

# Integrating Cloud Computing into Senior High-School Learning

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*Abstract:* - The purpose of this study was to identify the content structure and learning experience for integrating cloud computing into high-school learning offered by the High-Scope Project. For coping with new contents brought by fast advancing technology, education system should provide ways to integrating that new information of emerging technology into our curriculum for preparing students with up-to-date knowledge. There is a need to identify learning goals, the scope and structure of integrating cloud computing into formal learning. The selected learning experience of cloud computing were identified by following the theory of technology education. By applying the investigation method, the content was verified by invited professionals. Their evaluation resulted significant agreement between selected contents and technology principles. The reliability between evaluators was 0.87.

*Key-Words:* - **High Scope Project, Senior High Education, Emerging Technology, Cloud Computing**

## 1 Introduction

Cloud computing leads a new tide of information technology toward a whole new world of living style. Technology education is a subject area of common education and provides learner the opportunity of accepting technology. Innovative technology grows everyday and the information and knowledge of technology expands, too. Systems of technology in some areas are even exploded, such as energy & power technology and information & communication technology. In science education, how to integrating emerging technology into formal education becomes a concern. Education reform acts in Taiwan pointed out this trend and raised a “High Scope Curriculum Development” project to foster teachers to design teaching material and learning activities of emerging technology.

Cloud computing is a service for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources. It is the delivery of computing as a service rather than a product, whereby shared

resources, software, and information are provided to computers and other devices as a metered service over a network. Cloud computing provide computation, software, data access, and storage resources without requiring cloud users to know the location and other details of the computing infrastructure[1-2]. As a result, cloud computing is a popular topic for blogging and white papers and has been featured in the title of workshops, conferences, and even magazines. Nevertheless, confusion remains about exactly what it is and when it's useful.[3]

There is a need to identify the learning goals, the content structure and the learning experience of cloud computing in terms of senior high technology education, so can help high school learners coping with this emerging technology. At the same time, the research result could be effectively applied on integrating emerging technology into formal technology education.

## 2 Problem Formulation

Technology education in Taiwan set out a cloud strategy that had the potential for substantial savings in cost while also providing for greater control of IT infrastructure, newer technology, improved stability, and a more agile learning environment. Technology educators understood that the roles of IT professionals change as a result of adopting a different concept for managing the cloud, and that cloud has an impact on the people who live in the society.

In order to prepare high-school students for the future and to manage this transition successfully, educators realized that it is essential to take the people along and prepare them for the journey. High-scope project was established along this line.

## 2.1 Basics of Cloud Computing

*What is cloud computing and how can an organization decide whether to adopt it?*

Cloud computing is a distributed computing paradigm that focuses on providing a wide range of users with distributed access to scalable, virtualized hardware and/or software infrastructure over the internet. Cloud computing is in essence an economic model for a different way to acquire and manage IT resources.

An organization needs to weigh the cost, benefits, and risks of cloud computing in determining whether to adopt it as an IT strategy. This session seeks to help organizations understand cloud computing essentials, including drivers for and barriers to adoption, in support of making decisions about adopting the approach.

Cloud computing is a paradigm for large-scale distributed computing that makes use of existing technologies such as virtualization, service-orientation, and grid computing. It offers a different way to acquire and manage IT resources on a large scale.

A simple example of cloud computing is webmail. The webmail provider maintains the server space and provides access; the webmail user just plugs a web address into a browser and submits user information to access an account.

There is growing interest in cloud computing from consumers and providers. For example, *"Previous year, Intel, Yahoo and HP announced a joint test centre for cloud computing education and research. Last August IBM announced a \$360m data center in North Carolina to provide Cloud Computing facility to their clients."*[4]

One reason for this trend is the move toward cloud computing as a means to reduce IT hardware costs.[5] More adopters will result in more people seeing savings and thus working to reduce barriers to adoption. The growth in cloud computing consumers

will also drive a continuing increase in the number of providers.

## 2.2 Technology Education

Technology education is a subject of studying technology in which learners could learn about the context, process, and knowledge related to technology [6]. These entire three domains combine together as a universal model of technology.

Technology education provides a systematical understand of technology. This subject in high-school could and should provide the experience about emerging technology, including cloud computing.

## 3 Problem Solution

Based upon the characteristics of integrating emerging technology into formal curriculum, cloud computing literature was reviewed for establishing the learning goals, scope, and content structure. The learning experience of cloud computing was identified according to these selecting criteria.

A content analysis procedure was applied to verify the consistency of selected materials. Content professionals were invited to do the content analysis. The levels of selected content fitting into criteria were evaluated. The reliability among professionals were also evaluated.

### 3.1 Learning Goals of Cloud Computing

Education adopted an approach whereby they skilled their students to gain an understanding of the key principles of virtualization and cloud computing, ensuring that the workforce has the right skill set and competencies to enable the society to support the following transformational objectives with respect to the cloud:

- Transform the competencies of the IT experience from working in a "traditional" IT environment to working in a next generation service provider.
- Fit into services of cloud computing as a technology user.
- Reduce the risk and complexity inherent in a fragmented data strategy.
- Virtualizes to modern, future-proof platforms.
- Build an operating model of could computing.

### 3.2 Topics of Integrating Cloud Computing

The high school technology education curriculum were checked for the potential of integrating cloud computing. The best fitted topics are identified in table 2 and 3.

Table 1 Topics of Core Course

Topics	Major Content	Class in hours
Technology Development	1. Innovation of Technology 2. Impact of Technology	4
Technology World	1. Scope of Technology	8
Creative Design & Production	<ul style="list-style-type: none"> <li>● Principle of Creative Design</li> <li>● Practice of Creative Design</li> <li>● Project of Design &amp; Production</li> </ul>	24

Communication technology domain would be the best area for integrating cloud computing for high school students to recognize this emerging technology.

Table 2 Content of Advanced Course in the topic of communication technology

Topics	Major Content	Class in hours
Communication Technology	1. Electronic Communication 2. Information Communication 3. Communication Ethics 4. Communication Industry 5. Project of Design & Production	36(12+24 project)

There are core course and advanced course. In table 2, topics of the core course were listed with major content and class hours. The total class hours are 36.

For the advanced course, the topic is communication technology. The class hours are 36. The major content are also listed in the table 3.

### 3.3 Structure

The following is the proposed structure with both core and advanced course. The core course serves as a foundation for the advanced course. In Fig. 2, the structure was illustrated. In following sections, the proposed content of each course would be described.

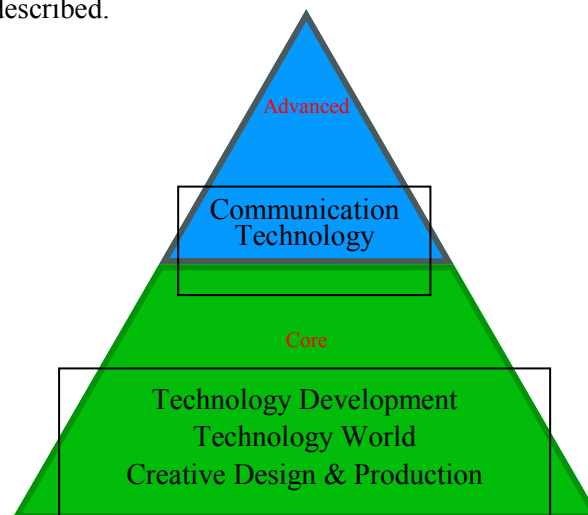


Fig. 1 Curriculum Structure for Emerging Technology of Cloud Computing

#### 3.3.1. Innovation of Cloud Computing

The learning experience of this topic would focus on the followings:

- The definition, essence, and meanings of cloud computing.
- Contemporary development of cloud computing
- Cloud computing in Taiwan

#### 3.3.2. Impact of Cloud Computing

The learning experience of this topic would focus on the followings:

- Relations among Cloud Computing, Living, Society, Culture
- Relations among Cloud Computing, Industry, economy development and National Competition Ability
- Cloud Computing and Environment Issues

- Cloud Computing, Ethics, and Law

### 3.3.3. Scope of Cloud Computing

The learning experience of this topic would focus on the followings:

- Principles of Cloud Computing
- Application of Cloud Computing

### 3.3.4. Creative Design Principles

The learning experience of this topic would focus on the followings:

- Creative Design of Cloud Computing Methods
- Creative Design of Cloud computing Procedures

### 3.3.5. Creative Design Practice

The learning experience of this topic would focus on the followings:

- Needs investigation of Cloud Computing
- Concept and design in Cloud Computing
- Operating Cloud Computing

### 3.3.6. Project of Cloud Computing Practice

The learning experience of this topic would focus on the following:

- Project based learning on Cloud Computing in real world problem.

### 3.3.7. Electronic Communication

This is a part of advanced course. The learning experience on electronic communication would focus on the following items:

- Communication Technology on Cloud Computing
- The electronic foundations and application of Cloud Computing
- The wired, wireless, and communication principles and application of cloud computing

### 3.3.8. Information Communication

This is also a part of advanced course. The learning experience on information communication would focus on the following items:

- Cloud computing computer system and application

- Cloud computing for the print media system and application
- Cloud computing for the multi-media system and application

### 3.3.9. Communication Ethics

This is also a part of advanced course. The learning experience on communication ethics would focus on the following items:

- Law and ethics of Cloud Computing
- Security issue of Cloud Computing

### 3.3.10. Communication Industry

This is also a part of advanced course. The learning experience on communication industry would focus on the following items:

- Contemporary Industry of Cloud Computing
- Impacts of society and life by the Cloud Computing
- Development and trend of Cloud Computing

## 3.4. Definitions and Taxonomy

For a emerging technology, it is important to establish concrete foundation for people to identify, discuss, and recognize. Following characters should meet:

- A practical customer-experience-based context for discussions on interoperability and standards
- Where existing standards should be related

The following definitions and taxonomy would provide an overview of cloud computing concepts. Based upon use case scenarios, it intends to show overview of cloud computing.

### 3.4.1. Definitions of Cloud Computing Concepts

Cloud Computing: Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction[1].

### 3.4.2. Delivery Models

The NIST definition of cloud computing defines three delivery models:

- Software as a Service (SaaS): The consumer uses an application, but does not control the operating system, hardware or network infrastructure on which it's running.
- Platform as a Service (PaaS): The consumer uses a hosting environment for their applications. The consumer controls the applications that run in the environment (and possibly has some control over the hosting environment), but does not control the operating system, hardware or network infrastructure on which they are running. The platform is typically an application framework.
- Infrastructure as a Service (IaaS): The consumer uses "fundamental computing resources" such as processing power, storage, networking components or middleware. The consumer can control the operating system, storage, deployed applications and possibly networking components such as firewalls and load balancers, but not the cloud infrastructure beneath them.

### 3.4.3. Deployment Models

The NIST definition defines four deployment models:

- Public Cloud: In simple terms, public cloud services are characterized as being available to clients from a third party service provider via the Internet. The term "public" does not always mean free, even though it can be free or fairly inexpensive to use. A public cloud does not mean that a user's data is publically visible; public cloud vendors typically provide an access control mechanism for their users. Public clouds provide an elastic, cost effective means to deploy solutions.
- Private Cloud: A private cloud offers many of the benefits of a public cloud computing environment, such as being elastic and service based. The difference between a private cloud and a public cloud is that in a private cloud-based service, data and processes are managed within the organization without the restrictions of network bandwidth, security exposures and legal requirements that using public cloud services might entail. In addition, private cloud services offer the provider and the user greater control of the cloud infrastructure, improving security and resiliency because user access and the networks used are restricted and designated.

- Community Cloud: A community cloud is controlled and used by a group of organizations that have shared interests, such as specific security requirements or a common mission. The members of the community share access to the data and applications in the cloud.
- Hybrid Cloud: A hybrid cloud is a combination of a public and private cloud that interoperates. In this model users typically outsource non-business critical information and processing to the public cloud, while keeping business-critical services and data in their control.

### 3.4.4. Essential Characteristics

The NIST definition describes five essential characteristics of cloud computing.

- Rapid Elasticity: Elasticity is defined as the ability to scale resources both up and down as needed. To the consumer, the cloud appears to be infinite, and the consumer can purchase as much or as little computing power as they need. This is one of the essential characteristics of cloud computing in the NIST definition.
- Measured Service: In a measured service, aspects of the cloud service are controlled and monitored by the cloud provider. This is crucial for billing, access control, resource optimization, capacity planning and other tasks.
- On-Demand Self-Service: The on-demand and self-service aspects of cloud computing mean that a consumer can use cloud services as needed without any human interaction with the cloud provider.
- Ubiquitous Network Access: Ubiquitous network access means that the cloud provider's capabilities are available over the network and can be accessed through standard mechanisms by both thick and thin clients.
- Resource Pooling: Resource pooling allows a cloud provider to serve its consumers via a multi-tenant model. Physical and virtual resources are assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter).

### 3.5. Evaluations

For verifying the result of content identified. A content analysis procedure was produced. All selected major contents were evaluated according to the technology principles of the universal model by invited professionals. There existed significant agreement between selected contents and criteria. The evaluators agreement was 0.87.

## 4 Conclusion

The results of this study provide an concrete evidence for the feasibility of integrating cloud computing into senior high-school learning. Following the strict learning goal and principles of technology education, the content selecting and learning experience could be ideally organized for fitting into original curriculum.

As the finding shown, there are four level knowledge of cloud computing technology provided for learning. Those four levels of knowledge are fact, concept, procedure, and meta-analysis. In this study, the fact knowledge mostly comes from definition.

Based upon definitions of cloud computing technology, this emerging technology become reality and could be further discussed and explained. The learning goals, knowledge structure, learning experience then could be identified to organize the subject matter. The content of cloud computing were identified and verified with the curriculum standard by this study.

The purpose of this study was to identify the content structure and learning experience for integrating cloud computing into high-school learning offered by the High-Scope Project. This study provided a response of coping emerging technology by integrating cloud computing into formal education.

By introducing learns with following topics, a core technology education course of integrating cloud computing are designed. Those topic are:

- Technology Development

- Technology World
- Creative Design Production

An advanced communication technology course is also designed. The major contents are:

- Electronic Communication
- Information Communication
- Communication Ethics
- Communication Industry
- Project of Design & Production

It is concluded that cloud computing could be integrated into high-school technology education as an emerging technology.

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