

# Education on Information and Communication in Indonesia : A Review

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# Education on Information and Communication in Indonesia : A Review

Riri Fitri Sari Dewi Yanti Liliana

## Abstract

Information and Communication Technology (ICT) development has transformed Indonesia in a lot of ways, including the way people communicate, study, work and live. In line with this, knowledge-based economy which relies on the use of cyber physical system and industry 4.0 has created the need for highly educated human resources. This paper reviews the education on Information and Communication Technology in Indonesia particularly in higher education based on the history of computing and communication in Indonesia; the proliferation of hardware and software; the raise of the Internet; and the need for skilled and educated human resources for the deployment of ubiquitous technology. We also recapitulate Indonesian higher education institutions in ICT, and subsequently discuss Quality Assurance in ICT Education. It can be concluded that information and communication technology education in Indonesia has been an enabler for the wide deployment of technology which has been the powerhouse for economic development.

**Keywords** : communication, education, information and communication, accreditation, telecommunication, quality assurance, ICT, Industry 4.0

## 1. Introduction

Information technology is the result of the merging between computer and communication technology. This technology has changed all aspects of life in our community in a rapid way. The development of science and technology have changed the way people think, live, work, study and conduct all activities. In this paper, we review the history of computing and communication education in Indonesia. Indonesia is the fourth largest country in the world in terms of population. The information society in Indonesia were marked with its participatory and more democratic society.

In 1990s the Internet technology has developed extensively and provided various programs, information systems, and applications which can be accessed in people's finger tips. One of the breakthroughs in Indonesia is the implementation of single identity number for the population of Indonesia. The Ministry of Internal Affairs of the Republic of Indonesia launched the Electronic Identity Card (KTP) which aimed at the use of IT services to manage human resources which include the education sector.

Information Technology is a technology to process data, which consists of obtaining, compiling, storing and manipulating it in many ways, to produce quality of information that is relevant, accurate and in time<sup>(1)</sup>. It should also be used strategically for decision making processes<sup>(2)</sup>. Information and communication technology (ICT) emerged and became familiar tools in Indonesian society. Today, ICT plays an important role, both in the fields of education, economy, social, culture, geography, religion, and various other fields.

During the COVID-19 pandemic, ICT has become the

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major enabler of less contact economy. People relied on social media such as WhatsApp, Instagram, Facebook, Telegram, Twitter to communicate. In education, the extensive use of variety of learning management systems such as Moodle, Google Classroom, Microsoft Teams, Google Meet, and Zoom provided some media alternatives for synchronous and asynchronous learning facilities.

The rest of this paper is structured as follows. 2. reviews the ICT in education in Indonesia. Section 3 presented the history of computing in Indonesia. 4. presented the ICT development for education in Indonesia. 5. presented the educational institution in ICT area. 6. discussed quality assurance in ICT education. 7. presented some discussion and analysis. 8. concludes the paper.

## 2. Review on ICT in Education in Indonesia

Balancing the needs for 270 million populations of Indonesia have been the great challenges faced by the Indonesian government and society at large. The history of the use of ICT in education, especially in learning, is strongly influenced by the development of ICT hardware, especially computers and networking as well as communication technology. Leinonen (2005) divided these developments into 5 phases<sup>(3)</sup>:

- ① Programming (1975~1985)
- ② Computer-based Training (CBT) with multimedia (1985~1995)
- ③ Internet-based Training (IBT) (1995~2000)
- ④ E-Learning (2000~2005)
- ⑤ Social media software, free and open content (2005~present)

Meanwhile in Indonesia, the ICT application on education is marked by the use of radio broadcast as the public source of information and news in 1925. The Radio of Republic of Indonesia (RRI) was established on September 11, 1945<sup>(4)</sup>. In 1962, the first Indonesian television station Televisi Republik Indonesia (TVRI) broadcasted its first air time.

Computers were introduced in Indonesia between the year 1970 and 1972 as a technology to process data. Education for human resources in computing was initiated afterwards. The University of Indonesia was the first among other universities to introduce computer science courses and research in Indonesia<sup>(5)</sup>. ICT in

Indonesia began to develop rapidly in the early 1980s, thanks to the rise of the processors (chip) technology which function as the brain of a personal computer.

In 1976, Indonesia was among the first country which launched its first satellite, under the name PALAPA A1<sup>(6)</sup>, followed by other satellites such as PALAPA A2 (1977), PALAPA B1 (1983), and PALAPA B2 (1984)<sup>(7)</sup>. Satellite technology was used as an Indonesian geostationary telecommunication tool that helps television broadcasts to get better broadcasting quality<sup>(6)</sup>. In addition, the use of the Palapa satellite radically changed the Indonesian telecommunication infrastructure which previously used cable telephone<sup>(7)</sup>. The long-envisioned Palapa Ring national broadband network has been in operation since the end of 2019 which incorporated eight different networks<sup>(8)</sup>. This optical ring put together high-speed network infrastructure to the eastern and outer part of Indonesia<sup>(9)</sup>. Mobile operators are also rapidly delivering high speed network to accommodate the rising data usage through telecommunication towers, small cells and rooftops.

In 1984, there was a drastic development, where network technology in Indonesia began to connect to the Internet via the UInet network, an internal University of Indonesia campus network connected via UInet network<sup>(10)</sup>. In 1988, the Internet appeared in Indonesia. Based on the records of ARIN and AONIC Whois search, the first IP in Indonesia was UI-NETLAB (192.41.206/24) which was registered by the University of Indonesia on June 24, 1988.

UInet managed to connect large campuses in Indonesia such as ITB, UGM, ITS, UNHAS, Open University and the Director General of Higher Education (DGHE) of the Ministry of Education and Culture. This large network is assisted by foreign institution using conventional cable telephone network infrastructure. Initially the purpose of the Internet was used as a tool for working and communicating via email systems and collaboration network<sup>(11)</sup>. In the 2000s, Indonesians began to use the Internet as a medium of entertainment and communication due to the emergence of social media. Subsequently in 1993, Indonesia was officially connected to the universal Internet network using the TCP/IP protocol. The "id" domain has been set for representing Indonesia. In the 1990s the Internet has grown more rapidly so that from the year 2000s up to now the Internet has become a necessity for the community<sup>(2)</sup>.

### 3. History of Computing in Indonesia

The history of computing in the field of education in Indonesia is depicted as a timeline in Fig. 1. Year of 1951 is the beginning of the development of educational technology in Indonesia using media or properties to support teaching activities<sup>(12)</sup>. In 1976, a domestic communication satellite was used to unite the country and enable information dissemination as well as education to remote areas<sup>(7)</sup>.

In 1980s, The University of Indonesia is one of the places that was first introduced to the existence and function of computers. Since then, computer technology has been introduced and spread throughout Indonesia<sup>(13)</sup>. 1990s is the era of Computer-Based Training (CBT) in which e-learning applications began to appear that run on standalone PCs or in the form of CD-ROM packages for content or multimedia form (video and audio) in mov, mpeg-1, or avi format<sup>(14)</sup>. In 2000s, teleconference system for distance learning that utilizes Integrated Service Digital Network (ISDN) was introduced. ITB, in collaboration with TELKOM, developed the first educational network.

Technological developments in the field of education in the 2000s for Learning support equipment technology in schools such as LCDs, projectors, laptops, and personal computers. In 2010s e-learning is in line with the momentum of the emergence of social media, where humans can share information about anything online. Computer Based Test (CBT) was first implemented in 2014 during the National Examination for high schools (UN) in Indonesia. The Year of 2020 is marked by the widespread use of online learning technology across the

archipelago during the pandemic, i.e., EdTech (such as the Teacher Room, Quipper Vidio, and Zenius) and Video Conference (Zoom, Google Meet, Skype) as well as unicorn start-ups platform for learning such as ruangguru.com.

### 4. ICT Development for Education

The ICT development in Indonesia has followed worldwide trend in which the convergence of broadcasting, computing, and telecommunication have enabled the global development of science and technology. For education purposes, in Indonesia the adoption of emerging technology across the country usually initiated not long after the new technology is introduced. Subsequently the application of the new technology is conducted. The new technology is integrated in to current condition in which many problems must be solved and many adjustments to the local condition must be conducted. Eventually, the technology will transform the society to slowly live in the condition in which they

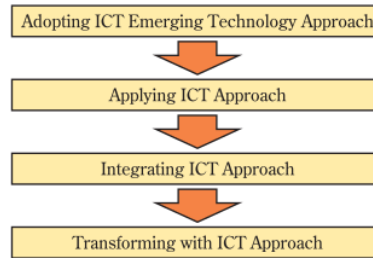


Fig. 2 ICT Development approaches

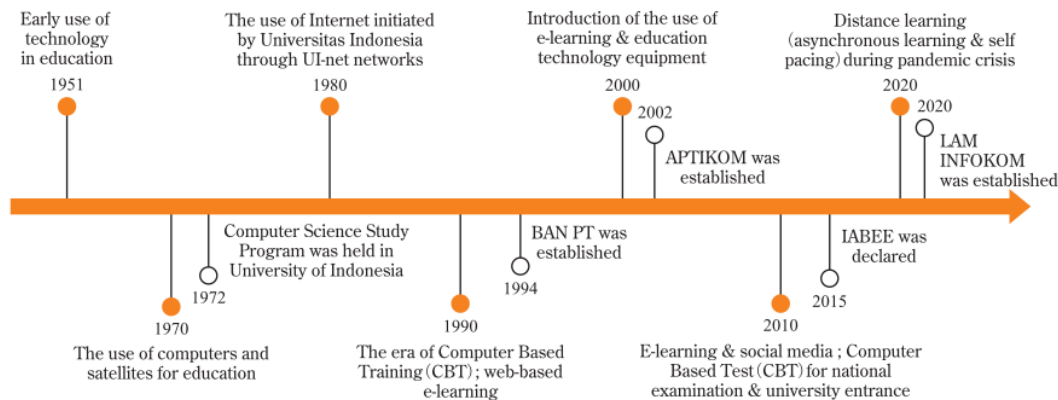


Fig. 1 The history of computing and communications education Indonesia

have to rely on ICT. These approaches can be seen in Fig. 2.

In order to implement ICT in education, a lot of programs must be widespread throughout Indonesia. In the beginning of the ICT development phase, this is aimed to raise the awareness of the ICT potential in education and to adopt appropriate emerging technologies. Application approach means that ICT must be applied in teaching and learning activities. Integration approach aims to integrate ICT into the curriculum, and transformation approach is targeted for ICT-based education. In Indonesia, this whole process of adopting new ICT approach for widespread use of knowledge and technology have been facilitated by government and private institutions.

### 5. Educational Institution in ICT

The government of Indonesia has nurtured and facilitated the rise of different initiative to build ICT-based educational institutions. For example in 1980s a lot of institutions open some informal courses to cater the need for computer literate human resources. Some of these institutions later on became universities that are well known for their experiential learning opportunities for the millennium generation. Fig. 3 depicted the ICT education strategy in which government via the Ministry of Education and Culture and the Ministry of Communication and Information coordinate the ICT education. The government encouraged the implementation of planning principle throughout the making of ICT policy, infrastructure, management, and evaluation to integrate ICT in the curriculum to transform the

education process into modern learning.

On considering some benchmarking result on Indonesian higher education institutions academic performance, some study programs in electronic engineering and computer science have received international recognitions and listed in rankings by subjects in Computer Science and Engineering such as Quacquarelli Symonds (QS) and THE rankings by subject. In 2020, QS ranked Bandung Institute of Technology (ITB) and Universitas Indonesia (UI) in 250~300. In addition, Gadjah Mada University (UGM), Bina Nusantara University (Binus), and ITS are ranked 451~500 in the world. For Engineering and technology rankings ITB is in 244 position, UI in 295, UGM in 355, and ITS in 451~500.

In THE by subject ranking in Engineering and computer science ITB and UI are ranked 601~800, while UGM, Padjadjaran University, ITS are ranked 801~1000. Brawijaya University, Diponegoro University, Telkom University are ranked 1001+. These means many computer related study programs in Indonesia are qualified and recognized in terms of its academic performance, publication, and human resources.

In 2002, the Association of Institution in Informatics and Computer Science (APTIKOM) was established<sup>(16)</sup>. Currently APTIKOM has 850 study program members. This association facilitates the cooperation to improve the management and development of higher education, in the field of informatics and computer science.

APTIKOM formulated the qualification standards for the Information and Computer science clusters aimed to be used as input for curriculum preparation based on

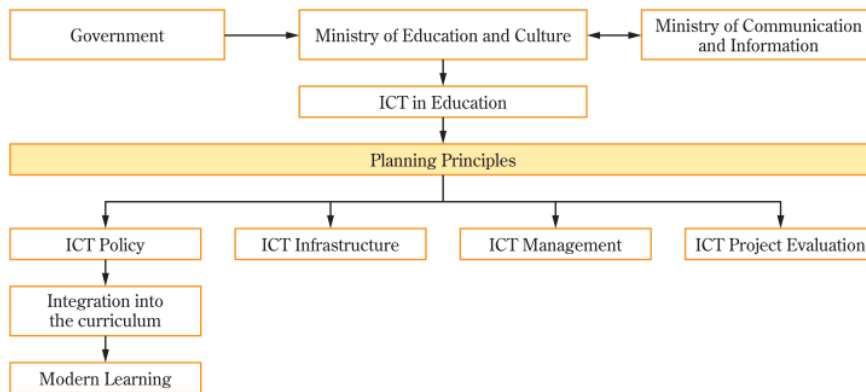


Fig. 3 ICT in education strategy<sup>(15)</sup>



competencies in higher education, as well as work training and work experience certification according to the competencies determined by the industry.

APTIKOM adopted Curricula 2005 as a guideline for curriculum development in the field of informatics and computer science. Curricula 2005 is an extension of the previous curriculum which divided the fields of informatics and computer science into three groups, namely: Computer Engineering, Computer Science, and Information Systems. In Indonesia, these three sub-fields are known as Computer Systems/Computer Engineering, Computer Science/Informatics Engineering, and Information Systems/Information Management. In accordance with developments, Computer Science generated a new concentration, namely Software Engineering; Information System makes a new concentration of Information Technology. Currently the curriculum used by related study program is based on international best practice standards issued by the ACM and the IEEE. Through its latest standard known as Curricula 2005, the clusters of informatics and computer science are divided into five main study areas, namely :

- (1) Computer System (Computer Engineering) emphasizes the individual's ability to design and develop digital-based hardware. The variations of the names are Computer Engineering, Computer Systems, Hardware Engineering, Digital Computerization, Digital Computer Science, etc.
- (2) Computer Science highlights the ability of individuals to design and develop various computational algorithms (computational theory and algorithms). The variations of names are Informatics Engineering, Computer Science, Computing Science, Informatics, Informatics Science, Computational Mathematics, etc.
- (3) Information System focuses the ability of individuals in designing, developing, and implementing organizational information systems as the main asset of the organization. The variations of names are Information Systems, Information Management, Management Information Systems, Information Systems Management, etc.
- (4) Information Technology concentrates the ability of individuals in planning, determining, and managing information technology, where the

features and capabilities of technology are for added value. The variation of names are Information Technology, Information and Communication Technology, Information Engineering, Teleomatics, etc.

- (5) Software Engineering emphasizes the ability to design and develop software. The variations of names are Software Engineering, Programming, Software Development, etc.

In addition to the five main fields of study mentioned above, a wide variety of new fields of study are offered by most academies (diploma level) due to high market demand, such as Computerized Accounting, Multimedia, Animation, Broadcasting, Programming, etc.

## 6. Quality Assurance in ICT Education

Indonesian Accreditation Board for Engineering Education (IABEE) is an accreditation agency for engineering higher education programs<sup>(7)</sup>. IABEE is a voluntary accreditation body which aims to improve the quality of engineering higher education by implementing outcome-based education (OBE) system. In 2019, IABEE applied for the provisional status of the Washington Accord (WA) which is a multilateral agreement between engineering institutions to enable the mobility of engineering practitioners.

IABEE was initiated by Directorate General of Higher Education (DGHE) of Indonesia with the support from Japan International Cooperation Agency (JICA). IABEE was declared on November 19, 2015 and inaugurated on March 13, 2018. IABEE accreditation is beneficial for many parties, i.e., students and graduates, study programs and education institutions; industry, government, and stakeholders. The IABEE goals are to change the engineering education focus in Indonesia, from input-based teaching to OBE system; and 10% of undergraduate engineering programs will be internationally accredited.

To be accredited, a program must meet common accreditation criteria as well as the rule and procedures of evaluation and accreditation. Those criteria are: ① orientation of graduate competence; ② education methods; ③ education improvement; ④ achievement of learning outcomes. Two accreditation categories are general accreditation and provisional accreditation. General accreditation is applicable for programs that

have implemented **outcome-based education system and produced graduates using the system**; while provisional accreditation is intended for programs that have been running outcome-based education system and at least the first-year students have completed learning using the OBE system. The evaluator team consists of academic, industry practitioners, and observer.

Other Information and Communication higher education institutions in Indonesia is also related to Independent Accreditation Agency (LAM) in Information and Communication (INFOKOM). This board was formally established on December 4, 2020 based on the recognition letter **by the Minister of Education and Culture of Indonesia** Number 75865/MPK.A.HK/2020 dated September 3, 2020. This marked the establishment of Quality Assurance for study programs related to information science, computers systems, information systems and related fields.

## 7. Discussions

Since the implementation of the Law No. 23 Tahun 2006, all citizen of Indonesia should only use single identity number in their identity card (KTP) by 2012. This number is used since a person was born, study, work and in all aspect of life. On planning a career path as an engineer, software engineer, media supervisor, telecommunication network specialist, a person goes through educational process which will certify him/her to be qualified for a job. A series of quality assurance must be in place in producing product and service, including the educational process. This is also the case with the school of engineering, computer science and telecommunication study programs which should produce graduate with **set of skills and knowledge**.

There are endless **efforts in academia and industry in Indonesia to advance the education and training of the communications and computer workforce**. The efforts encompassed **new teaching efforts, technologies, alliances, certification, and accreditation activities**. Within the field of **telecommunications and network engineering education**, a shared vision to enhance knowledge, practices, and scholarship among similar programs in different universities has been established. Forum for head of electrical engineering departments in Indonesia (FORTEI) **is an example of the collaboration**. Some insight for **effective educational practices developed through scholarly approaches** has contributed to applications of good **practices in classrooms and laboratories**.

Some collaboration in **assessments of student learning and course development, new resources supporting student learning, and advancements in teaching some of the latest communications technologies** become the evidence of collaboration.

In Indonesia quality assurance in delivering education to produce engineers is defined by the National Accreditation Agency and association of independent accreditation agencies. **The National Accreditation Agency for Higher Education (NAAHE)** or so called BAN PT was established in 1994 by the Ministry of Education and Culture in order **to assure the quality of higher education institutions (HEIs) and their programs**. The national Quality Assurance system in higher education is outlined in Law No. 12 on Higher Education issued in 2012. NAAHE accredits **Higher Education Institutions** institution and all programs. Since 2015 the accreditation process for some program level has been conducted by Independent Accreditation Agency for Higher Education (LAM PT), such as in Health (IAAHEH/LAMPTKes), **Indonesian Accreditation Board for Engineering Education (IABEE)** which is an independent, non-profit organization founded as an autonomous part of the Institution of Engineers Indonesia (PII), as well as LAM Infokom for Information and Communication study programs.

Study programs in more than 850 members is aimed to **develop and foster quality culture in the management of engineering higher education**. This **is achieved by assurance that the Study Programs are operated in compliance to minimum standards, and by encouraging continuous quality improvement in engineering higher education institutions**. More quality assurance can be enforced throughout higher education institutions in Java and outside Java. Quality assurance effort to fill in different criteria and empowering less develop and new institutions will help to minimize the education gap in Indonesia.

## 8. Conclusion

A digital economy is essentially a knowledge-based economy which depends on specific skill sets that must be pursued abundantly in Indonesia. The government of Indonesia tried to implement Industry 4.0 technology by enabling the transformation to the digital economy. Developing the human capacity is necessary for this transition, and the effort have been presented in this paper. Great talent and nationwide participation are

important for building a digital environment in Indonesia.

In the context of Indonesia, accreditation of a program at national level is compulsory and directly related to its legal status, registration in the Higher Education Database (PDDIKTI) maintained by the Ministry of Education and Cultures, and to its operational permit as required by law. HEIs, donor agencies, employers, parents, and students use accreditation for their selection criterion for different purposes. These Indonesian accreditation boards collaborate with its stakeholders in accreditation and is actively involved in bilateral, regional, and international collaborations with overseas QA agencies and networks. It can be stated that in Indonesia, most study programs related to Information and communication and computer will be accredited by BAN, IABEE, or LAM INFOKOM. Continuous learning and talent scouting for improving education in different parts of Indonesia will be enforced by committed human resources who are willing to keep updating and sharing information on improving the notion of quality in input, process, and output, as well as continuous improvement in all aspects. It should be noted that the quality gap between state-funded and private-funded organization should also be minimized to enlarge access to quality education in Indonesia.

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