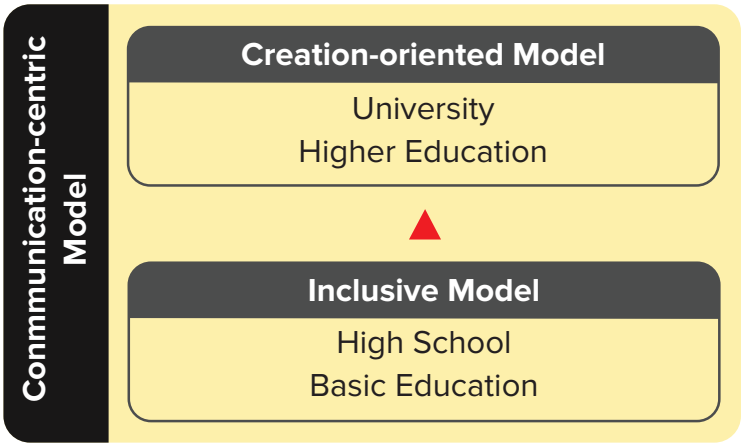
The communication-centric model, on the other hand, probably gives us the most urgent decision to make. The Cambodian youths, particularly those at university level and beyond, can be considered as having enough capacity to interact, share and collaborate through digital technology. However, they are at increasing risk due to their low safety literacy. In an analogous way, they are now provided with an incredible network of highways within which they are driving without the necessary understanding or appreciation of the traffic laws. Things will become messy in a similar fashion to the horrifying statistics of road accidents Cambodia is constantly experiencing right now if interventions are delayed.

Based on the advantages and shortcomings of the four models discussed above and the results of this study, the digital literacy framework we believe will serve the best interest of Cambodia is a cascading one, composing of the inclusive and creation-oriented models that are both encompassed by the communication-centric model (Fig 13). The foundation of this framework is the inclusive model where everyone is guaranteed equal and sufficient digital literacy competence meant for sustaining office productivity. With this framework, the digital literacy effort being implemented at the moment can continue because it is viewed as an inclusive model. This model, however, will be gradually replaced by the creation-oriented model when the youth has moved to the higher education level such as the university. The two models must be accompanied by the communication-centric model at all educational levels. This is done to ensure that digital communication skills have been gradually integrated into the whole digital curriculum.

9. RECOMMENDED POLICY OPTIONS

The findings presented in this report point to the needs for digital literacy improvement that will benefit the Cambodian youths. The first step of the intervention will be the development of a digital literacy framework. Then comes the development of a strategy to operationalize the framework. The following discussions intend to provide the Cambodian government some policy options and implementation recommendations. These discussions are sequenced as best as possible. However, it is important to note that many actions may occur in tandem.

Figure 13: Suggested cascading framework



9.1. Institutionalize digital literacy development

The rapid digital revolution we are witnessing is increasingly becoming disruptive for many aspects of Cambodia's social, cultural and economic developments. Digital literacy improvement, meanwhile, has yet to fully receive strategic considerations at the policy level. Institutionalizing digital literacy, thereby, is the first step towards turning it into a compulsory development mandate. Despite its overarching sphere of influence, as with any other literacy development, digital literacy shall always begin with the education sector. To grease the institutionalization process, the following policy options should be considered.

Policy 1 - Formulate a flexible national digital literacy framework: The discussions on the literacy models in section 8 provide some references for the Cambodian government to develop a model that suits its most urgent development agenda. We saw that there is no one-size-fits-all model that can be used to formulate the framework. Instead, the best approach for Cambodia now is to cascade or mix some models into

one framework. Based on our findings, we believe the best framework should consist of a cascade of at least three models. The inclusive model currently in use should be kept, but modernized and only used at the high school level. Universities should expend their curricula to prioritize creation-oriented literacy. These models should again, be encompassed by the communication-centric model to increase the safeguarding competence of the people.

Policy 2 - Mandate the development of institutional frameworks: The national framework is overarching by design, thereby, unsuitable for actual implementation at the various literacy development levels. Mandating educational institutions to streamline the national framework to meet their unique contextual demands and capacity is the first step towards operationalizing the national framework. Educational institutions must be mandated to devise their own digital literacy framework so that proper public and private investments can be aligned to achieve better digital literacy worthy of sustaining the economy.

9.2. Reconsider infrastructure investments

Having good frameworks facilitate the implementation of literacy development requires infrastructure investments to operationalize the frameworks. Sound and realistic investment plans ensure properly targeted fund dispersion and to guide the development of sound investment plans, the government may consider the following policy options as potential interventions.

Policy 3 - Conduct cost-benefit analysis of state sponsored computer labs: Computer labs have been the hallmark of countless digital literacy endeavors. They are highly visible to the general public and command huge press attention. However, their true costs and perceivable benefits have increasingly come under scrutiny. We tend to embrace their benefits without conducting serious cost-benefit analysis. From the author's experience with the operation of computer labs, costs of building, equipping, maintaining and safeguarding the facility can potentially outrun the benefits. The arrival of powerful mobile computing devices such as laptops further highlights the urgency on the needs to reassess the practicality of building computer labs. And with more efforts being directed towards bringing digital education closer to learners, computer labs have lost its luster even further. There are arguments that the funds used to build the labs and their supporting facilities and the expenses used to cover maintenance can be better used to subsidize the cost of laptops so that students instead can own the devices themselves. This notion, by no means, is suggesting that the government and its development partners abandon the idea of setting up computer labs at schools and universities. Instead this policy option aims to ensure that the deployment of computer labs is done in a beneficial and sustainable way where scarce resources are dispensed to those most in need.

Policy 4 - Promote societal contributions: As discussed earlier in the findings (section 6.5.4 p. 32) digital literacy increases when youths own a personal computer. Access to a computer affords students more computing time and facilitates self-learning. With the price of a decent laptop much cheaper than a high-end or comparable to a mid-range smartphone, investing in a personal computer that has a far more productive potential than a smartphone is a no-brainer. And with Cambodia now a lower middle-income country, a large portion of the Cambodian households should be able to afford a school-ready laptop for their children. When they can afford a smartphone that costs as much as a laptop, asking them to invest in their children's digital literacy that will open the door to better employment opportunities does not seem too far-fetched. But the main issue is how the government can convince them to take proactive actions that will contribute to universal digital literacy and free up the limited government funding so that it can be diverted to address other urgent needs of the marginalized youths such as providing more computing time through school computer labs to the rural poor. A campaign such as "bring your laptop to school" should promote societal contributions and creates a strong culture of shared responsibilities.

Policy 5 - Enhance public-private partnership: In our infrastructure assessment presented in section 6.2 (p. 17), we were concerned that piracy has played a huge role in carrying the software infrastructure. This issue is going exactly in the opposite direction of our intention to teach our students the appreciation of digital citizenship, copyright and intellectual property. Tolerating piracy will not do us any good both from a legal and moral point of view. And as a member of the WTO, Cambodia is bound to abide by the Agreement on Trade-Related Aspects of Intellectual Property Rights or TRIPS. This means Cambodia must at some point root out software piracy, at least, from its public institutions. However, software has always been a buttress of digital literacy. Eradicating piracy would mean making our computing devices unusable. To address this issue, the government can explore any opportunities to establish public-private partnerships with software companies to allow for the use of proprietary software for educational purposes at a much-reduced license or subscription fee. Public-private partnership is a win-win approach because by allowing the use of the software in public schools, the private sector stands to benefit from a more capable workforce that will demand significantly less investments in on-the-job training.

Policy 6 - Promote the use of open-source technology: The biggest technological revolution in the last two decades is driven perhaps by the realization that innovation and creativity cannot thrive in closed and disconnected environment or in silos of protectionism. Instead they need openness and transparency achievable only through open data, technologies, standards and policies. In addition to enhancing public-private partnership to secure access to commercial software, there are many instances when using alternative tools instead of the proprietary resources is imperative. This is when open-source technology comes in to fill the software infrastructure void. Cambodia

stands to benefit from open source technologies in several ways. The most obvious one is financial benefit generated by saving from software licensing and subscription fees. The second one is related to legal compliance. Embracing open-source technologies puts Cambodia on the right track to fulfilling some of its TRIPS commitments and enhances its national image and outlook. Open-source technologies will also leverage innovation in Cambodia's academics and research and development sectors which will play a huge role in the creation-oriented literacy framework.

9.3. Invest in open learning resources

The findings illustrated in Table 12 (p. 18) highlighted the urgency of tackling some of the most prevalent challenges that are blocking the youth's digital literacy development. Insufficient English capability, lack of study materials in Khmer and unsuitable curriculum deserve urgent attention from the government. To address these issues, the following policy options might offer some implementable solutions.

Policy 7 - Reimagine digital learning resources: The revelations presented in Table 17 (p. 25) provide a chilling reminder that we are now living in an omnipresent digital world that has transformed our learning experience in a way that the older generations would have found unimaginable. The youth are turning to multimedia-rich and highly interactive web resources for their learning and self-development and using the cyberspace to cultivate their literacy. The popularity of YouTube tutorials, online reading, and web-based virtual exploration suggests that the paper-based, printed book approach to learning has seriously come under threat of becoming irrelevant. Rather than seeing these learning behavioral changes as troubling, the government should take this opportunity to reimagine how it can transform its government-censored study materials to capture the new learning behaviors of the masses. Complimenting printed reading materials by multimedia-rich e-learning resources will greatly enhance the digital literacy and help to control pleasure-centric digital consumerism such as unrestrainable social networking habit or relentless cyber entertainment and turn the tide back towards self-development through digital self-learning. Furthermore, incorporating digital entrepreneurship curricula in university or vocational courses will substantially enhance the uptake of entrepreneurship by youth and promote youth startup.

Policy 8 - Standardize digital terminology: Through its many efforts to preserve national prestige and aspiration, Cambodia has embarked on many missions to Khmerize (make things Khmer) ICT or digital technology terms. These translation efforts were nothing short of pure determinations to bring digital technology to the hands of the ordinary Cambodian people who do not understand English or other foreign languages. The results of these effort are mixed. There are incredible translations as well as outlandish linguistic plunders that should never have made its way to the official high school ICT textbooks. In spite of these translation efforts, the youth is still using their digital devices primarily in English (refer to Fig 3, p. 24). The fact that Khmerization of the ICT terms

has failed to capture the youth's imagination because it is either too limited or too complicated or meaningless has two profound impacts on digital literacy. First, because the translation has never been standardized, several translated versions of the same term can be found in many different uses, resulting in confusion among users. This confusion consequentially leads to users completely ignoring them and turning back to the original English terms. This leaves the users a long-lasting impression that using Khmer terms is not by any means helpful in their digital literacy endeavors. Second, the lack of Khmer locale in the majority of programs or apps means that the users still need to struggle with trying to decode the meaning of the words they see on the application's interface and then relate them back to their equivalent Khmer terms. This process introduces unnecessary and sometimes misleading mental language switch between English and Khmer. Using English directly will eventually prevail because it is just omnipresent. In this sense, standardizing the translation and encouraging the use of transliteration for terms that do not have Khmer equivalents will increase localized content that also uses English terms when necessary. Straight word-by-word translation without any proper semantic considerations will do more harm than good.

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