A Conceptual Framework for Effectively Addressing the Digital Divide in Thai Primary Schools : A Case Study of Thailand

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Abstract— **This research addresses the problems, causes, and solutions of the digital divide in the primary schools of Thailand to propose the conceptual framework for implementing digital divide. This framework has been developed based on a literature review and a face-to-face interview-based survey. Thirty two primary schools in six provinces of Thailand which are Samut Sakhon, Phetchaburi, Phra Nakhon Si Ayutthaya, Suphan Buri, Sing Buri, and Chai Nat were surveyed. The factors are the infrastructure, the characteristics of population, the cost and quality of their Internet Service Provider, and government policy. Each factor must be considered to support effective digital divide implementation**.

Keywords— Digital Divide; Primary School; Internet access; Computers

I. INTRODUCTION

Information Technology and Communication (ICT) plays a great influence in every part of business and education [1]. The ICT has become the main channel for accessing information from the Internet, for instance e-commerce, e-government, e-learning, e-education, working online, social network, entertainment, and other application services [2]. In the aspect of the learning environment, the ICT is appropriate application applied not only for improving teaching methods but also supporting learning activities in the school. An example includes enhancing the interactivity between teachers and students by using interactive whiteboard technology, handwriting practices on a tablet PC, and English language voice lessons in English class [3][4][5][6]. On the other hand, the average number of students per computer in primary schools in Thailand is fourteen [7]. From this statistic, it shows that ICT in many schools is insufficient. This leads to the digital divide in supporting learning activities. The term digital divide has been defined by OECD [8] as the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access ICT and to their use of the Internet for a wide variety of activities. The factors that cause the digital divide are include the opportunities to have or have not ICT, a lack of infrastructure and poor telecommunication systems, living in rural areas with minimal population, and a lack of ICT skills [8][9][10][11].

Therefore, this research will be conducted on factors arising from the use of ICT in primary schools in Thailand by face- to-face interview to collect data for ICT development in primary schools. The factors are based on the survey data of the digital divide from thirty two primary schools in Thailand. The analysis of survey data are presented and are used to determine the factors related to the digital divide. Finally, the conceptual framework for the development of addressing the digital divide for primary schools in Thailand is then proposed.

II. LITERATURE REVIEW

This part presents the digital divide in foreign countries, digital divide in Thailand, and the factors related to the digital divide.

A. Digital Divide in Foreign Countries

A digital divide has occurred in many countries, and from different causes. Therefore, the solutions for bridging the digital divide of each country were different depending on the economic status, infrastructure, education of population, etc. [8]. The examples of digital divide are:

- The government in Sri Lanka is donating laptops through the One Laptop per Child (OLPC) initiative, for selected primary schools to enhance the new styles of learning [12]. The Sri Lankan government must provide the budget for buying laptops and the maintenance of them.
- Bangladesh developed community information centers such as public libraries, and increasing the number of

computers that can connect to the Internet for providing public access to their population. From this solution, the population can access the Internet without need for a private PC and internet link at home [13][14] and therefore decreases the cost of PC and internet link for the population.

- P. F. Cleary [15] describes the policy implications for primary schools student in United States. First, providing free or low cost Internet, where school students can access Internet at home or out of home. Second, teachers and parents must provide training, technical support and expertise for their children. Finally, enhance the online and distance education, so students can embrace self-learning.

B. Digital Divide in Thailand

Thailand has many policies and solutions for bridging the digital divide. Most policies are set by the government. The examples of policies are:

- Increasing the coverage areas of the third generation mobile telecommunications (3G) wireless network across the country. This solution is suitable for developing countries, such as Thailand, India, Vietnam, etc., because in rural areas as they still lack fixed line infrastructure. Therefore, the implementation cost of fixed line infrastructure in rural areas is very high, compared with wireless networks, such as 3G, WiFi, and WiMax. An wireless network antenna can cover a wide areas, moreover wireless networks do not need fixed line infrastructure to each household [16].
- The policy on the use of information technology to improve education in primary schools based on a child-centered approach. Moreover, the government creates a Cyber Home System (CHS), serving as a medium providing teaching materials for students. When students want to learn content, it can be retrieved instantly. The medium of instruction will be sent to the students via the Internet. The government has recognized the importance of the equipment used for Internet browsing. Therefore, the government presented the tablet PCs policy for education to the media as a key technology for the development of education in the country today. The tablet PCs are distributed to students through the "One Tablet PC Per Child". This project focuses on the first year of primary school students with the objective of reaching 539,466 students in the future, it is used as a medium of learning for the individual, to share experiences, and learn from each other. The students can access information from the Internet [17].
- The Ministry of Information and Communication Technology is installing WiFi to about 50,000 hotspots nationwide available without charge. That covers public areas and allows public access to the Internet without charge to the population. This bridging of the digital divide in access to information, enhances quality of life, and education of the population in Thailand.
- There are some organizations, such as King Mongkut's University of Technology Thonburi (KMUTT) [19], The Mirror Foundation [20], that collect obsolete personal computers (PC), donated by personal, public organizations, and private organizations. Those organizations not only collect the PCs but also they will check and repair the PCs so that it is in good working condition. After that, they donate them to primary schools in rural areas that have a shortage of computers. This method can reduce the digital divide, moreover it reduces a great deal of electronic waste that impacts the environment.

C. Factors Related to the Digital Divide

From studying the literature review, there are four factors related to the digital divide include infrastructure, characteristics of population, cost and quality of internet service provider, and government's policy. The details of each factor are presented below.

1) Infrastructure

Infrastructure and Telecommunication factors are commonly referred to as fixed line telephone, Internet access (dial-up, broadband and 3G), electricity, computer, mobile device and tablet PC. These forms of infrastructure are crucial factors for accessing the Internet [21]. The lack of infrastructure is the beginning factor that causes the digital divide. The completeness of infrastructure between urban and rural in developing countries such as Thailand, India, China, etc. is very different. In developing countries, excellent infrastructure is limited to urban areas, however in rural areas they still lack infrastructure. Because in rural areas population density is low, and the distance between each household is great. The infrastructure must cover a wide areas, so the investment and maintenance cost is very high. The demand of Internet access in rural areas is quite low also, because the main occupation of rural areas is agriculture. Therefore the development of infrastructure in rural areas is very slow, because it is always ignored by the government and private company [22][23]. As we seen that a great deal of primary schools are located in rural areas that lack infrastructure and ICT. In 2008, The National Statistical Office Thailand (NSO) surveyed the average number of students per computer in primary schools, and found it was 14 students/computer, vocational education 8 students/computer, university education is 11 students/computer and non-formal education 109 students/computer. From the NSO's result it indicated that the number of computers were not insufficient compared with the number of students. Moreover, the NSO analyzed the percentage of computers which can access the internet, and found that in primary schools it was 66.7%, vocational education 85.7%, university education 96.3% and non-formal education 60.5% [7].

2) Characteristics of Population

The characteristics of population factors, consists of nationality, age, gender, education background and income that are important [15]. Education background and income are

always the most important factor for determining the digital divide, because income is highly related with the cost of ICT. The NSO surveyed the impact of household's income and Internet access in 2008, and found that the lowest group with Internet access has an income of less than 10,000 Baht as 1.0%, and the highest group with Internet access has an income of more than 30,000 Baht as 45.9%. From this result, the digital divide between low income and high income is still broad [7].

Education background strongly impacts with ICT skill and Internet access, the populations, who have studied in higher level education such as bachelor degree or higher than bachelor degree, will have more opportunities for using the Internet. Moreover, the populations, who study in higher degree education, have a faster learning skill, understand English and have more basic knowledge. Most websites and user's manuals are written in English, therefore population with a higher education background can use ICT better than those with a lower education background [24]. From the NSO's surveyed of internet access, the result indicated that the lowest group was the population who studied at lower level primary school represented 11.8% of users, and the highest group was the population who studied higher than a bachelor degree and they represented 74.2% of users.

Moreover, the digital divide is caused from not only income and education background but also nationality, gender, and occupation also have an impact on the digital divide. For the age factor, the senior population are using the internet less compared with the younger age groups [16].The lowest group is the senior population (older than 50 years old) at only 5.5%, and the highest group are adolescents (15-24 years old) at about 51.9%[7]. For digital divide of gender was no significant difference between males and females, 62.2% for males and 63.7% for females [15]. Furthermore, the effect of nationality factors with the digital divide were an important factor, in the United States, nationalities, because there are many immigrants in the United States, for instance Asian, White non-Hispanic, Black non-Hispanic, Hispanic, American Indian/Native American non-Hispanic. The largest group, using the Internet at 68.8%, is Asian, and the lowest group, using the Internet at 45.2%, is Hispanic [25]. However, in Thailand, the result from NSO did not concern nationality, because they are so few immigrants in Thailand, and therefore the questionnaire of the NSO was in Thai language only.

3) Cost and Quality of Internet Service Provider (ISP)

The cost for Internet access in Thailand is quite high, compared with the income of the Thai population. Hence, many people cannot afford to access the Internet at home, because the price is too high for them. The most popular price range in Thailand is 400-599 Baht per month, which is the lowest price from Internet service providers (ISP). This is enough for accessing the web, searching for information and for entertainment. The price range over 800 Baht is for companies and Internet cafes, which have more than five users and require fast internet connection for interactive applications such as video conferencing, voice over Internet, etc. [7]

The cost of mobile internet access is very expensive, because the cost is calculated from the actual transfer data at about 350 Baht per gigabyte, excluding the cost of calling. The average total cost for a mobile phone with 3G Internet access is about 700 Baht per month with limited 1.5 gigabytes data transfer. In the case of unlimited data transfer the cost is more than 900 Baht per month, but the 3G speed is limited to only the first 2 gigabytes of data transfer, and when over 2 gigabytes the Internet speed decreases to that of EDGE technology. For this reason, the people who access the Internet from their mobile phones represent only 5.5% of the population. Moreover, if the populations are in the rural areas, the 3G signal cannot provide enough coverage so the mobile phone Internet speed using the slower EDGE technology. The speed of EDGE is very slow at only 128 kbps. [16]

4) Government's policy

ICT polies and regulations are defined by multiple levels of organizations, which are national government, region, province, district and school. ICT policy maintains the goal of enhancing ICT in primary schools, and implementation of ICT policy follows the procedure from the government to reach the ultimate goals, and includes the expectations, goals, content and procedures. The factors of ICT policy consist of applying ICT for teaching, the provision of professional development, the outcomes of ICT skill of teachers and students, hardware and software to require and support, ICT curriculum, funds to distribute, etc. [26]. In Thailand, most policies come from the government, defined for all primary schools in Thailand, such as the "One Tablet PC Per Child" policy, which allocates a tablet PC for every first year primary school child [17]. The "ICT Free WiFi for Public" policy from the Ministry of Information and Communication Technology provides 50,000 access points throughout Thailand for the population to access the Internet without charge [27].

From the literature review, each factor has a strong influence on the digital divide development. There are many digital divide frameworks. However, those frameworks are not appropriate with the case study of primary schools in Thailand. Therefore, this research proposes the conceptual framework of digital divide development for primary schools. The methodology, survey conclusion, and the conceptual framework are presented in further sections.

III. METHODOLOGY

A. Data Collection

This survey was conducted in the last quarter of 2012. The research covered 32 schools from 1556 schools, located in six provinces of Thailand, and they were Samut Sakhon, Phetchaburi, Phra Nakhon Si Ayutthaya, Suphan Buri, Sing Buri, and Chai Nat. These 32 primary schools want to involve with the digital dive project contributed from School of Information Technology (SIT), King Mongkut's University of Technology Thonburi (KMUTT). Moreover, these primary schools are located 200 kilometers distance from SIT, KMUTT.

This research used a face-to-face interview-based survey. The focus participants of this research were separated into two groups. The first group were the teachers who were related with ICT both teaching and maintenance of the ICT, including

the head master of each school. The second group were the primary schools students. The results present by using the descriptive statistic in chart format.

B. Interview

The researcher was interested in measuring the digital divide that occurred in the primary schools, determined by infrastructure, characteristics of population, cost and quality of ISP and the government's policy. This research collected data by using a face-to-face interview-based survey. The questions were predefined for controlling the answer and time. This study consisted of participant observation, interviews focus group discussion. The researcher collected data by taking notes, take the photos and video recording.

IV. RESULT AND DISCUSSION

The data analysis for the status of ICT in 32 primary schools in Thailand is presented in this section.

A. Infrastructure

The infrastructure concerns in this research are the number of students per one computer, the computer availability, and the performance of the computer.

The number of students per one computer is set up not only to determine the adequacy of computers in the computer classroom provided at a school but also to show the efficiency of learning in the school. The number of students per computer is calculated from the number of students in the computer class with the number of available computers. The number of available computers should be minus one, because the available computers do not include the teacher's computer. This formula is shown in equation (1).

$$no.of\ students\ per\ computer = \frac{no.of\ students\ in\ each\ grade}{no.of\ available\ computer - 1} \quad (1)$$

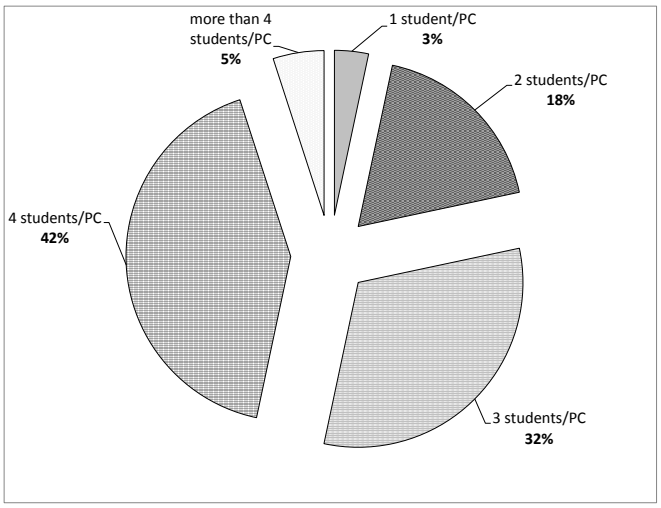

Fig. 1. The number of students per one computer

From Figure 1, it can be seen that there is only 3% of the 32 primary schools that a student uses a computer while they are in the computer class. Furthermore, 18% of the 32 primary schools show that two students use one computer together in the computer class. Moreover, the ratio of using one computer per 3 students is 32%. Most schools achieve to 42%, which means they can provide one computer per 4 students. Finally there are 5% of the 32 primary schools where more than 4 students use one computer while they are in the computer class. From this data, the lack of computers to be used in the computer class will lead to the learning efficiency. The students lack the skill to use them and lack of practice by themselves while they are in computer class.

The computer availability in primary schools is calculated from the number of available computers divided by the number of all computers. This formula is shown in equation (2).

$$no.of\ computer\ availability = \frac{no.of\ available\ computer}{no.of\ all\ computers} \quad (2)$$

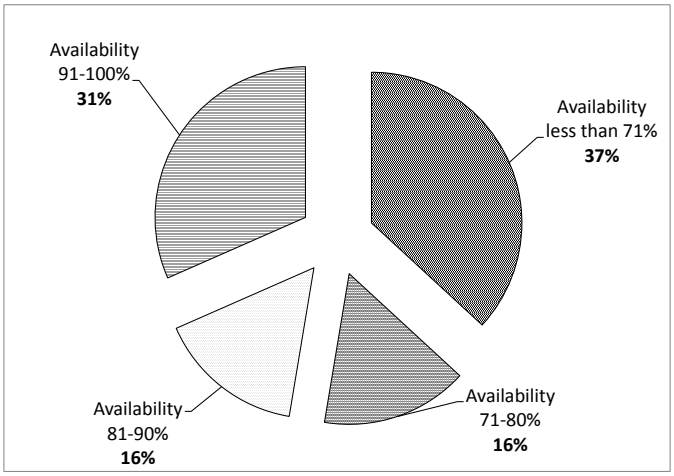

Fig. 2. The number of computer availability

From Figure 2, it can be seen that primary schools (22%) have the computer availability at less than 71%. Moreover, there are 19 primary schools out of 32 primary schools (59%) that have computer availability between 91% and 100%. Furthermore, there are 13 primary schools out of 32 primary schools (41%) with computer availability between 71% and 90%. From this data, it can be seen that some primary schools have computers to be used in the school but lack of computer maintenance occurs. The cause of lack of maintenance comes from the lack of skill of the teacher to fix the problem arising from the computer or lack of budget provided by the government. Therefore, the teacher cannot find new computer components to replace the old ones.

The performance of computers is considered in the aspect of CPU speed, the memory capacity (RAM), and the hard disk capacity which is compared with the computer specifications that can be installed on Windows 7 or Windows 8. The specifications of computer to install Windows 7 or Windows 8 is 1 gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor, 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM (64-bit), 16 GB available hard disk space (32-bit) or 20 GB (64-bit) [28][29]. The survey result is shown in Figure 3.

From Figure 3, it can be seen that most of primary schools (91%) have the CPU speed and hard disk capacity to install

Windows 7 or Windows 8. Unfortunately, most of these schools (88%) have computers with a memory capacity (RAM) lower than the standard to be used for installing Windows 7 or Windows 8. Therefore, the primary schools that have the suitable specifications to install Windows 7 or Windows 8 are equal to 13%.

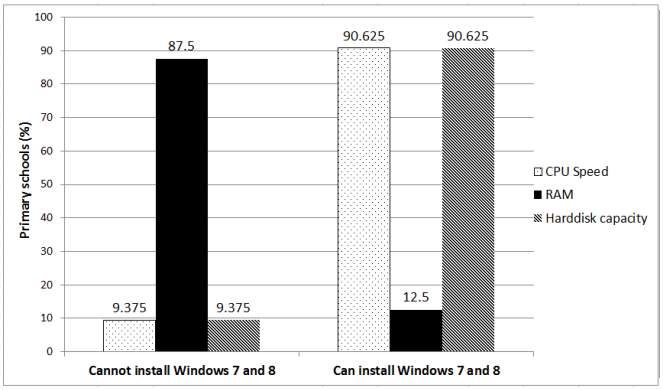

Fig. 3. The computer performance

B. *Characteristic of Population*

The demographic factor is another important factor that is causing the digital divide, especially the basic factors of education and income. The main index used to measure the digital divide, in this research, is the attendance at training courses of primary school teachers. The survey result is shown in Figure 4.

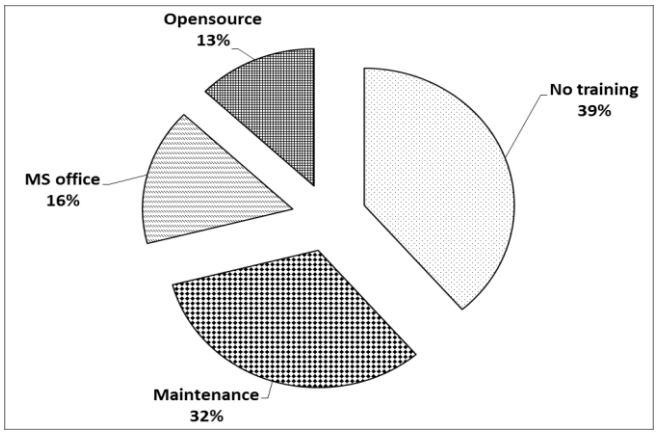

Fig. 4. The attendance in training courses of primary school teachers

From figure 4, it can be seen that the most computer teachers in primary schools (39%) never attended the training classes. Only 32% of computer teachers attended the computer maintenance classes. Only 16% of computer teachers attended the Microsoft office class. Finally only 13% of computer teachers attended the open source application class. From the result, it can be said that teacher attendance in computer classes was inadequate. This leads to a lack of skills in having the expertise in using computer.

C. *Internet Connection*

There are 4 internet connection types in the survey of primary schools which were 1) no internet connection. 2) connection via satellite using the IP Star 3) connect through ADSL signal at 2-4 Mbps and 4) connected via ADSL at speeds greater than 4 MB. The survey results of the internet connection is shown in Figure 5.

From Figure 5, most of primary schools (53%) connect the internet through the ADSL signal at 2-4 Mbps. Moreover, there are 7 schools out of 32 primary schools (22%) that use satellite via the IP Star to connect the internet. Furthermore, there are 4 schools out of 32 primary schools (13%) and 4 schools out of 32 primary schools (13%) that use ADSL at speeds greater than 4 MB to connect the internet and no internet connection respectively. From the data, most of primary schools are connected with the unstable signals such as the IP star or ADSL signal at 2-4 Mbps. These types of connection will lead the school to encounter trouble with the internet connection when it is raining. Moreover, the speed of internet connection is slow because of a lot of bandwidth usage.

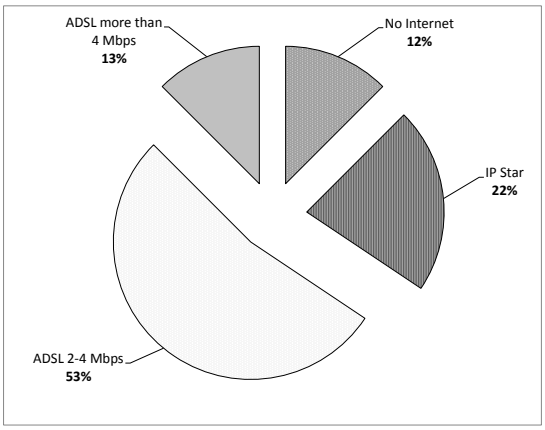

Fig. 5. The internet connection

Nowadays most mobile devices, such as tablet pc and mobile, connect to the internet by using WiFi. However, most primary schools (87.5%) do not have WiFi, therefore the tablet PC donated by the government cannot access the internet. Therefore, the government should support WiFi access points at the schools, which receive tablet PCs from the government.

D. *Government's Policy*

The government provision of computers to primary schools compare with donations from the universities or other organizations to the primary schools is shown in Figure 6.

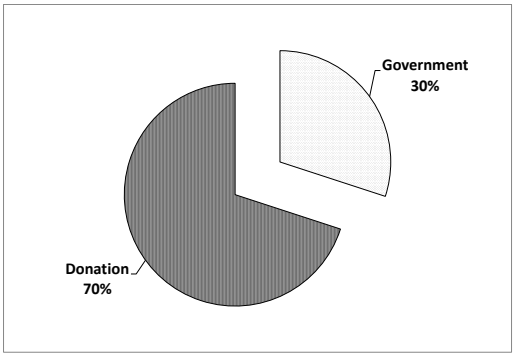

Fig. 6. The comparison of computers provided

From Figure 6, it can be seen that of computer from the government is equal to 30% but the donation by the public, such as the universities, is equal to 70%. Therefore, the policy of supporting computer in the primary schools should be set by the government.

E. The Conceptual Framework for Implementing Effective Digital Divide

From the literature review and the survey results, the factors related to the digital divide is proposed and shown in Figure 7 include infrastructure, population, internet service provider, and government's policies. In order to perform a successful digital divide project, these factors should be considered together. If the lacks of any one factor to the implementation of digital divide, it may be an unsuccessful project. This means that if the infrastructure and internet provider factors are ready and the government fully supports the budget but the teacher lack of computer knowledge or teachers do not want to learn new things. This will lead to the lack of sustainability of digital divide project.

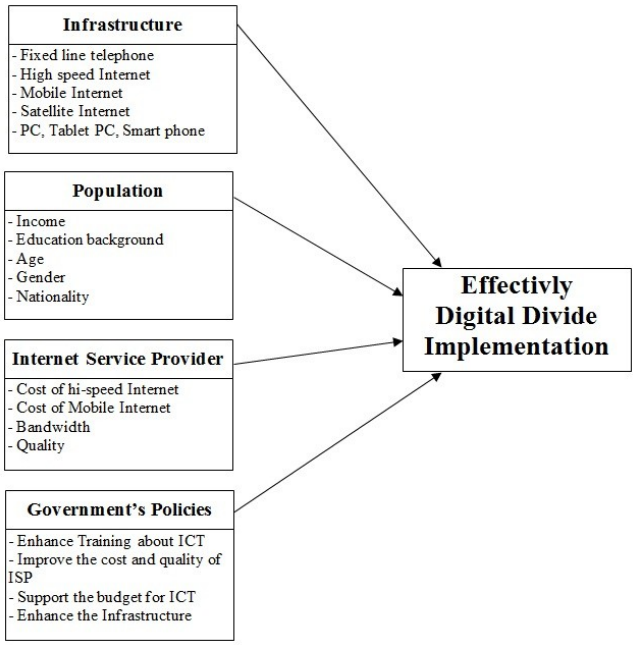

Fig. 7. The conceptual framework for developing digital divide

V. CONCLUSION

The conceptual framework for addressing effective digital divide in primary schools in Thailand is proposed in this paper. It consists of the infrastructure, the educational background, the cost and quality of Internet service provider, and the government policy. These factors are proposed by surveying in the last quarter of 2012 thirty two schools out of 1556 schools that located in six provinces of Thailand which were Samut Sakhon, Phetchaburi, Phra Nakhon Si Ayutthaya, Suphan Buri, Sing Buri, and Chai Nat. This framework is useful for education organizations and other related organizations such as Office of the Basic Education Commission, Ministry of Information and Communication Technology to develop effective and sustainability solutions to address the digital divide in primary schools. The affirmation of these factors related to the digital divide proposed in this framework should be considered for further research.

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