The role of information and communication technology in developing smart education

Roslina¹, Muhammad Zarlis², Herman Mawengkang³ and RW Sembiring⁴

¹Politeknik Negeri Medan, Department of Computer Science, University of Sumatera Utara, Medan, 20155, Indonesia
²,³,⁴ Department of Computer Science, University of Sumatera Utara, Medan, 20155, Indonesia
E-mail: roslina@students.usu.ac.id / roslina@polmed.ac.id, m.zarlis@usu.ac.id, hmawengkang@yahoo.com, rahmatws@yahoo.com

Abstract. The right to get a proper education for every citizen had been regulated by the government, but not all citizens have the same opportunity. This is due to the other factors in the nation's infrastructure, Frontier, Outermost, and Disadvantaged (3T) which have not been accommodated to access information and communication technology (ICT), and the ideal learning environment in order to pursue knowledge. This condition could be achieved by reforming higher education. Such reforms include the provision of educational services in the form of a flexible learner-oriented, and to change the curriculum with market based. These changes would include the provision of lecturers, professors, and professional teaching force. Another important effort is to update the quality of higher education with resource utilization. This paper proposes a new education business model to realize the Smart Education (SE), with an orientation on the proven skills and competitive. SE is the higher education system to optimize output (outcome) learning with combine individual learning and collaboration techniques based network system, informal practice learning and formal theory. Utilizing ICT resources can improve the quality and access to higher education in supporting activities of higher education. This paper shows that ICT resources can support virtual connected with the use of shared resources, such as resource of information, learning resources, computing resources, and human resources.

1. Introduction

Ideals of higher education in Indonesia has been proclaimed by the founders of this nation. These ideals contained in the body of the Constitution of 1945, in particular Article 31, Paragraph 1 of the National Education. The right to get a proper education for every citizen had been regulated by the government, but not all citizens have the same opportunity. This is due to other factors in the nation's infrastructure, such as, Frontier, Outermost, and Disadvantaged (3T) are not accommodated to access the technology, information, and learning environment ideal to gain knowledge [1]. Information and communication technology-based knowledge led to change higher education paradigm that can not be negotiable to prepare the next generation that has competence in the national and international job market, and will meet the diverse employment opportunities. Whether through research and technology, as well as the realm of higher education, these changes produce more prospective scientists and future leaders who are able to work in the new millennium [1].

This condition could be achieved by the reform of higher education. The reforms include the provision of flexible educational services, learner-oriented and market share, revised curriculum, the provision of lecturers, professors, and employed. Another attempt is to improve the quality of higher education which is also done through the use of information and communication technology (ICT), the new education business model, and orientation on the proven skills and competitiveness [1].

The reform of higher education should be achieved through educational content in Indonesia. In Indonesia the teaching staff have to fulfill what is called TriDharma in order they could generate qualified and industry-oriented research. Students absorb knowledge with intake featured educator
resources to encourage their quick thinking, analytical, achievement, and innovative. Educational staff such as laboratory assistants also produce findings with professors. Elite higher education providers and controlling structural components will generate appropriate policies to prepare for future high-quality education and the ability of science and technology and innovation to support nation competitive. Figure 1 shows the workforce of education product in Indonesia [1].

![Figure 1. The workforce of education product in Indonesia [1].](image1)

Based on the number of labor force by education level as seen in figure 2. The majority of the graduates of Elementary School, which is 32,492,539 persons (26.5 percent). The labor force coming from the university level (undergraduate) amount 10,210,481 people (8.3 percent). The lowest number comes from the diploma, 3,337,985 (2.75 percent). [2]

![Figure 2. Labor force by level of education registered [2].](image2)

Figure 2 shows the number of vacancies registered about 800 thousand jobs, while the number of registered job seekers reached 1.4 million people. When compared with the fulfillment of the workforce which amounted to only 700 thousand only, then this means that there are 100 thousands of jobs that are not filled because job seekers do not meet the requirements in filling vacancies. The number of job seekers who meet the job is only half of the total registered job seekers. This is due to the gap between the needs of industry desired workforce do not match those produced by higher education. In producing a competent workforce and education, should be able suitable with changes
of the environment, society and technology, the pattern of education provision must be flexible and smart knowledge as Smart Education (SE).

2. Smart Education (SE)
SE can be defined as the characteristics of the smart learning tools, learning center that is optimized for individual learning, teaching himself directly, learn intellectually and learn together in the interaction with the use of information technology [3].

According to Lim Junghoon (2011) SE is a learning system to optimize output (outcome) that combines learning with individual learning techniques based on collaboration social networking system, learning practice of informal and formal theory. SE with optimal environment is to encourage students in the learning center with more active than the regular educational environment, by adding a number of factors such as the reference data and the latest information in the learning content, utilizing multimedia resources and interaction between students and teachers in real time.

In the future SE environment can improve collaboration and information sharing through online learning systems and interactions in the SNS. SE is not only focused on the approach and behavior of technology points independently, but with the distribution of smart appliances in the educational environment and the ability of educators to adopt smart appliances [4].

The rapid growth of the Internet and the development of environmental technologies such as smart phones and smart pads provide a consistent effect on the economy and public education. Trends creating a new term in the learning that is smart learning and smart education were created. Smart learning focus to technology-embedded learning to improve interaction and collaboration between learners. Due to instantly focus on cooperative interaction, smart device, which is useful for optimizing and maximizing instructional equipment direct interaction [5]. From the research results it can be concluded that one of the components that play an important role in the development of the SE is the utilization of ICT resources to interaction and collaborative studies.

3. SE concept
Improved quality of education and scientific achievements of higher education by building relationships through rules metric human-free digital monitoring and active cyber cloud in the educational process and scientific activities with the concept of Smart Cyber University (SCU) [6].

The SCU concept describe social cyber metrics culture, to creating smart network infrastructure personal with smart infrastructure, cloud control to digital monitoring and cloud management on education process, scientific activities and other resources to achieve a high quality in education and academic life.
4. The Role of ICT
The main purpose of the development of the SE is to improve higher education quality and access through the use of ICT to support the activities of tri dharma. Through virtual connected, SE is expected to occur the use of shared resources, such as resource of information, learning resources, computing resources, and human resources.[5][9]

The principle used in the SE network utilization is open source and open access so as to encourage collaboration and reduce the cost of investment and operation. ICT development for higher education is focus at the development of applications and the development of digital teaching materials to be used jointly between universities.

Trough teleconference enabled the joint study and learning between universities can be efficient and cheap. Enrichment learning through e-learning, blended learning, carried out in real time (real-time, synchronous) or virtual time (asynchronous). Resource sharing digital learning media can be done by e-journals, e-books are sourced from outside or developed by universities themselves. [7]

5. SE ICT Architecture
According IASA (International Association of Software Architects), an organization must develop a four of architecture integrated with each other, as well as the higher education as a hosting organization of the education system. Fourth architects are: [8]

a. Business architecture and organization
   Framework for a holistic and integrated perspective related to the business structure and organization of higher education institutions.

b. Information architecture and database
   Holistic and integrated perspective framework relating to information management systems and databases institution.

c. Application architecture and Software
   Framework perspective intact as well as related full portfolio of software applications and other modules that are interconnected in the management of campus.

d. Hardware architecture and network infrastructure
   Perspective framework on the existence of hardware and design of the network infrastructure that connects all points of communication in the university environment.

Figure 4. Higher Education Architecture [8].

6. Discussion
SE is the higher education system to optimize output (outcome) learning with combine individual learning and collaboration techniques based network system, informal practice learning and formal theory.
By utilizing ICT resources it would be possible to improve the quality and access to higher education in supporting tri dharma activities of higher education. ICT resources can support virtual connected, the use of shared resources, such as resource of information, learning resources, computing resources, and human resources.

7. Conclusion
The role of ICT in SE concept is the process of integrating the business and organizational architecture, information architecture and Database, Application and Software Architecture, Hardware Architectural and network infrastructure in organizing the higher education system to produce smart people.

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