A Comparative Analysis of Information and Communication Technology in Education in Five Asian Countries

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Acknowledgments

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Abstract

Information and communications technology (ICT) has been a key driver for education in many countries. Recognizing that ICT can contribute to economic development, all countries are interested in its expansion. However, the experience has been mixed. This paper examines the emergence of ICT in Asia, identifies key success factors and challenges in the implementation of ICT in education and presents the lessons learned from the experience of five countries in Asia. The main findings from the study are the following: (i) ICT has been useful in the teaching of science, (ii) ICT has improved the access and quality of education, (iii) there is a huge digital divide among the Asian countries due to varied capacities and resources, (iv) capacity building of teachers and their motivation were key drivers for successful implementation of ICT in schools, and (v) ICT has transformed teaching from teacher-centered to student-centered learning. Lessons for Bhutan from the experience of implementation of ICT in Singapore, Republic of Korea, Sri Lanka, and Bangladesh are as follows: (i) Good ICT infrastructure is fundamental; (ii) good ICT policy is imperative for implementation; (iii) social, economic, physical, and political barriers pose challenges; (iv) implementation of ICT requires major investment; (v) continuous capacity building of teachers and professional learning is needed; (vi) building partnership with multiple agencies, organizations, and countries is important; and (vii) implementation should be in phases in view of limited resources.

I. Introduction

The twenty-first century has been dubbed the knowledge century. In most countries, the demand for knowledge has increased exponentially, but the education systems are struggling to meet the needs. A country's development depends on human capital. Developing human capital demands quality education. Countries that harness information and communications technology (ICT) can leapfrog stages of development by increasing the opportunities for economic development and engagement, strengthening networks, and making public services more efficient.

The integration of ICT in education provides better access to education, which considers the specialized learning needs of vulnerable people, including those from poor families, children of migrant workers, children with disabilities, and women and girls. ICT also opens up access to lifelong learning and facilitates interactions at individual, national, and global levels.

Furthermore, ICT has redefined the concept of classrooms by creating platforms for online learning, offering new options for information delivery, and creating new ways of teaching and learning. Students who have acquired ICT knowledge through education and are able to integrate into social and professional spheres will be prepared to drive innovation and significantly contribute to economic and social development in the digitized world.

This paper reviews the implementation of ICT for education by examining trends and lessons of experience from five countries in Asia—Singapore, Republic of Korea, Sri Lanka, Bangladesh, and Bhutan—and discusses the policy implications for developing countries.

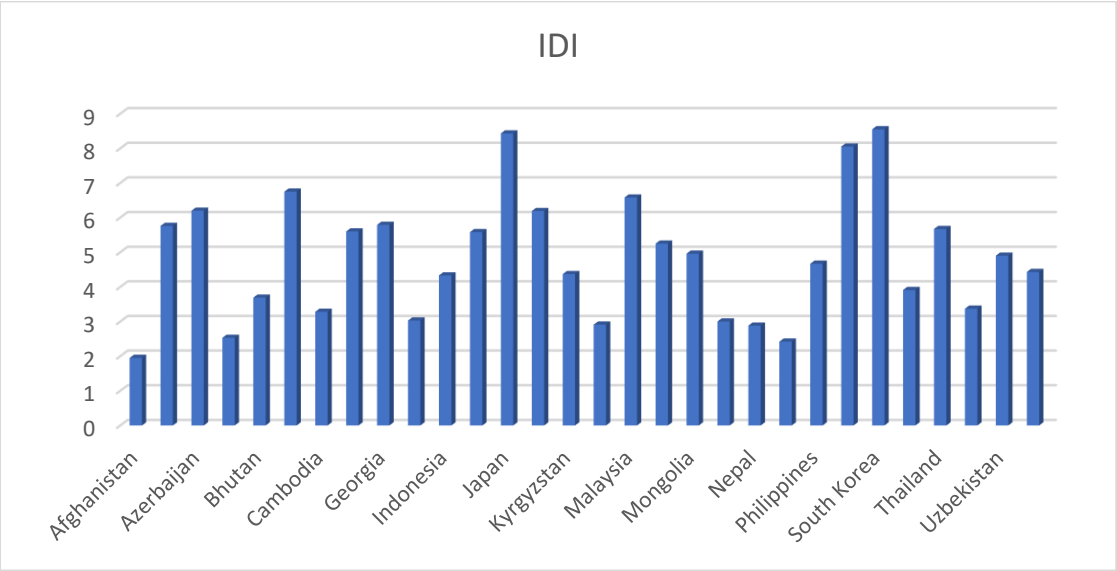
II. Emergence of ICT in Asia

Internet emerged widely in the 1990s and digital technologies have come a long way since the invention of the first computer (OECD, 2017). The advancement of ICT in Asia has created opportunities and policy challenges of digitalization. Big data analytics and artificial intelligence (AI) is changing the dynamics of society. Firms, governments, and individuals can easily access volumes of data that are useful in critical decision-making as big data analytics can process and interpret these data.

Asia and the Pacific have been leading information and communications technology (ICT) growth in the past decade. About 49% of people in Asia are using the Internet, which is the highest among the seven continents. However, Asia and Africa have 48% and 35%, respectively—the lowest Internet penetration rate of the population as calculated corresponding to the number of Internet users to the population of the continent. This is mainly because about 60% of the population is living in Asia (ADB, 2017). The lower growth rate of internet usage in Asia and Africa affects the accessibility of the internet for the public, businesspeople, educators, and children in the schools. This has a negative impact on the integration of ICT in schools across countries with low internet penetration.

Countries like the Republic of Korea, Japan, Singapore, and Brunei have the highest ICT development index (see Figure 1), and they are classified as advanced digital society; Pakistan, Nepal, Myanmar, Bangladesh, and Afghanistan have the lowest ICT development index and are categorized as emerging digital society (GSMA Intelligence, 2015). The digital divide among the Asian countries is wide. The challenge would be much greater in those countries having low ICT development index as it indicates the low percentage of individuals using the internet, low fixed broadband subscribers, low active mobile users, the low percentage of households with computers, and a low percentage of households with internet access.

Figure 1: ICT Development Index in Asia, 2017



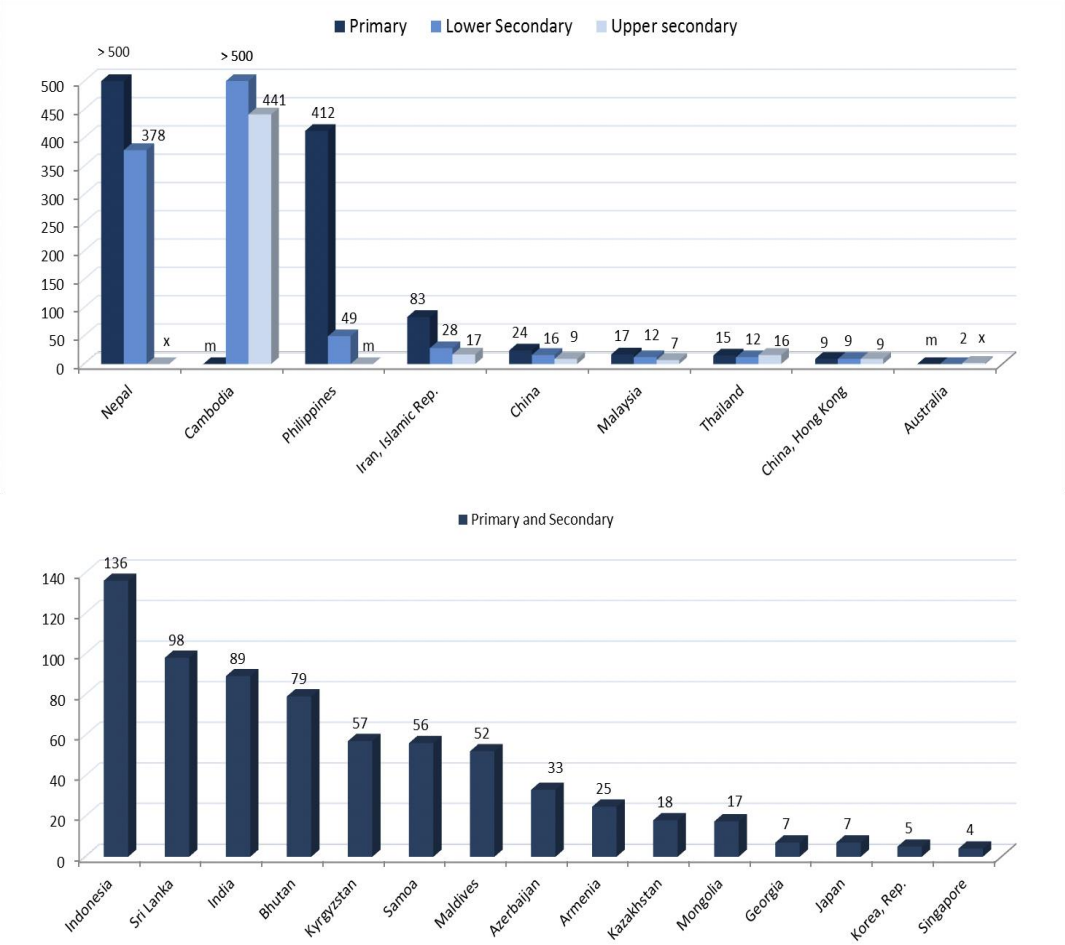
Source: International Telecommunication Union (ITU), 2017

The digital divide is growing due to slow progress in fixed broadband among low-income countries. The high costs of internet access has deterred the adoption of broadband in most low-income countries. In contrast, the better ICT infrastructure, the greater purchasing power of the ICT equipment, more broadband subscription, and good Internet connectivity in high-income countries have moved the countries way ahead of the low-income countries. Central and western Asia have made substantive investments on ICT provision, predominantly hardware-led, created ICT development policies for their education system because ICT was deemed to be fundamental for work in the twenty-first century. Parents and students recognized that the mastery of some level of ICT knowledge and skill will be key drivers for employment opportunities in the future (ADB, 2012).

Countries like Bangladesh, Nepal, Cambodia, Philippines, Sri Lanka, Azerbaijan, and Bhutan have the lowest number of schools connected to the Internet. Whereas Singapore, Republic of Korea, Republic of China, Brunei Darussalam, Bahrain, Maldives, Georgia, and Armenia have achieved 100% Internet connectivity in the schools, followed by Japan and Thailand which is nearing 100% (see Figure 3). The student-to-computer ratio varies across countries in Asia (see Figure 2). This difference will have a significant impact on the access of internet, integration of ICT in schools, and the use of information for teaching and learning. Hence, inequality of access to ICT and quality education will prevail.

The need for teachers' training on the use of ICT in software applications, use of open-source software, use of multimedia, multimedia language labs, network management, and basic hardware maintenance became important. Many countries in Asia were not able to provide sufficient training to enable teachers' knowledge and skills to use ICT to the best effect across all curriculum due to lack of finances, human resource capacity, facilities, and infrastructures.

Figure 2: Student-to-Computer Ratio

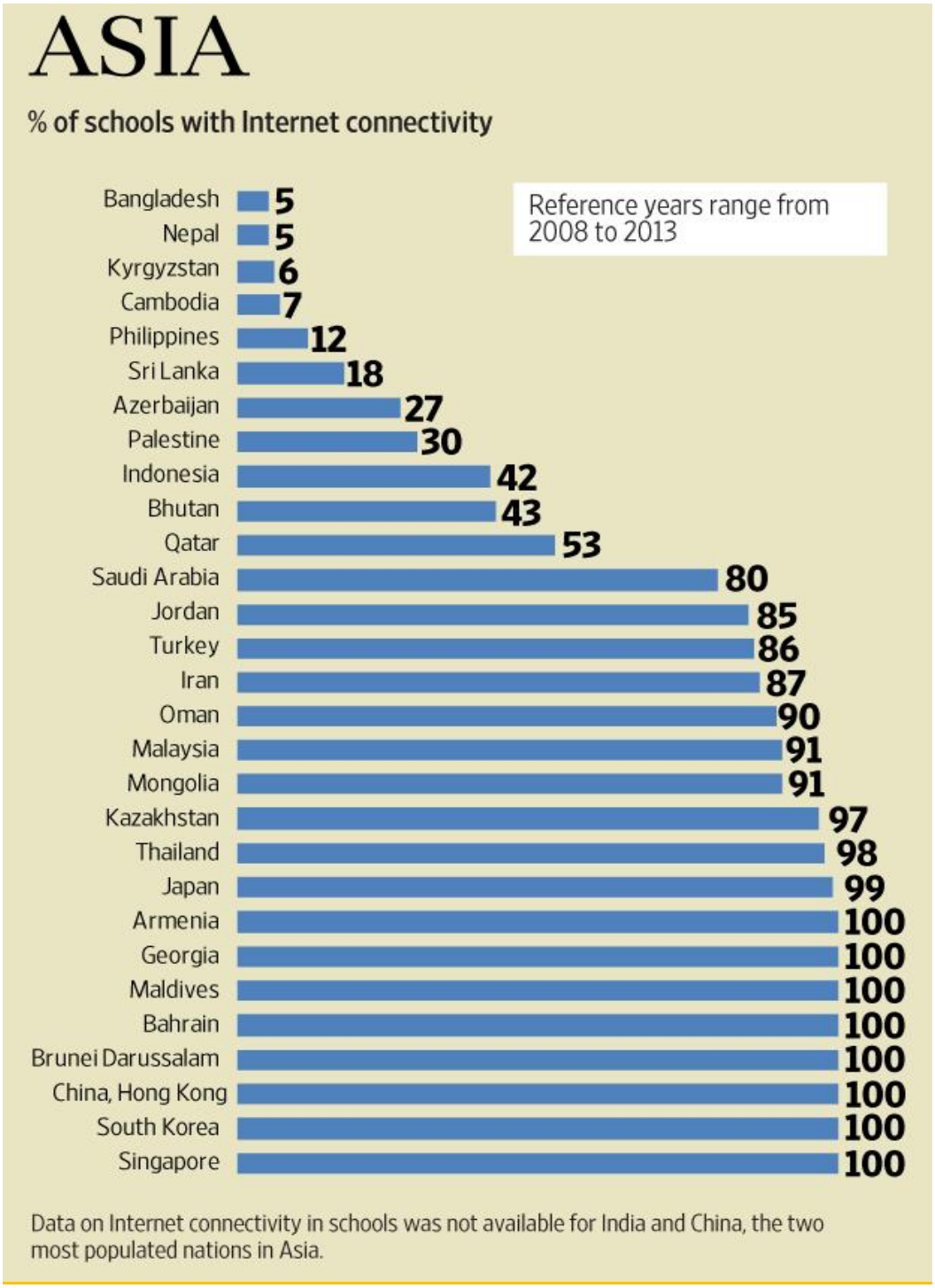


Initially, most of the national ICT for education was focused on hardware, providing computers to schools. The lack of adequate financial resources in the school budget was a common problem. The curricula and syllabi in most of the Asian countries remain seriously overloaded by subject content. Curricula were strongly oriented toward knowledge acquisition through rote learning. The use and development of ICT skills across most curriculum subjects are determinate due to limited time and space. Hence, the use of ICT as a tool for teaching and learning is also limited to a few subjects where digitized textbooks and e-course materials are

available (ICT for Education in Central and West Asia, 2012). The schools must have adequate funds, facilities, equipment, good Internet connection, and skilled ICT teachers to enable the schools to effectively use ICT in teaching and learning.

The key constraints on the effective use of ICT in developing countries were the availability of electricity, availability, and cost of connectivity, poor maintenance services, the costs of training, cost of consumables, and underdeveloped telecommunications. The widening of the domestic digital divide was caused by the inequality in socioeconomic and the differential costs of Internet provision in rural and urban areas. Besides, school environments in most of the Asian countries were poor; inadequate and poorly designed furniture, poor computer room design and layout, and poor-quality of ICT installations. Lack of trained teachers and e-materials in local languages, policies, and strategies related to curriculum, syllabus, and assessment were not aligned to current ICT needs and requirements. Due to this, students' and teachers' access to the Internet was limited (ADB, 2012).

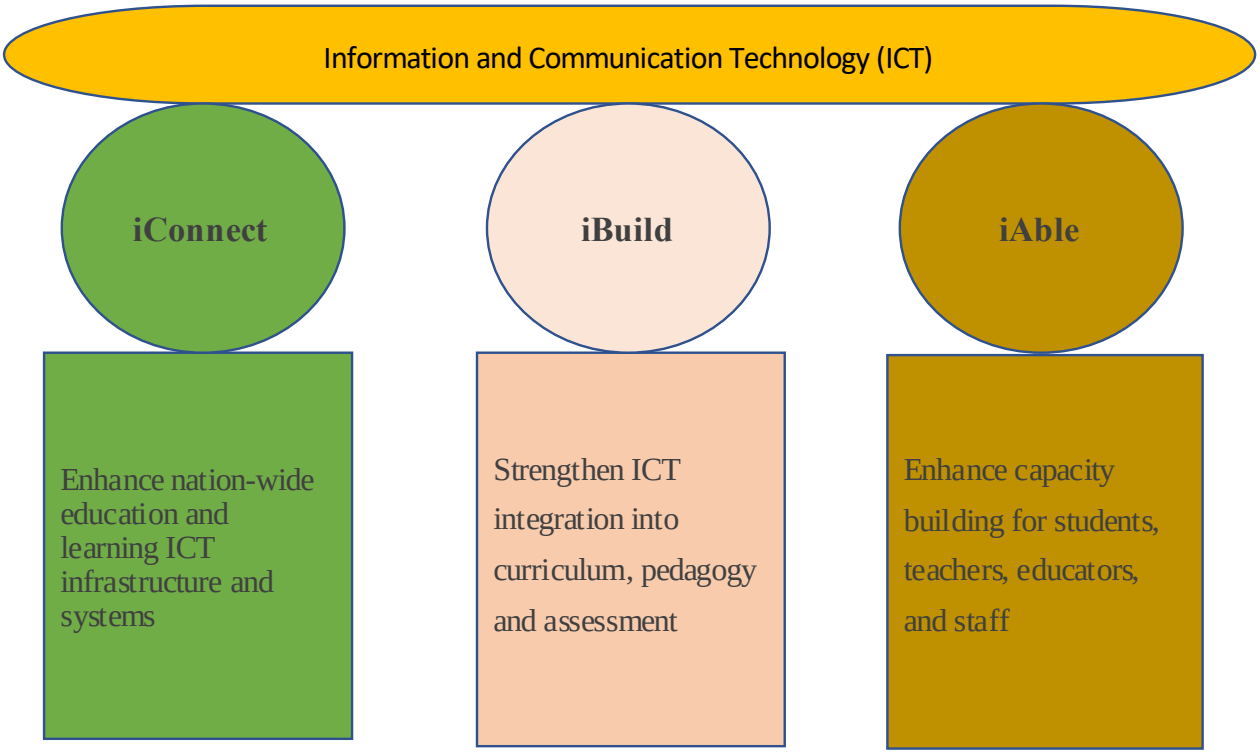
Figure 3: Percent of schools with Internet connectivity in Asia



Source: https://www.livemint.com/Politics/1Lj9pKDdXbd7aFRZZwSY6K/Indias-education-sector-lags-in-ICT-infrastructure.html, Srivastava, M. (2014).

III. Framework of ICT Implementation (iConnect, iBuild, and iAble)

Figure 4: Frameworks of ICT Implementation

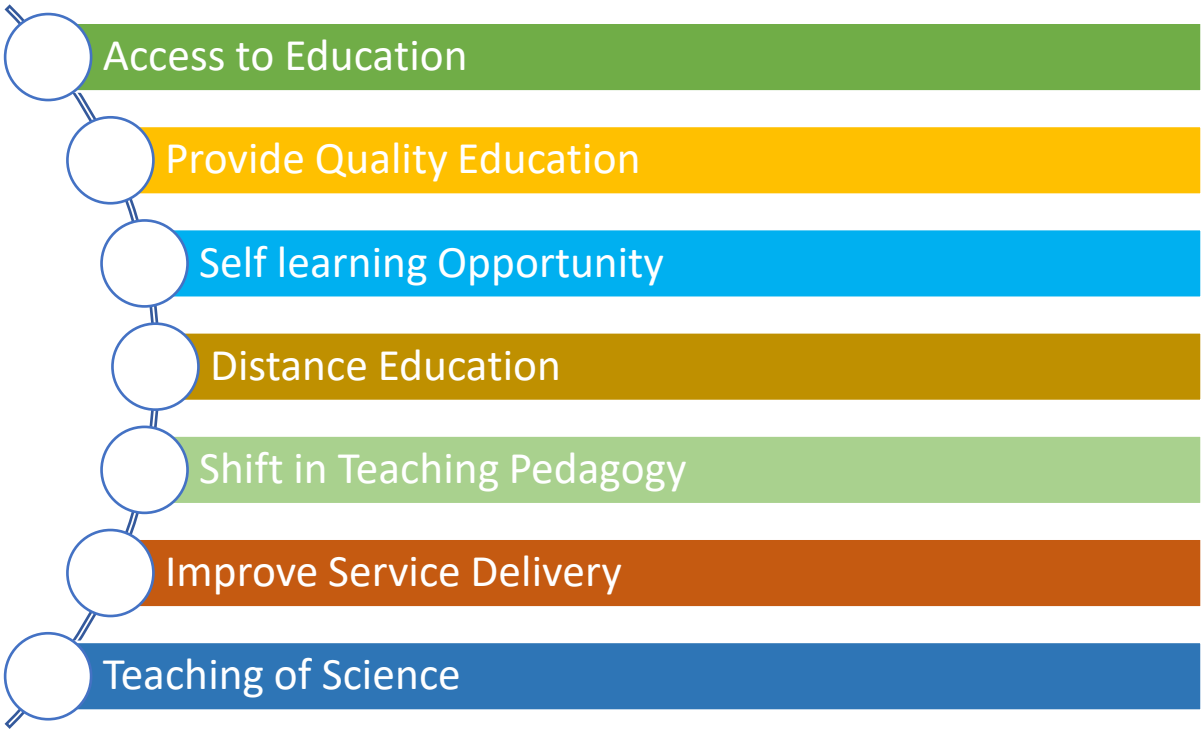


The framework used to examine the implementation of ICT in Singapore, Republic of Korea, Sri Lanka, and Bangladesh is as shown in Figure 4. It has three main components: (1) **iConnect**—enables better access to ICT resources, computers, and the Internet in the educational institutions and communities to support teaching and learning across the country; (2) **iBuild**—develops the content for an ICT-driven curriculum to support a vibrant ICT-led teaching and learning environment; and (3) **iAble**—focuses on programs that will develop the capabilities of students, educators, and supporting staff so as to best utilize the many investments into infrastructure, systems, and content in the education sector. These three components are complementary to each other. Implementation of ICT in education would be easy and efficient if these three components are achieved. On the contrary, if anyone of the components is not achieved, it will affect the other two components as well.

IV. ICT in Education in Asia

The twenty-first-century economy requires school graduates to have sound knowledge about modern electronics, accepting computer technology and other forms of media that will give a competitive edge to the graduates in the global employment market (Mwanda, Mwanda, Midigo, & Maundu, 2017). The use of ICT gives potential advantages in improving teaching and learning. To harness the potentials of ICT, the education system must respond by providing learners with ICT skills. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) aims to provide quality education for all, strengthen both the teaching pedagogy and content of teaching and learning materials, and promote innovation and knowledge-sharing through ICT (UNESCO, 2005).

ICT bridges the knowledge gap in terms of improving the quality of education, increasing the opportunities in education, building knowledge through improved access to resources and people, and connecting populations in remote areas. ICT is becoming more affordable, accessible, and interactive. ICT's role in making educational outcomes relevant to the labor market, in revolutionizing content and delivery in education, and fostering information literacy is becoming more significant (UNESCO, 2008a). The benefits of using ICT in education are the following:



1) Access to Education

In a traditional method, students learned about the world from teachers in classrooms and labs and through books. Now ICT has extended the learning environment beyond classroom walls. Students can get in-depth information about the subjects and topics that they wanted to know with technology. *Microsoft Encarta* and *Wikipedia* are outstanding sources of easily accessible and understandable reference materials.

The integration of ICT into the education system will enhance the effectiveness and efficiency of education delivery and increase the potential to facilitate greater access to information and services for underprivileged groups. This can also change the educational needs, both in terms of the content and the delivery of educational services. Countries that are able to harness the full potential of ICT have greater access to educational opportunities and socioeconomic development. Japan, Hong Kong (China), and the Republic of Korea have prospered because of the quality of their human capital and the use of ICT (ADB, 2004). Developing countries must learn from these countries and adopt ICT for schools.

2) Provide Quality Education

ICT is a valuable tool for enhancing the quality of teaching and learning. For instance, students can learn complex concepts in more concrete ways by using computer simulations and visual technologies. Students' instructional technology made lectures more interesting, and technology made notetaking much easier. Students and teachers can always verify the information using the Internet if there are any concepts to be clarified. There are multiple sources of information that can be accessed to filter and select the most appropriate information and knowledge.

Technologies are found effective in developing skills and enhancing the learning of students by a study conducted on the use of various ICT tools in STEM education. Technology has enabled a child to learn based on their abilities, interests, and needs at a pace that best suits them. ICT is increasingly accessible, intuitive, reliable, and diverse in its application (*Debry & Gras-Velazquez*, 2016). Barak (2014) explains that the development of ICTs in the form of mobile devices, such as laptop computers, electronic pads, and smartphones, and the development of interactive applications can enhance teaching and learning.

3) Self-Learning Opportunity

ICTs are used as intermediaries to empower the learners and to help the teachers support the students and deliver relevant knowledge regardless of location and time of day. It has helped learners to do self-learning in the absence or when there is a shortage of teachers. According to Sibiya (2003), “students can now use e-mail, websites, video streaming, social media, and video conferencing technology to develop their learning skills. These media give the students new and compelling ways to learn, compete, interact with their global friends, and exchange knowledge and ideas.” Hew and Brush (2007) recognized additional benefits of using technology because it provides opportunities for teaching and learning that may otherwise be difficult to attain. Computer-mediated communication tools help students from any geographical location to easily connect and speak to one another and to experts, which enhances the learning process (Hew and Brush, 2007). Besides, conceptual understanding can be built through the process of interactivity, simulation, and visualization by using ICT (Subramaniam, 2007).

4) Distance Education

ICT has rapidly transformed secondary and post-secondary education in developed countries in multiple ways. In particular, the educational process has moved into the virtual world. Individual students can get an education online without having to attend school or university. ICT opened opportunities for working students, parents of young children, and children with disabilities to achieve their educational goals through such technology-mediated instruction, which is accessible anytime from almost any location.

ICT made online learning possible, offered new options for delivery of information, and created new channels to provide training and support for in-service teachers. This has changed the concept of classrooms. Students who have acquired ICT knowledge through education and are able to integrate into social and professional spheres will be prepared to drive innovation and significantly contribute to economic and social development in the digitized world.

The needs and aspirations of people for continuous education and the upgrading of skills without age, profession, distance, and geography are possible because of ICT. Quibria and Tschang (2001) mentioned the importance to recognize that learning with ICTs and trends in distance education are inextricably connected with the demands of present society for lifelong learning. Furthermore, Open Educational Resources (OER) and Massive Open Online Courses

(MOOCs), considered the latest (sixth generation) in distance education, have played significant roles as educational resources, and they are expected to change the nature of openness in education by enabling open provision of educational resources (ADB, 2013). Hence, distance learning is recognized as a strong mechanism to supplement the educational needs of the poor and people who are not able to go to formal school. Radios and television have historically been quite an effective mechanism to deliver information and knowledge in many countries (Quibria & Tschang, 2001). Open and distance learning universities are taking advantage of the opportunities available for working adults and those in rural areas for higher education. This has been critical in creating and enhancing access to higher education for Asian countries (Hong & Songan, 2011).

5) Shift in Teaching Pedagogy

Traditionally, teaching and learning were all based on curriculum centered on textbooks. The teaching was more teacher-centric with less engagement of students in learning. The teaching and learning were limited to the four walls of the classroom.

Today, the introduction of ICT in schools has changed the whole dynamics of teaching and learning. Teaching is more student-centric, and the teacher has become a facilitator. Learners are required to have confidence in their intellectual abilities to communicate, interpret, reflect, and resolve (Forde, 2007). Jonassen and Reeves (1996) posit ICT functions as information sources and cognitive tools supporting and enabling students to be responsible for their learning. Herrington and Oliver (2000) confirmed that ICT supports the learning environment as learning environments become inquiry-based and problem-centered within authentic settings. Hattangdi and Ghosh (2005) found that with ICT, learning in higher education systems is no longer confined within programmed schedules and timetables. This flexibility allowed learners to take part in learning activities without time constraints, hence, increasing the opportunities for more students to participate in formal learning programs. Alharbi (2014) recognized that the use of ICT by teachers can offer interactivity at greater width and depth. Besides, the effective use of ICT can make classrooms more communicative and have more positive educational ethos.

6) Improve Service Delivery

From an educational perspective, ICT is deemed important. The chalkboard, textbooks, radio, television, and film were widely used for educational purposes over the years, but the

influence on the educational process by computers has surpassed all. Ogiegbaen and Iyamu (2005) specifically mention that users will develop their intellectual and creative ability through ICT. Schools, colleges, universities, and libraries are linked electronically to provide the users' access to information and resources even in the remote areas. Investments in ICT for education at the basic and secondary levels support information literacy as a building block for learning at a higher level. It also helps to train teachers to apply student-centered pedagogy to develop critical and analytical thinking. Students have access to information and engage in interactive learning experiences through ICT. This leverages ICT's potential to make the teaching and learning process better. A classroom where ICT is widely applied encourages student-centered learning and creates active learning environments for students to construct knowledge rather than to be passive learners. ICT allows teachers and students to choose appropriate learning styles and also to create a conducive learning environment (ADB, 2017).

7) Teaching of Science

The use of ICT in teaching science, in particular, has immense value where there are inadequate science labs and resources. ICT is widely used by teachers to plan a lesson, design interactive activities, engage learners to explore, work collaboratively, and support classroom management.

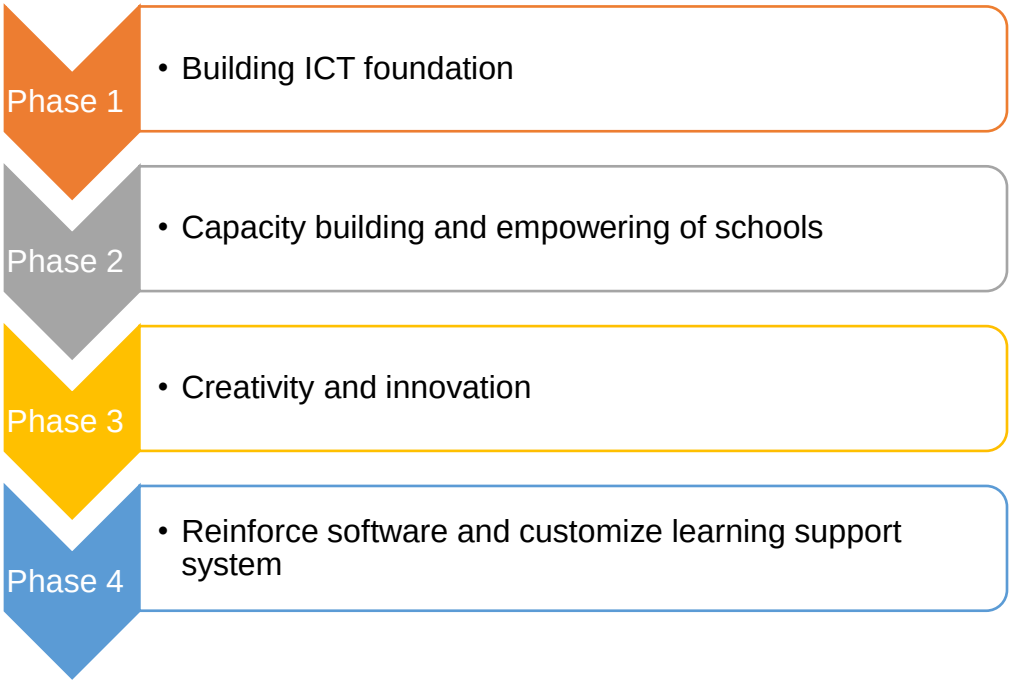
The use of ICT in teaching science has been more successful than any other subject (Abdullahi, 2014). Veselinovska and Kirova (2016) mention that integrating ICT in teaching biology facilitates learning, helps in revision and acquisition of knowledge, and students have adequate educational content in their hands. The teaching process can easily be integrated into modern technological developments. All in all, this shapes the personalities of students in many aspects and at all levels. Learning becomes faster, it is easier to expand and integrate multiple knowledge, enhances the ability to do research, develops critical thinking and creativity, and students learn to be collaborative in their work.

There are many virtual and remote laboratories available for school and higher education students alike, like the Drosophila Virtual Lab (for experiments with digital fruit flies) or Go-Lab (for remote access experiments and virtual scenarios using real data). Interactive simulations and game-based programs develop students' intuitive understanding of scientific concepts (*ICT for STEM Learning*, 2016).

The science curriculum and pedagogy of teaching science is being reshaped as ICT access in schools becomes more widespread. Internet resources, other new tools, and resources that facilitate and extend opportunities to get into in-depth learning beyond the classroom are made accessible for all. A study by Osborne and Dillon (2010) posits that access to secondary resources and data, however, places greater need to provide science education that helps to develop higher-order cognitive skills of analysis, interpretation, evaluation, and synthesis of evidence to validate theories and explanations. The study confirms that this type of education will not only help to develop but strengthen students' cognitive skills and intellectual abilities.

Behar and Mishra (2015) in the Global Information Technology Report identified reforming telecommunications, delivering quality digital educational content, and embracing collaborations to develop a system that brings educators or teachers together to share their expertise and content as three crucial challenges that must be addressed to maximize the potential of ICTs in education. ICT will benefit schools, teachers, and students only if the digital networks and services are reliable and affordable. There have to be inclusive telecommunications policies that reflect the need for a wide diffusion of digital networks and targeted measures for disadvantaged people, firms, and regions. The access to a digital network is limited for Asian countries by high prices (OECD, 2017).

V. Implementation of ICT in Phases



The advanced countries in Asia—Singapore and the Republic of Korea—have made significant development in the implementation of ICT in education. Today, they have reached a crucial phase: innovating and reinforcing software and customizing a learning support system. These countries have taken two decades to implement all these phases. Moreover, they have made huge investments in each phase. For instance, Singapore spent two billion dollars in the first phase. But the countries like Sri Lanka, Bangladesh, and Bhutan are in the transition period from phase 1 to phase 2. There is a huge gap between these developed and developing countries. However, these countries need not take long to implement the same with the lesson learned from the experience of advanced countries and with the advancement of technologies in ICT. Otherwise, it would be very difficult to catch up with the advanced countries and the gap between developed and developing countries would remain wide. The challenge for these countries is to develop strategies to provide sufficient funds and also ensure that the duration for each phase is not more than two years.

Table 1: ICT in Singapore, Republic of Korea, Sri Lanka, Bangladesh, and Bhutan

	Singapore	Republic of Korea	Sri Lanka	Bangladesh	Bhutan*
Internet connectivity in schools	100%	100%	18%	22%	100%
Student-to-computer ratio	4:1	5:1	98:1	**	17:1***
ICT laboratory in schools	100%	100%	17%	38%	100%
ICT laboratory assistant	100%	100%	34%	61% of secondary schools	87.5%
Training of teachers	100%	100%	10%	8%	100% basic skills
Percent of ICT to be included in a lesson	30%	10%	**	**	30%
ICT class	All classes	Classes 3 and above	Classes 1 and above	Class VI and above	Class IV and above

* Information is based on only 8 schools
** Data is missing
*** It is an average ratio based on only 8 sample schools

Countries like Singapore and the Republic of Korea have moved way ahead of Sri Lanka, Bangladesh, and Bhutan in the implementation of ICT in education. The schools in these countries have greater access to ICT with 100% of the schools having Internet connectivity and all schools having an ICT laboratory and ICT lab assistance. The student-to-computer ratio is 4:1 and 5:1 for Singapore and the Republic of Korea, respectively. Moreover, 100% of the teachers are trained in using ICT with advanced skills. This is very important for the implementation and integration of ICT in schools. But Sri Lanka, Bangladesh, and Bhutan are still struggling to provide access to ICT for schools. There is fewer schools connected to the Internet, the student-to-computer ratio is very low, many schools are without ICT laboratories, and only 10% of the teachers are trained to use ICT. Bhutan seemed to be doing better than Sri Lanka and Bangladesh. However, it must be noted that the data represents only eight schools of Bhutan as compared to all the schools in other countries.

In order to strengthen ICT and integrate ICT in teaching and learning, all the schools have to be connected to the Internet and student-to-computer ratio has to be reduced to at least an ideal ratio like that of Singapore and the Republic of Korea. All the teachers must be provided with both basic and advanced ICT skills if ICT is to be integrated into teaching and learning. Access to ICT

and ICT facilities must be strengthened for Sri Lanka, Bangladesh, and Bhutan to harness the full potential of ICT in education.

VI. Key Success Factors and Challenges for Implementation of ICT

The implementation of ICT in education has never been easy even for the developed countries in Asia. It is worth understanding the factors that led to the successful implementation of ICT in schools and the challenges encountered during the implementation.

A. Success Factors

Implementation of ICT in Singapore and the Republic of Korea have been successful because these countries invested heavily in building good ICT infrastructures. They established very good ICT labs in schools with adequate computers and other technology. A Strong internet connection and high capacity were also made available to all the schools.

The ICT facilities were made available in all the schools so that students and teachers can access the Internet at any time. Moreover, the ICT facilities were provided to the schools at a cheaper price so that all the schools can use it. Even the cost of the Internet was also made cheap and affordable to all the students and teachers.

Good ICT policy has helped all these countries to implement ICT in education. This was supported by strong and continuous support from the government and the people. For instance,

the government and people of the Republic of Korea were very supportive in the implementation and integration of ICT in schools (Lim, 2015). This has made the implementation of ICT for education easy.

The government alone cannot achieve everything. Partnership with private organizations and building networks with national and international organizations have played a key role in supporting and building the foundation of infrastructures and implementation of ICT in the schools. The establishment of training centers and research centers has been another key factor. For instance, Korean Education Research Information Service (KERIS) in the Republic of Korea and Bangladesh-Korea ICT Training Centre for Education (BKITCE) helped in building human resource capacity and creating resource materials and information that are readily accessible online.

The success of integrating and implementing ICT in schools depends on teachers. Therefore, Singapore created a system of recognizing and awarding the teachers who are using ICT in the schools (MoE, 2008). This kind of motivation has worked well, and more teachers are encouraged to apply ICT in their daily teaching in schools.

B. Challenges in implementation

The implementation of ICT has not been easy for all countries. Since the establishment of infrastructure and ICT facilities in the schools require huge investments, the limited budget was the major challenge especially for developing countries like Sri Lanka, Bangladesh, and Bhutan. This problem is further added by the high cost of Internet service in the countries. Poor countries could not afford to pay for the services.

The sustainability of the ICT program was another challenge. The cost of repair and maintenance was very high. Moreover, technology advancement was taking place rapidly. So things got outdated within a short time. It is very difficult for schools to keep pace with the advancement of technology. Besides, teachers' ICT skills and knowledge required an update. So a continuous professional development or training for the teachers was important and very costly.

The large number of schools and students was another challenge. The governments of the respective countries were not able to reach out to all the schools and provide adequate ICT

facilities. The facilities were better in the cities, and there were poor facilities in the rural parts of these countries. This has increased the inequality between rural and urban schools in terms of ICT facilities and access to Internet services.

Difficult geographical locations, poor economy, inadequate human capital, lack of government policy, lack of ICT master plan for education, increasing number of schools, and lack of capital have hindered the implementation and integration of ICT in education in all the Asian countries, including Singapore, Republic of Korea, Sri Lanka, Bangladesh, and Bhutan. These factors further increased the cost of Internet services and infrastructures.

Singapore and the Republic of Korea have implemented ICT for more than two decades. Today both countries have reached the innovation phase. It has not been easy for these two countries to reach the present state. They have invested huge amounts of money from the very beginning of the implementation of ICT, and they kept on investing every year. The demand for ICT facilities and capacity building of the teachers and staff kept on increasing due to the advancement of technology. Otherwise, technology and ICT skills became irrelevant after certain years. In order to keep up with the pace, ICT facilities have to be replaced with new technology and teachers have to be trained to use them as well. These became costly as they were required regularly.

VII. Lessons learned from the experience of these five countries

There is a multitude of lessons that Bhutan can learn from the experience of Asian countries for the integration of ICT in education. Some of the countries in Asia have become pioneers in implementing ICT in education and integrating ICT in teaching and learning. However, there are also many countries still struggling to provide the basic ICT services and facilities in the school. There are lots of opportunities for Bhutan to learn from the success and failure of these countries in Asia.

i. Integration of ICT in education requires good ICT infrastructures like telecommunication network, Internet service, computer labs, computers, and other technologies. Countries with poor ICT infrastructures have not benefitted much from the advancement of ICT. But countries like China, Singapore, and the Republic of Korea have ensured excellent ICT infrastructure so that the schools and other institutes can easily access and use ICT.
ii. Singapore, Republic of Korea, China, and Thailand are leading in terms of ICT in education and integration of ICT in teaching and learning. These countries have spent a huge budget for decades in developing ICT infrastructure in the schools and Internet service. The implementation and integration of ICT in teaching and learning require huge investments.
iii. These countries have formulated an ICT master plan, implemented in phases with different visions, missions, and objectives. For instance, Singapore has implemented the third master plan and the Republic of Korea has implemented the fifth master plan. This has helped them to prioritize the need for ICT infrastructure and service.
iv. These countries have experienced and realized that providing computers, projectors, and equipment is not the solution. The teachers and leaders in the schools need to be trained to use ICT. Therefore, all these countries have provided both basic and advanced training for the teachers to use and integrate ICT in the schools. The ICT training is also incorporated in the preservice teacher training institutes so that the teachers have the ICT skills when they finish their training. Moreover, short courses are designed for in-service teachers to provide the skills and knowledge required with the advancement of technology.
v. The schools, teachers, and students of those countries having better ICT infrastructure and Internet services have benefitted more in the acquisition of twenty-first-century skills and knowledge. ICT has transformed the traditional method of teaching to student-

centered teaching. Students have more time for independent learning, and they could also learn beyond what is prescribed in the textbook.

vi. The implementation and integration of ICT in teaching and learning have been successful because these countries have diversified their national curriculum by adding ICT as another subject. Different sets of curricula were planned for different levels. Each set of curriculum provided different ICT knowledge and skills for the learners.

vii. The development of ICT infrastructure and its integration in teaching and learning in the schools have taken a slow pace despite spending a huge budget and other resources in most of these countries. This is because of the increasing number of schools and students every year. Moreover, the cost of ICT infrastructure and equipment is costly. Advancement of technology is at a rapid pace and the countries were not able to be in sync with the changes.

viii. When ICT infrastructure, resources, service and support, and training for teachers are appropriately given, integration of ICT in teaching and learning had been very effective as in the case of the Republic of Korea and Singapore.

ix. Some of these governments have also realized that it is not possible for the government alone to fulfill the needs of the ICT and Internet connection. Partnership with private companies and organizations played a vital role in providing Internet service and building infrastructures like telecommunications. Therefore, most of these countries joined and worked together with private companies.

x. The use of ICT in education has helped to improve the acquisition of knowledge and enhanced the learning of twenty-first-century skills. It has also made the learning easy and accessible at any time from any place.

xi. Projects uniquely designed with specific targets and objectives have helped in the implementation of ICT master plan for education in most of the countries.

xii. The use of ICT and its integration in teaching and learning have become very effective for those countries who were able to develop computers with their language. For example, Sri Lanka government has installed own language in the computers and all the information stored is also accessible in their language. This significantly helped the children to learn and understand better.

xiii. Singapore has implemented a project in partnership with parents. This project has been successful in providing computers to the students. Moreover, it has helped to build a relationship among the students, parents, and the school. A positive relationship motivates students to learn and teachers to work hard.

VIII. Conclusion

ICT has been a key driver of education in Asia for a long time. ICT in schools has changed the classroom environment and the methods of teaching and learning in schools. Teaching and learning have become easy and quick with the information readily available online. Implementation of ICT in education has not only improved the teaching and learning in the schools but it also helped to prepare the children for the twenty-first century. ICT in education has the potential to develop children to become creative and critical thinkers.

ICT has provided equal opportunity for education to all people, including children with disabilities, children from poor families, men and women, people who are aspiring to continue their education. It has opened up a platform for distance learning through online education. Access to education, information, and resources have increased significantly. Teachers and students can use the information at any time. Teaching and learning are expanded beyond the classrooms.

The implementation and integration of ICT in schools are dependent on the potentials of the teachers. The schools having competent teachers with good ICT knowledge and skills were able to integrate ICT into teaching and learning. But the schools that did not have any competent teachers were still struggling to integrate ICT into teaching and learning despite having facilities and technology in the schools. This also created inequality in the quality of education delivered across the schools and the country.

Its implementation has never been easy for the countries in Asia. However, countries that were able to successfully implement ICT have been able to provide quality education to the children in the schools. The human capital became strong and better, and they were able to fulfill the requirement of the twenty-first-century market. The socioeconomic development of the country also improved with better implementation of ICT in the schools as more students became productive and creative workers.

Therefore, the countries investing in ICT for education will be at the forefront in the twenty-first century. Effort must be put in by every country to ensure that the future citizens receive a quality education and the right skills for the development of the country’s economy.

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