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# The application of information and communication technologies on digital learning to reduce the digital divide

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## Abstract

Digital learning is gaining a lot of attention in these few years. However, digital learning is still not yet widely adapted. One of the main reasons is due to the digital divide. Digital learning requires the learners to possess certain equipments and skills to participate. Due to the education level, income, generation, behavior, geographic location, etc., learners may not have the required equipments or skills or both to join digital learning. Moreover, insufficient professionalism and the lack of content also hinder the promotion of digital learning. Many nations have national policies to reduce the digital divide, mainly in establishing the necessary infrastructure such as network and computer to broaden the accessibility of digital technology, and deploying online government services to encourage the usage of the digital technology for public. One the other hand, the quality and quantity of the digital content for digital learning is still insufficient. The lack of an open platform, authoring tool chain, convenient digital right management mechanism, system supporting mobile behavior and customization, etc., are some sources of

the problem. We will describe several ongoing projects that are aimed to solve or reduce these issues. Combined with the efforts from the industries, such as system integrator, chip manufacturer, and mobile communication vendor, these projects will help encouraging the industries to invest in the creation of digital content.

**Key Words: Digital learning, digital right management, offline learning, home learning**

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## 1. Introduction

The 21st century has transformed into the so-called Knowledge Based Economy (KBS). The KBS is primarily based on the production, distribution, and application of knowledge and information. At the heart of these changes are the innovations made possible by information and communication technology (ICT), which are transforming the ways in which economies, and the people within them. ICT has therefore become one of the main drivers of growth in not only the economic growth but also the quality of social condition.

The importance of ICT to both economic and social development explains the priority of bridging the so-called “digital divide.” The digital divide is defined as the gaps that separate segments of society as well as whole nations into those who are able to take advantage of the new ICT opportunities and those who are not. Crossing the digital divide is essential for being competitive, as expressed in the 2000: A better world for all report as we have just produced with the IMF, the UN, and the World Bank Group. This critical importance was affirmed by the G8 leaders at their Okinawa Summit in Japan last month, when they agreed to set up a “Digital Opportunity Task Force.”

The digital divide issue should be attacked from several sides, including policy and technology. National policies help to establish the essential infrastructure, improve the availability of digital learning to everyone, promote an open platform, encourage research, etc. In the technology domain, one goal is to ensure that digital learning is accessible and suits everyone, with the entry-level skill requirements as low as possible. Since the quality and quantity of the digital content is critical for digital learning, technologies that encourage the industry to

create digital content is very important.

In this document, we will first analyze the relations between learning and digital divide. We will also identify potential approaches to reduce the digital divide. We will then provide literature survey regarding related national policies, such as US, UK, Japan, Korea, and Taiwan. Afterwards, we will look into the technology side and describe some involved issues and some of our ongoing projects that are aimed to solve the problems.

## 2. The digital divide issues in learning and the approaches to reduce the digital divide

More and more information are being digitized, including the learning materials. It is becoming a common practice to search and use the materials available on the Internet for the purpose of learning. This digital literacy is available only if the individuals have the necessary skills and equipments. Unfortunately, digital divide will limited the availability of these materials, which in turns causes unfairness in education. On the other hand, education is a way to narrow the gap of digital divide. By improving the skills of the individuals, the availability of the information will be broadened.

### 2.1 The digital divide issues in learning

There are two main issues that cause inequality in learning: lack of access to digital technology and limited education.

#### 2.1.1 Lack of access to digital technology

Many of the learning materials are turning digital. One of the easiest ways to widely spread these materials is to put them on the Internet. For

example, MIT OpenCourseWare has published MIT course materials on the web to provide free access to this information. To access digital literacy we need digital equipments. A computer in any form is required to parse and display the digital materials, and access to Internet is necessary if Internet is used as the distributed channel. There are many factors which may limit the available of these digital technologies.

Cost: Due to the advances in ICT and open competition, the costs of the equipments are sliding. However, they are still unaffordable for those who have no money to spare after paying the cost of living. The costs including those of the ICT equipments, Internet access, cable access, etc. Furthermore, there are the costs of maintaining and upgrading these products, buying learning materials, and paying the monthly costs of accesses.

Generation: While most of the youth are used to ICT such as computer and Internet applications, many of those over 40 are no regular user for these high-tech toys. Inequality in education between the youth and the adults is a main reason in this gap. The youth get training on ICT at school and among each other. On the other hand, the adults are short of ICT training, due to the lack of time, motivation, insufficient coverage of adult training, etc. They usually are trained only on demand. Furthermore, the inexperience of parents on ICT also has an impact on the education of the youth. The parents have to learn whether their children are participating an online learning session or just playing online game when they are using the computers. The parents also have to learn the value of ICT and digital learning. This generation gap is more severe in developed countries.

Infrastructure: Digital learning needs a well-established

infrastructure as the carrier. Nowadays, Internet is such an infrastructure that it is commonly used to deliver online learning. Others infrastructures such as TV broadcast network, radio network and mobile communication network are also being used or evaluated. However, building an infrastructure is extremely expensive. In the developed countries, these infrastructures have already been deployed in the urban areas, but the coverage in the rural areas is less satisfying. This limits the access of the information to these areas, and the opportunities for the local individuals (workers, teachers) to obtain the required skills. In the developing countries, the problem is even worse.

Design: The design of the ICT products also pays an important role. The design issue lies in both hardware (physical) and software (virtual). The hardware should match the physical appearance and behavior of the users, and the software should be easy to understand and operate. Most of the ICT products are not designed for the disabled, which limits the access of ICT and thereby the information to the minority. Moreover, the elders find that the ICT products are hard to understand and use. This affects many individuals since there are more than 10% of the populations in some countries those ages are over 65. This is one of the obstacles that should be overcome to promote lifelong learning.

### 2.1.2 Limited education

In the current stage, the products of digital technology require special skills and knowledge to understand, setup, operate, maintain, and upgrade. For the mass users, they require entry-level knowledge and skills to setup, operate and maintain the digital devices and maybe Internet access for digital learning. For the professionals, they have to understand ICT deeply to help others to install, setup, maintain, and

upgrade their products.

**Skills:** ICT has advanced a lot in the previous years and is becoming much easier to use. For example, the settings of mobile data network in the earliest form are hard to setup, while they can be automatically setup by dialing a number in the current stage. However, basic skills in operating and maintaining the ICT products are still required to participate in digital learning. The acquisition of these skills is limited by the issues described in the previous section. Moreover, the acquisition is also affected by the regulation and the willingness of providing ICT training in schools and training centers. The governments are responsible of ensuring not only the young people, but also the adults and the elders to be able to participate in ICT training and to continue to improve their skills and knowledge. For the educational institutes, training in ICT is quite common nowadays. Since self-learning in ICT is also very common, students already have different levels of understanding and skills. One of the issues for these institutes is to provide suitable training to the students based on their understanding and skill, age, gender, family life, etc.

**Professionals:** To ensure that the individuals are well trained to participate in digital learning, a large force of ICT professionals is necessary. These professionals include the teachers, the workers, and the content providers. The teachers should have enough skills to teach the students about ICT and be skillful enough to utilize digital learning for teaching. One of the problems is that digital learning is a relative new field, and many teachers need training themselves to utilize the technology effectively. The workers provide digital technology to the customers to less their burdens in installing, setting up the products, maintaining and upgrading. On job training is a reliable source for the

workers to obtain the necessary skills, but it is expensive for the medium and small business to design and operate their own training courses. Finally yet importantly, digital learning requires extensive digital materials, and simply digitalizing the learning materials is not enough. The content providers have to design and tailor the content to suit the devices, the infrastructures, the users, the teachers, etc. Since digital learning is still maturing, much work and research is required to satisfy the above needs.

### 2.2 Approaches to reduce the digital divide

Digital learning can be used as a tool to reduce the digital divide, and by narrow the gap, the coverage of digital learning can be broadened. To reduce the digital divide and broaden the availability of digital learning, several approaches are listed below.

#### 2.2.1 Encourage research

By encouraging the research on digital technology, the design of the ICT products can be improved and their costs lowered. Products with better design can reduce the entry-level difficulties for the mass. Improved process of manufacturing can cut the costs so that ICT is more affordable. New learning models can help delivering the knowledge in a more efficient way. Furthermore, in the process of development and research, skills of the participants in ICT are also improved. With proper channels and media, the knowledge can be shared among the professionals.

#### 2.2.2 Standardize platforms and technologies

One of the problems in ICT is the existing of multiple standards. For example, in digital learning there are several open and numerous

proprietary standards and formats. These multiple standards will affect the sharing of the learning materials in a negative way. Media produced for a platform are usually incompatible to other platforms, and the content providers have to choose carefully, usually based on the market share of the platforms, for their content. A standard and open platform is necessary to maximize the availability of the learning materials. An open platform can help to assure the equality in the availability of the technology, and allows the developer to customize the materials and carriers for the individual needs.

### 2.2.3 Improve the skills

The skills of the teachers, content providers and developers are critical in digital learning. Teachers have to understand the new technology and the applications in order to use them to support teaching and to pass the knowledge to the students effectively. The training of the teachers requires the cooperation of the educational institutes, the government, and the teachers themselves. Institutes and government have to help the teachers to acquire the new technologies continuously. Moreover, channels among the teachers can be helpful in experience sharing and discussion. For the content providers, the better they can understand the new technologies, the better they can prepare the materials in both the form of media/distribution and the content itself. Some developers are used to focus on the technologies and the functions, without really understanding what users need. If these developers are more skillful in understanding human behavior and the requirements of digital learning on the ICT products, they can produce better ICT products that are extremely easy to use. Special requirements must also be satisfied so that individuals such as disabled and elders can also

participate in digital learning.

### 2.2.4 Increase the opportunity of ICT access

No matter how cheap is the cost of the ICT products, they will still be unaffordable for some families and individuals. The government or the enterprises may give public access to the ICT equipment in community centers or free Internet connection to the households. Furthermore, kiosks can be placed at the public locations such as train and bus stations, or may be even on the traffic lights or lampposts. Places well equipped such as network bars can also act as learning centers. Moreover, teaching the parents of the importance of ICT will also help increasing the opportunity of learning digital technology for their children.

## 3 National policies

In this section, we will examine the policies of reducing digital divide in several countries, which is related to digital learning. United States and British are two countries that are the frontiers in digital divide research. Korea is quite advance in ICT and close neighbors of Taiwan. Their policies will be good references.

### 3.1 Foreign countries

The role of the US government is to increase the opportunity to go online, improve the ICT skills via training courses, and create extensive content, so that every individual has adequate skill and chance to utilize the digital technology. Their policy of narrowing the digital divide is based on two principles: universal service and equal access. Their goal is to protect the citizen’s right of information access. There are several programs aimed to bring pervasive network access to the individuals and

the families: E-rate[1], TOP (Technology Opportunities Program)[2], Neighborhood Networks[3], RUS (Rural Utilities Service)[4], etc. LAAP (Learning Anytime Anywhere Partnerships Program)[5] and ITTI (Indian Telecom Training Initiative)[6] are programs that are designed for education and learning. There are also several programs to provide information access to the disabled people, such as WAI (Web Accessibility Initiative)[7] and TRS (Telecommunications Relay Service)[8].

UK Online is the UK's policy to bridge the digital divide, which focus on business, public network centers, public libraries, and government services. There are programs that improve the network environment at home, workplace, and community; help establishing the digital content market to encourage online activities; provide second hand computers to the low-income households; build a mobile ICT centers to promote ICT for the public; and provide network services in every public library. In the education and training section, every school is granted free Internet access. ICT training in school and lifelong training is being established. College courses are provided to the enterprises and the public, and free ICT courses are given to the jobless. Programs include NGfL (National Grid for Learning)[9], Ufi (University for Industry)[10] and UK

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1 E-rate, http://www.sl.universalservice.org/
2 Technology Opportunities Program, http://www.ntia.doc.gov/otiahome/top/
3 Neighborhood Networks Initiative, http://www.hud.gov/nnw/nnwindex.html
4 Rural Utilities Service, http://www.usda.gov/rus/
5 Learning Anytime Anywhere Partnerships, http://www.ed.gov/programs/fipselaap/index.html
6 Indian Telecom Training Initiative, http://www.fcc.gov/indians/ITTI/
7 Web Accessibility Initiative, http://www.w3.org/WAI/
8 Telecommunications Relay Service, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-237022A1.pdf
9 National Grid for Learning, http://www.ngfl.gov.uk/
10 University for Industry, http://www.ufi.com/

online centres[11].

In Japan, the promotion of ICT in education is regarded as a national priority. The 100-School Networking Project[12] is an experiment for the practice of sophisticated utilization of school-networking. The E square Advance (e2a) Project[13] is the follow up of the E square (e2) Project. The project is designed to study and systematize the advanced methods and requirements of effective IT use in the class, and to present the results to the teachers, schools, boards of education, related industries, etc.

In Korea, the Act of Closing Digital Divide is set to ensure equality in Internet and telecom access. Public access centers are built to provide IT training, network equipments, telecom services to the public. National and local IT training plans are made to financially help the disabled, minority, elders, etc. to improve IT skills.

### 3.2 The current related policies in Taiwan

In Taiwan, there are projects such as e-Taiwan[14], IPv6 Project[15], Taipei CyberCity Initiative[16], ABCDE projects[17], that are aimed to provide better quality of life and improve the competitiveness of the industry and the government. These projects are more or less related to the bridging of the digital divide. In this section, we will introduce the policies that are aimed to (1) broaden the availability of

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11 UK online centres, http://www.dfes.gov.uk/ukonlinecentres/default.cfm
12 100-School Networking Project, http://www.cec.or.jp/e-cec/CEC_100school.html
13 The E square Advance (e2a) Project, http://www.cec.or.jp/e-cec/CEC_E2A.html
14 e-Taiwan Project, http://www.etaiwan.nat.gov.tw/
15 IPv6 Initiative, http://www.etaiwan.nat.gov.tw/
16 CyberCity Initiative, http://english.taipei.gov.tw/content.jsp?categid=64&topicid=-1&langid=1
17 ABCDE projects, http://itap.tdp.org.tw/content/application/tdp_itap/cnt.class/index.php?cnt_id=4397

telecommunication and Internet access for the public; (2) give Internet access to the schools and the libraries; (3) provide electronic government services; (4) promote digital learning.

The costs of the telecommunication and Internet accesses are dropping since the opening up of the telecommunication market. Between1995 and 1997, licenses for the mobile communication services were released, including digital low-tier cordless telephony business, 2G mobile telephone, mobile data communication, etc. They were, then, followed by fixed network communication and resale services from 1999 to July 2001. In February 2002, five 3G licenses were issued via price-bidding process. The price drop is one of the reasons that the number of the individuals and families that have Internet access, including broadband Internet and mobile network access, is rising. According to the latest statistics by ACI-FIND of III[18], there were 2.7 million broadband (DSL and cable modem) subscribers in Taiwan by the end of September 2003, representing a 45% increase compared to the same time period of the previous year. According to International Telecommunication Union (ITU), the penetration rate for Taiwan's broadband Internet access has reached 9.4%, fourth place worldwide, trailing South Korea, Hong Kong, and Canada. There are 9.3 million Internet subscribers (accounts) in Taiwan by September 2003. Dial-up subscribers account for nearly half of the amount, DSL and Mobile Internet subscribers accounts for about one quarter respectively. According to Directorate General of Telecommunications (DGT) under Ministry of Transportation and Communications (MOTC)[19], there are

[18] "Broadband Subscribers in Taiwan 2003," http://www.find.org.tw/eng/news.asp?pos=0&subjectid=4&msgid=81

[19] "Mobile Internet Subscribers in Taiwan 2003,"

25.3 million mobile phone subscribers in Taiwan by February 2004, with a penetration rate high as 113%. Among them are 2.2 million Wireless Application Protocol (WAP) and General Packet Radio Service (GPRS) subscribers. The more wide-spread is the networking access, the more coverage digital learning can achieve.

Providing the schools with networking access has been a main concern for Ministry of Education. By 1999, all schools in Taiwan are providing with networking ability, while all secondary and elementary schools have computer classrooms with broadband access. In 2003, the number of teachers and students that are frequent Internet users is 3.45 million. These people will more likely to possess ICT skills in order to participate in digital learning.

Since the initiative programs of e-government in 1997, Taiwan has improved e-services to some extents. The e-government programs are pushing towards a convenient and efficient government in four dimensions: infrastructure, e-management, information integration, and public e-services. Individual city governments are also working on promoting public welfare and enrich the lives of the residents. The goals of Taipei's CyberCity project are (1) increase the use of internet to decrease the use of roads; (2) equal access to Internet services for all; (3) view internet services as public utilities; (4) create a ubiquitous network of public services; and (5) enhance Taipei's competitive advantage by bringing the internet to its people in an accessible manner. Information technology is being integrated into the operations of city government. Ways to improve the services offered to the public via ICT is being

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http://www.find.org.tw/eng/news.asp?msgid=75&subjectid=4&pos=0

explored. Then the non-governmental related information will be provided through a public interface network. These efforts will encourage the adults to explore and utilize ICT.

The National Science and Technology Program for e-Learning[20] is focused on digital learning for the public, narrowing digital divide, open platform, skill development, etc. Activities and channels for digital learning are planned for the workers, farmers, community, enterprise, officials, professionals, etc. An open platform known as digital schoolbag is being tested and evaluated in elementary schools. This platform includes the mobile device hardware and software, learning material format, business model, applications, development tools, evaluation tools, content management, content protection, etc. There are also plans to attack the problem of skill development in all dimensions, such as taxes, certification, and training centers.

## 4 Using ICT to reduce digital divide

In section 2 we have described that the digital divide on digital learning is mostly due to the limited access to digital technology and limited education. In the policy section, the government has reduced the digital divide to a certain extend by encouraging establishment of infrastructure and services and promoting research. In the technology domain, ICT can be applied to narrow the gap, which will be discussed in the following section.

[20] National Science and Technology Program for e-Learning, http://elnp.ncu.edu.tw/

### 4.1 Issues

Due to the efforts of the government and the industries, the infrastructure for Internet and cellular access in Taiwan is quite well-established in terms of coverage. These accesses are also improving in quality, i.e., the transmission rate keeps rising and the connections are more reliable. However, these connections are only channels for the delivery and processing of the digital learning. Another critical part in digital learning is the digital content. Currently, there are not much digital learning materials publicly available. Although every school has Internet access, seldom are these access involved in teaching. One of the problems is that the digital materials are difficult to author, usually requiring highly skilled professionals to invest a long time and a high cost to make one, which are unaffordable for the teachers. Another reason is due to the uncontrollable distribution nature of the digital content. These content take a lot of time and efforts to author, but are pretty easy to be copied. The content providers are thus uninspired in creating digital content. The lack of the standard in content authoring and management also contributes to the scarcity of the digital content. Even though there are standards such as OeB and SCORM in content representation, the lack of an open platform for the delivery and the presentation of the digital content still hinder the digital content industry.

Another issue is the mobile nature of people. Everyone in Taiwan has more than one mobile phone on average, and is carrying many other mobile devices such are PDA. However, digital learning platforms usually do not support the mobile devices and mobile behaviors, due to the variety of the device specifications and the lack of offline learning supporting. The authorization and authentication of the digital content

supporting the mobile behavior of a learner is also lacking.

The interaction between the tutors and the learners is another issue. Some courses require the input of the body condition of the learners, such as body building and medical care. The inclusion of the sensors to detect learner status will be necessary for these lessons.

### 4.2 Digital learning research projects

There are many digital learning related projects aimed to develop appropriate ICT to enhance digital learning in terms of authoring, delivery, management, interaction, etc. We will describe our efforts in enhancing digital learning and reducing digital divide in the following.

#### 4.2.1 Digital content storage

Digital learning materials are digital content, which require sort of protection to encourage the content providers to create them. Online digital content are usually protected with access control and authentication, while offline content are usually put on optical discs and are protected with serial numbers and keys. These mechanisms provide elementary protection but are quite easy to break.

There are various portable storage devices that can be used to carry digital content and to store related learning progress, such as USB disk, SD, Memory stick, and CF. These storage are becoming cheaper and cheaper, thought not as cheap as CD, these have the advantage of being recordable. Among these devices, we argue that USB disk is well-suited for digital content storage and delivery. Not only is USB ubiquitous, easy pluggable, and mature, we can implement secure channel on these disks to provide strong protection for any content from unauthorized accessed. The contents are encrypted with a key, and this key can be obtained from

the USB disk only from the secure channel, as shown in figure 1. The encryption key is invisible to the users and there is no easy way to access this key outside the designated protection scheme. How this key can be used to decrypt the content is known only by the learning system.

Figure 2 shows the system architecture of the USB digital content protection. The host can access the keys and the certificates only via the security functions. To access the ordinary files, the host sends standard SCSI-2/UFI commands to the device. To access the keys and the certificates, the host use proprietary SCSI-2/UFI commands to access the device. The keys and certificates are thus hidden from the ordinary file accesses. Extra hardware can be added to encrypt the channel to provide further protection.

### 4.2.2 Offline mechanism for mobile learning

Mobile learning allows learners to participate a learning course no matter where they are and what devices they are using. Currently, digital learning is usually carried out through desktop computers. However, not everyone has the luxury of using a desktop computer due to the cost or his mobile behavior. Due to the cheaper cost and the supporting of nomadic behavior, mobile learning can further improve the accessibility of digital learning. Since an Internet connection is not yet assured on the road, offline learning is an important aspect in mobile learning.

Mobile devices can be roughly divided into devices with network access and those without. Even those with network ability may go offline at some certain places. For a network-enabled device, a LMS agent is included and is responsible to keep track and store the learner’s progress in the device while it is offline. When the device’s network access is

recovered, the LMS agent will connect with the LMS server and synchronize the learner's information, as shown in figure 3. For mobile device with no network access, there is also a LMS agent keeping track of the learner's progress. When the learner desire to synchronize the records with the LMS server, the device is connected to a desktop computer with network access. The progress is then transferred with the computer as a relay as shown in figure 4.

There are several problems that are not yet addressed. First, offline learning is usually segmented, i.e., learner usually downloads a segment of the learning material due to the time and storage constraints. Learning material supporting offline learning should also be able to be partitioned into small segments. Second, the mobile devices vary in functions and specifications. Learning material may not be able to be presented on all devices. One of the solutions is to provide multiple formats of the same content to support as many devices as possible. Another solution is to use transcoding to adapt the content to a device while downloading. Third, conflict of the LMS progress record may arise during synchronization. Actually, this problem is also faced by PIM synchronization components, and their solutions may give insight on how it can be solved.

### 4.2.3 Interactive learning at home

There are a variety of ways to learn at home nowadays, from watching TV tutoring programs to participating in digital learning with desktop computers. However, most of these training courses are quite limited in interaction or require certain level of skill to operate, which limits the accessibility of the courses. Home learning should be easy to operate and interactive, so that the entry-level skill requirement for the learners can be lowered and the system can regulate the content and the

learning flow based on the learners' responses.

The learning materials are presented via the TV, sensing devices are deployed at home to capture and return the learner's response to the course provider to control the flow of the course. One of the scenarios is the health caring course for a pregnant mother to learn how to take care of herself and her baby. The course can provide appropriate information based on the body condition of the mother. Other possible courses include body building, fitness training, etc. The required technologies include context awareness and data mining. The capturing of the domain knowledge is also very important.

## 5 Summaries

In this paper, we have described the digital divide issues in digital learning, the national policies, and some projects aimed to bridge the gap. The digital divide issue is mainly an accessibility problem. Due to the education level, income, generation, behavior, geographic location, etc., digital learning may not be available to everyone. Moreover, insufficient professionalism and the lack of content also hinder the promotion of digital learning. Taiwan government has done a great job on helping the establishment of the necessary infrastructure, such as network and computer, to broaden the accessibility of digital technology. They have also encouraged research by financing e-Learning technology programs. Many of the government services have also been put online to demonstrate how digital technology can benefit everyone.

On the other hand, the quality and quantity of the digital content for digital learning is still far from satisfying. The lack of an open platform,

authoring tool chain, convenient digital right management mechanism, system supporting mobile behavior and customization, etc., are some courses of the problem. We have several ongoing projects that are aimed to solve or reduce these issues. Combined with the efforts from the industries, such as system integrator, chip manufacturer, and mobile communication vendor, these projects will help encouraging the industries to invest in the creation of digital content.

**Figure 1 USB storage with protection scheme**

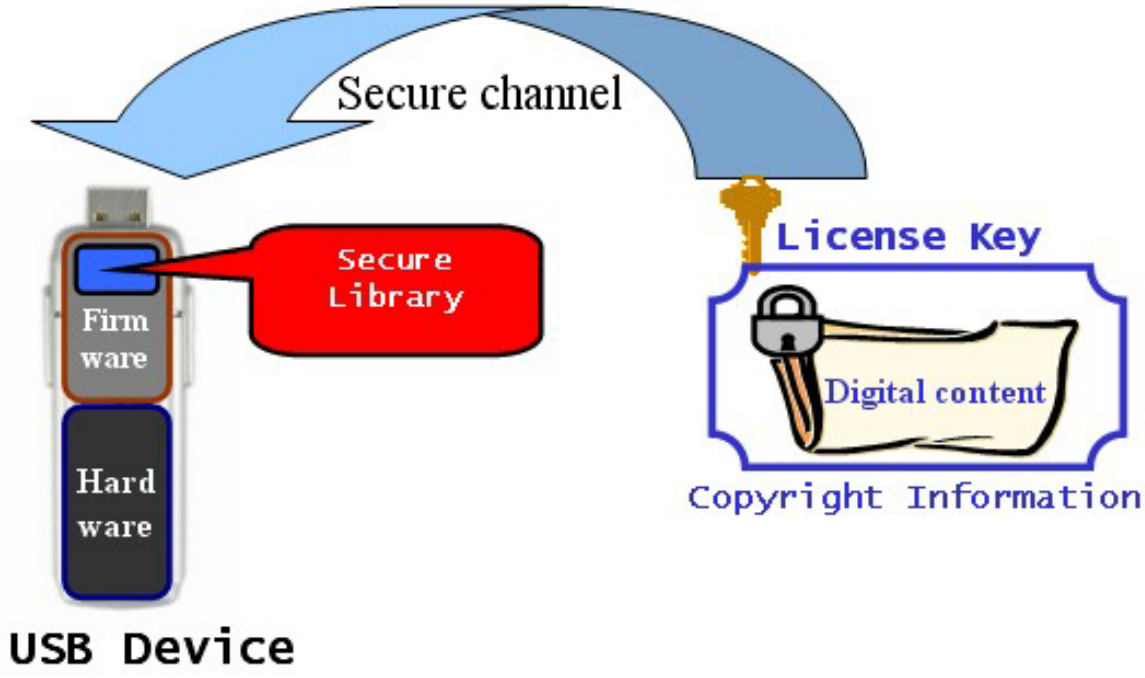



**Figure 2 System architecture of the USB protection scheme**

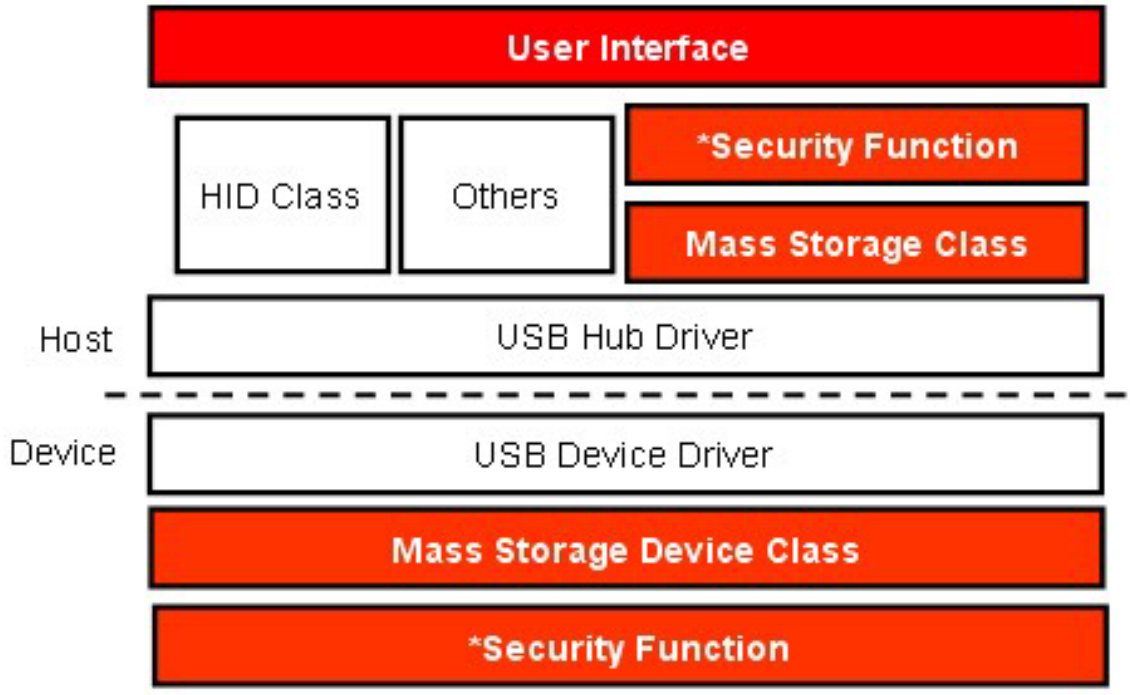


**Figure 3 Offline learning on network-enabled mobile device**

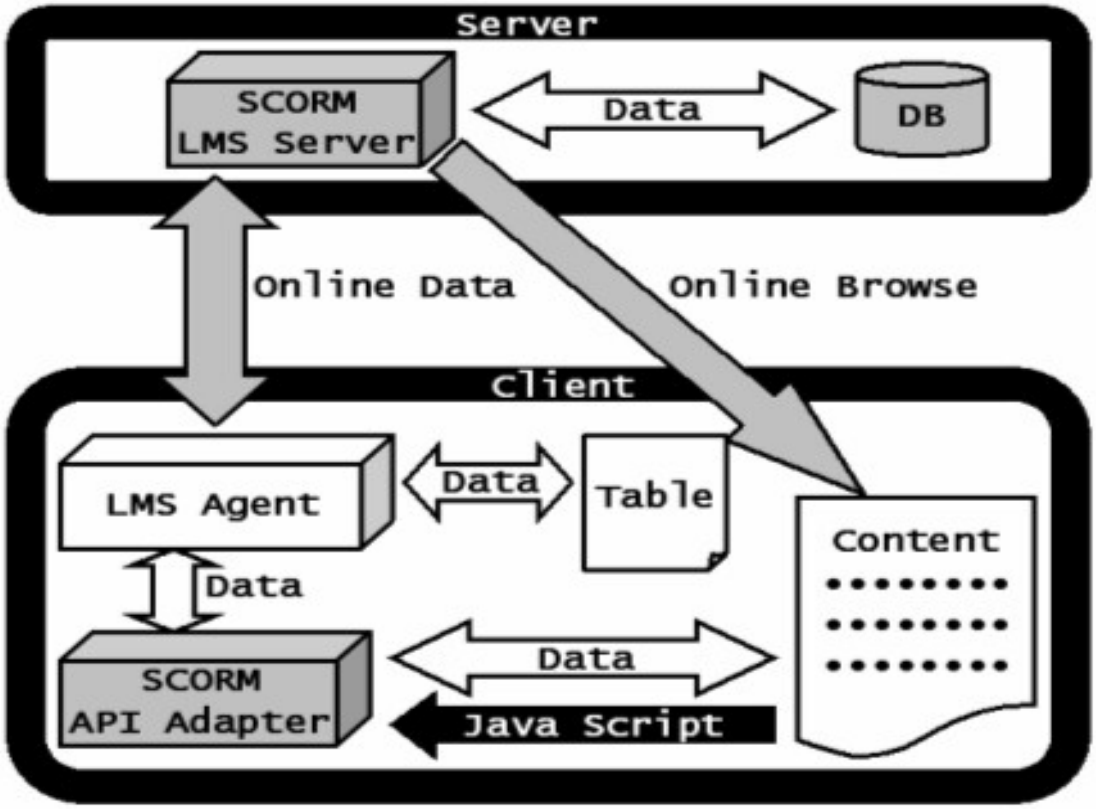
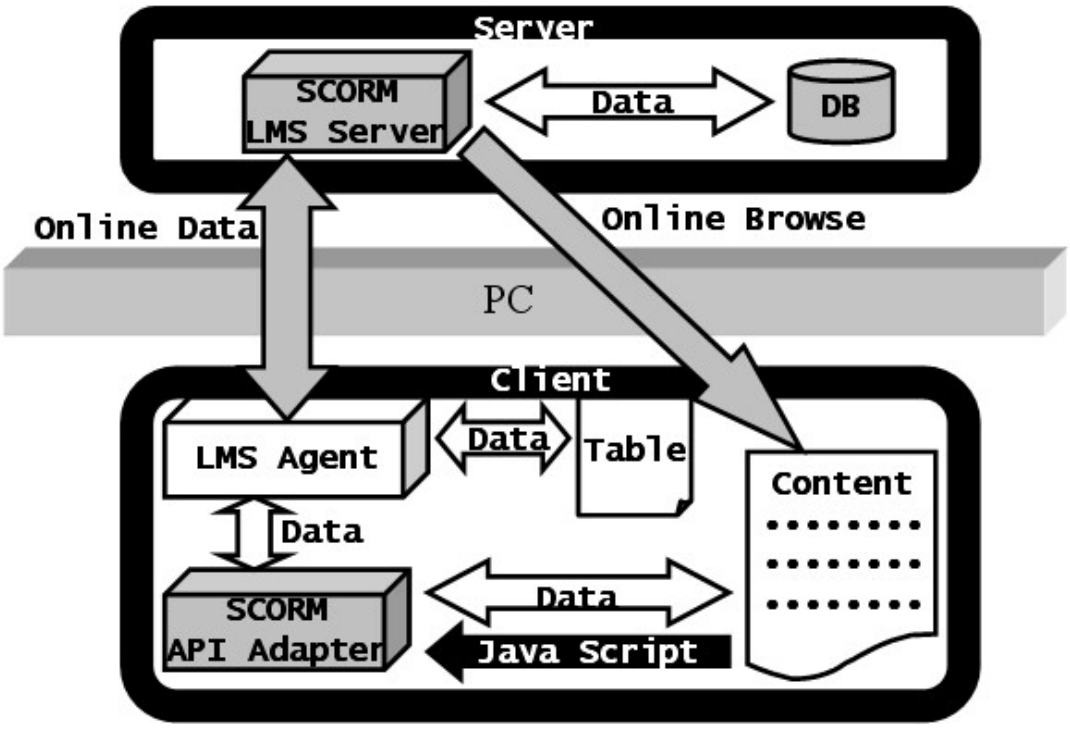



**Figure 4 Offline learning on mobile device with no network access**



# 應用資通訊科技於數位學習以減少數位落差

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## 中文摘要

數位學習在近年來是一個熱門的題目，但是數位學習在目前仍未能大規模推行，造成此現象的主要原因之一是數位落差。數位學習需要有足夠的設備與技能才能夠參與，因為人有著教育程度、收入、家庭背景、習慣、地理位置等差異，造成一些人無法參與數位學習。另一方面，師資及數位教學內容的缺乏也對數位學習有影響。目前有不少國家針對數位落差的問題制訂相對應的國家政策，幫助建立數位科技所必須的基礎建設，增加大眾接觸與使用數位科技的機會，並架設線上的便民服務作示範，使大眾瞭解資通訊技術所能帶來的方便性。不過在現階段可供數位教學使用的數位內容在質與量都不足。廠商未大規模投入數位內容創作的原因包括了開放平台、編輯工具鏈、方便可普及的數位版權管理、支援行動行為及客製化系統等之缺乏。文中描述的幾個進行中的計畫針對上述的問題提出解決方案，降低數位落差的影響。這些計畫結合業界的參與將可吸引廠商投入數位內容的製作。

**關鍵字：數位學習、數位版權管理、離線學習、家中學習**