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Development of Competency-oriented Social Multimedia Computer Network Curriculum

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Abstract

In the revised 2015 curriculum, it is emphasized that fostering of the students as the capable ‘creativity-convergent’ individuals can be achieved by offering them the opportunities to cultivate the basic knowledge in liberal arts, society and scientific technologies through schooling. While retaining the basic principle of ‘fostering creative people’, this fundamentally-reformed curriculum involves improvements in the elementary and middle school curriculums in response to the national and social demands in which active responses to the changes in the educational environments and amelioration of the problems posed in the field applications are required. Accordingly, a novel future-oriented curriculum is necessary for the classroom teaching, and to realize the goal, the 'Competence-oriented Social Multimedia Computer Network Curriculum’ adopting the virtualization and the ‘Bottom-up’ methods has been proposed in this paper as a feasible and practical curriculum. Our curriculum will be compared with the recent Cisco high school curriculum and analyzed contemplating recent curriculums in US, UK, Japan and India. Two 1-year practice courses are examined to prove the validity of the proposed curriculum for a period of two years as a qualitative research project. The results of the comparative analysis will show that our proposed curriculum is superior to the Cisco high school curriculum in the aspects of economic feasibility and learning satisfaction.

Key Words: Curriculum, Bottom-up Methods, Computer Network Curriculum, Social Multimedia

I. INTRODUCTION

As a subject of learning, the capability to solve problems self-directedly and creatively is especially required in current society. Under this situation, Republic of Korea's ministries of Science, ICT & Future Planning (MSIP); Education (MOE); Trade, Industry & Energy (MOTIE); and Culture, Sports & Tourism (MCST) have announced the blueprint that included such contents after having ‘The Briefing Session for the Realization strategy of Software-centered Society'.

MSIP took on the subject 'Realization strategy of Software-centered society', and as for the rest of the ministries, 'Innovation plan for the Software education for elementary and middle school students' for MOE, 'Software fusion & application strategies' for MOTIE, and 'Software copyrights protection and convergence of their usage' for MCST, respectively.

According to the briefing, the curriculums are first to be reorganized pivoting on the Software education in order to train the future talents [1-4]. The Information-related contents of the curriculums in elementary schools will be changed to the ‘Basic Software Literacy Education’, and as the 'Information Subjects' in middle schools. Also, in high schools, the 'Information Subjects', which are of optional advanced levels, will be switched to ‘Software Subjects', as the general elective courses.

"Structurally, when the students who have completed the general elective courses wish to learn more, they take courses in the advanced optional courses" said the Creative Human Resource policy maker of MOE, adding his expectation by saying, "there are some comments that the such selection tendency is lower for the advanced optional courses, but many students would choose them once the subjects are changed as the general elective courses."

The main point of revised 2015 curriculum is to fundamentally reform our educational system to foster all students to develop themselves as the capable creativity-convergence people by allowing them to cultivate the basic knowledge in liberal arts, society and scientific technologies through schooling. Maintaining the basic idea of 'fostering creative people', which was pursued by the revised 2009 curriculum, it aims to improve the curriculums in elementary and middle schools in order to be able to cultivate creativity-convergent human resources, reflecting the national and social demands to actively respond to the changes in the educational environments

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and to ameliorate the problems posed in the filed applications.

The improvements in the curriculums and classroom teaching for fostering of competency that is required by the future society are necessary and for this reason [5,6,7,8], first, it is essential to present the competence which are required in future society in the outline and subject education courses and to converting the classroom teachings to student-participation classes such as the 'collaborative learning' through reduction of leaning amount, and the second is that the fostering of capable convergent people by reflecting national and social requirements(e.g., Software educations and safety educations) is needed. However, prior to the conversion to general elective Software course, it was considered that the study for the newly revised curriculum is necessary.

Thus, the 'Competency-oriented Social Multimedia Computer Network Curriculum' [11-16] which had employed virtualization and the Bottom-up Methods was designed and developed as an adequate possible curriculum. In this paper, we've attempted to induce an educational effect by constructing servers using "Bottom-up Method" to reduce time and costs when students configure actual systems. Since solving the network problem through various server constructions involves systemicity as in mathematics, the "Bottom-up Method" approaching is necessary - letting students to utilize virtual computers while they try to input suggested commands and source codes to solve the problems that they have been encountered.

II. THEORETICAL BACKGROUND

The curriculum in the computer networking field has a systemicity similar to the one in the mathematics curriculum, but having a tendency to flow downward faster (e.g., from the institutions of higher education like colleges or graduate schools to secondary schools such as middle schools or high schools).

To give an example, in early 2000, the subject like E-mail service development or service algorithm was labeled as the subject which was considered to have a higher level of difficulty applicable to the doctorial dissertations (Stanford University Computer Science course) but recently in Republic of Korea, they are being adopted in the undergraduate studies and Meister high schools.

Meanwhile, many studies have been carried out. Especially, prior to the 2007 revised curriculum, there were studies which had presented various plans to improve the problems in relation to the curriculums of computer courses in 6th and 7th curriculums.

Soo-Burn Shin, Tae-Wuk Lee [9] pointed out the problem that the contents of computer courses are narrowly based on Software applications and suggests the necessity of restructuring the contents by magnifying academic values and clarifying inherent structure of knowledge to correspond with the educational objectives in elementary and middle schools. Jung-Ho Park, Jae-Woon Lee, Tae-Wuk Lee [10] indicated the lack of the systemicity and sequence as the problem of middle school computer curriculum and raised a question on the software skill-oriented learning. They suggested that the areas of computer principles, algorithms and programming and information ethics should be enhanced by modifying and supplementing existing curriculums.

When examining existing studies related to the computer educations, they can be distinguished as the ones that have indicated the problems and improvements, and that have considered the essence and identity of computer education.

At present, high schools are divided into the general high schools which focused on the common subjects aiming to enter the advanced schools and the specialized high schools which aim to advance into society or upper level schools. The specialized school curriculums are organized to mainly run common subjects in 10th grade and offer specialized subjects in 11th and 12th grades following 'The National Common Basic Curriculum'.

2.1. Computer curriculums and Social Multimedia Computer curriculums of foreign IT advanced countries

2.1.1. Computer curriculums and Social Multimedia Computer curriculums of the USA

Traditionally, 3Rs (i.e., Reading, wRiting and aRithmetic) have been emphasized in the USA education system [1,8,18,23] but the significance of the computer education is growing due to the development of information technology and ever increasing interest in computer education.

The characteristic of the USA's high school curriculum system is that the nation does not make national level curriculums but each state runs their own specialized educational systems. The same goes for the computer education so that the national education informatization project such as the establishment of the nationwide school network is carried out at national level but curriculum development is exercised at each school district of respective states, where independent education is performed(Young-Kwon Bae, Jin-Sook Lim, Tae-Wuk Lee [18]). Most of the states include computer subjects in

science and technology related courses rather than treating them separately.

Different from us(Republic of Korea), since the national level curriculums are not being provided in USA, each state employs the technical and computer science standards suggested by the organizations like ISTE (International Society for Technology in Education and ACM(Association for Computing Machinery) or companies such as Microsoft high school Curriculum, Cisco high school Curriculum, IBM high school Curriculum and Apple high school Curriculum) when they prepare computer education-related curriculums [21-25]. Although each school conducts distinguished education but it would largely help to understand the USA computer education system if we examine curriculums offered by ACM or other companies preferred by many states:

First, students need to be prepared to understand fundamental characteristics of the computer science and where it holds its position in our modern society. Second, students should understand both the principles and functions of the computer science. Third, students should be able to utilize the functions of computer science, especially algorithmic thinking when they are involved in problem solving activities in different subjects. And finally, the advanced educations should be offered to the students who have gifts or shown interests.

2.1.2. Computer curriculums and Social Multimedia Computer curriculums of the UK

Summary of 'A study of the UK computer curriculum Mi-Ryang Kim [17] is as follows: The computer courses in early computer education system of the UK was also non-independently established and learning contents were merely about information technology described in the technology-related subject which was just one of 10 relevant basic courses. However, technology subject was regarded as a major course along with mathematics, science and English and its importance had been emphasized in the national curriculums.

In UK, the infrastructure for computer education has been prepared by establishing the national learning network and by adopting ICT as an independent subject, they set the condition to be able to accomplish systemic education for all students up to 9th grade [23-27]. The information technology is not limited to ICT courses and the student can also access to independently established ICT educations even after 9th grade by choice. They provide the systemic and active support for ICT education at the political level and such institutional/financial supports are becoming as a foundation for fostering outstanding individuals who are supposed to lead the UK's information-oriented society.

2.1.3. Computer curriculums and Social Multimedia Computer curriculums of the Japan

In Japan 1990s, there was a demand for the new educational system suited for a new epoch to foster individuals with talents who would lead 21 century.

Under such social background, they've started the movement 'Building the schools that have more relaxation but distinct characteristics' and a new curriculum which aims to cultivate students' competence in life has been revised and announced for elementary and middle schools (1998) and for high schools (1999), followed by all-out implementation (2002) for elementary and middle schools and for high schools (2003), adapting to the order of newly enrolled.

The "information subject" was designated as the compulsory subject and established in the high school curriculum. Doing so, they are to develop a manner that enables them to independently respond to the information society by enhancing their abilities to determine and analyze the information using computers.

2.1.4. Computer curriculums and Social Multimedia Computer curriculums of the India

Summary of the study relayed to the India computer curriculum Mi-Ryang Kim [17] is as follows: India has achieved recognition as IT power in fact as well as in name. They produce about 30% of IT professionals in Silicon Valley and hold the 2nd place following US in world software market.

Moreover, their competency is recognized widely so that 185 out of 500 Fortune companies entrust their software outsourcing works to them.

Although information infrastructure of India is comparatively poorer than most of other advanced countries, they are considered to overcome such disadvantage with the development of software-oriented IT industry. Excellent IT human resources, STP (Software Technology Parks) plan and strong software industry development policies largely contribute to the recognition of the India as the IT power [24,25].

India's computer education, which has been enhanced much more than any other countries, is the foundation of their growth. Comparing to the fact that other nations are giving weights to the utilization of computer functions, India's computer curriculums emphasize on the algorithms and applied mathematics. Also, it's possible to observe that they are introducing programming languages in early stages but the lessons for the software applications and network use come in later compare to the other nations.

In our country, we encounter programming languages when we are in colleges but in India, they can be learn those languages at the elementary school level through

regular curriculums and deal with C++ or Java languages at middle and high schools revealing that they are receiving high-level programming education [23,25,27].

In Republic of Korea, students first learn how to use computer for the sake of arousing the interest and the high school curriculums focus on overcoming the game addition and internet misuse.

On the other hand, in US, UK, Japan and India, such problem is prevented by letting the students in elementary schools to realize that computers are the friendly tools to solve the problems and delaying the access to the contents that merely raise the interest only.

They make it possible to enhance problem-solving ability and also to increase the understanding of computer principles through programming at the middle school level. High school level allows the students to choose the higher-level computer courses for the training [22,24,25]. Thus, it seems that we need such curriculums for our high schools.

2.2. Competency-oriented Curriculum

In our country, there are many studies and efforts to fuse the competency in the curriculums and we call those curriculums that have reflected such competency as the variety of terms like the 'Competency-oriented Curriculum', 'Competency-based Curriculum', and 'Competency-integrated curriculum' [11-13].

Especially, the nation-affiliated institutions such as 'Korean Educational Development Institute' and 'Korea Institute of Educational Development & Evaluation' prefer to use the term 'Competency-based Curriculum' whereas Kyung-hee So [19] , Min-Ho Shon [20] use 'Competency-oriented Curriculum'.

However, in fact that all these 3 terms make competency development as their main purpose and that strongly emphasize the necessity of competency development without dismissing the importance of acquisition of the propositional knowledge in existing subject-centered curriculums [12,21], it seems that their meanings are not so different after all. Therefore, in this paper, the term 'Competency-oriented Curriculum' will be used as the unified terminology.

Different from the subject-centered curriculums, the 'Competency-oriented Curriculum' focuses on the results rather than the contents and the lessons are composed of the core competency, not the subjects. Also, while the subject-centered curriculums are realized with teacher-oriented education, the competency-oriented curriculums are achieved with the learner-centered learning and pursue integrated education. Moreover, evaluation and teaching methods are also changing so that teachers are to have the classes focusing on the performances of the learners rather than conducting the gramming or lecture education. Accordingly, development of varied teaching methods are needed. Also, for the evaluation in this curriculum, the assessment for the particular knowledge and theoretical contents is carried out not just by existing one-off tests but students' performance processes and their specific outcomes are evaluated. This way, the differences between the competency-oriented curriculum and existing subject education courses are multidimensionally (i.e., in contents and methods of learning, teaching methods and evaluation) clear. And the greatest difference between these two curriculums is that the competence-oriented curriculums clearly emphasize that the learner is the master and the main body of his/her learning.

2.3. Virtual Computer

The Virtual Computer or Virtual Machine is an assembly of virtual hardware which has been created by virtualized operating system and, similar to PCs or server computers, it includes BIOS, CPU, memories, hard disk and NIC (Network Interface Card). As far as the operating system (developed from the technology that can use expensive CPUs and memories in the large scale computers using timesharing method and installed to virtual computers) is concerned, it does not differ from actual physical ordinary systems but in reality, such virtual hardware exist in some kinds of file form and are used by one pertinent computer exclusively.

2.4. Bottom-up Method

Bottom-up Method is a means to progressively solve larger problems by solving several small problems leading to resolve that larger problems. Students can learn problem solving method through computers naturally via this method.

On the other hand, network problem solving through server construction involves systemicity similar to the problem solving in the areas of mathematics, it is considered that Bottom-up Method approach is needed for the systematic learning. Thus, by inputting commands and source codes suggested to view and solve problems, students will be able to go through systematic learning efficiently constructing servers using virtual computers.

Meanwhile, the characteristic of the Korean computer networking curriculum is that the descending speed is so fast that the Meister high schools tend to educate students without official course materials but give lessons with college textbooks or latest literatures selected and organized during the ‘specialty-aptitude’classes. Thus, development of relevant education supplies and teaching materials is an urgent requirement such that we propose a curriculum which reflects such needs in Section 3.

III. COMPETENCE-ORIENTED SOCIAL MULTIMEDIA COMPUTER NETWORK CURRICULUM

3.1. Target Curriculum of Competence-oriented Social Multimedia Computer Network

Following Figure 1 is a designed target Curriculum of Competence-oriented Social Multimedia Computer Network Curriculum. It is an example of that has used the Bottom-up Method.

The each server's address has been assigned as ns, www and mail for DNS, web server and mail server respectively. For example, in the case of web server for domain example.com, the address is www.example.com; mail server for edu.com, it is to have address of mail.edu.com. That is, 3 domains have been configured and each domain has been configured to have more than 1 server as shown in Table 1.

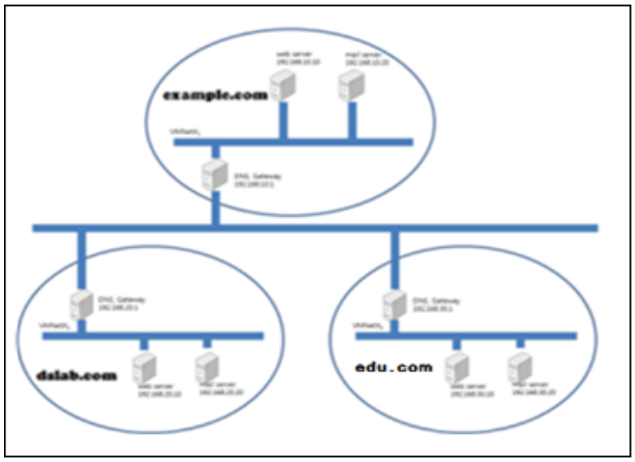

Fig. 1. Target Curriculum of Competence-oriented Social Multimedia Computer Network.

Table 1. Status of IP allocation for each domain.

DOMAIN	SERVER	ADDRESS	IP	NOTE
example.com	DNS, Gateway	ns.example.com	192.168.10.1	Ubuntu linux server
	Web	www.example.com		
	Mail	mail.example.com		
dslab.com	DNS, Gateway	ns.dslab.com	192.168.20.1	Ubuntu linux server
	Web	www.dslab.com	192.168.20.10	
	Mail	mail.dslab.com	192.168.20.20	
edu.com	DNS, Gateway	ns.edu.com	192.168.30.1	Windows Server
	Web	www.edu.com	192.168.30.10	
	Mail	mail.edu.com	192.168.30.20	

Additionally, Competence-oriented Social Multimedia Computer Network Curriculum has been designed with Bottom-up Method by installing VMware ESXi 4.1.0 virtual machine to 3 IBM system x3250 servers, and by developed this Curriculum, we have devised the Competence-oriented Social Multimedia Computer Network Curriculum which enables training of networks with low cost.

3.2. Competence-oriented Social Multimedia Computer Network Configuration

Below Competence-oriented Computer Network Curriculum Configuration shows that various servers are being built in each 3 IBM System x3250, and each virtual machine configured the network by distributing the network using VLAN. At each LAN, server construction and operation were performed. All servers were connected to one hub and in order to separate networks, VLAN was configured. The networks were separated by setting VLAN ID of 10 for the first network, and 20 for the second, 30 for the third. Then each server's node IP was also configured as above Figure 2, and having one domain for one network, servers that include other service elements were configured. It is an example of that has used the Bottom-up Method.

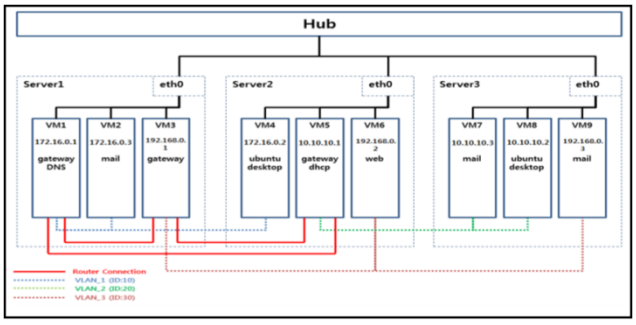

Fig.2. Diagram of Competence-oriented Social Multimedia Computer Network.

3.3. Social Multimedia Computer Network Server Configuration

As below Figure 3, Social Multimedia computer network server configuration is composed of 9 nodes and by combining each 3, total of 3 networks have been configured. Since all comprising nodes are being connected to one hub, VLAN has been configured to separate networks. It is an example of that has used the Bottom-up Method.

3.4. Physical Architect of Competence-oriented Social Multimedia Computer Network

To establish efficient network environment, both VMware Work station 7.1.0 and VMware vSphere Client

4.1.0 (virtualization software products of VMware, Inc) were used for the PC, and for the each physical server (3 IBM server system x3250), VMware ESXi <fig 4> Comparison of router characteristics 4.1.0 (also of VMware, Inc. product) was installed then Competence-oriented Social Multimedia Computer Network Curriculum was established through virtualization. It is an example of that has used the Bottom-up method. The actual server devices used are shown in Figure 4.

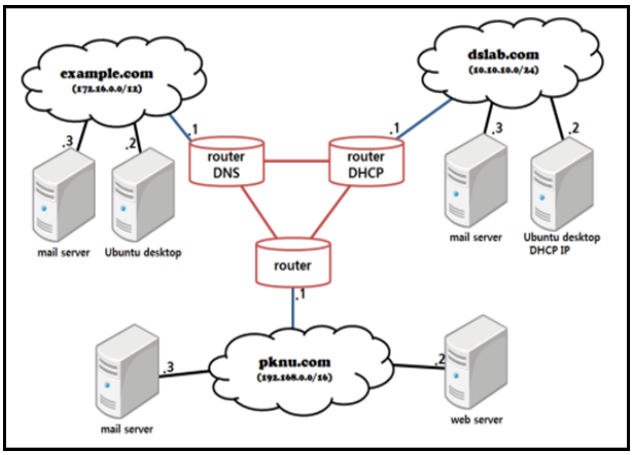

Fig. 3. Social Multimedia Computer Network server diagram.

Fig. 4. The IBM System x3250 used in this Paper.

3.5. Comparison with commerical Curriculum

Following Table 2. is a comparison with commerical Curriculum. For a comparative study, we have drawn a comparison between the basic network educational objectives and curriculum employed by Cisco High school Curriculum (USA) and our proposed Curriculum.

Table 2. Comparison with commerical Curriculum.

Object	Cisco High school Curriculum (USA) [8]	Our proposed Curriculum
Server	Linux Server, MS Server, UNIX Server	HTTP, DNS, Mail, Database, Linux Server (Ubuntu Server), MS Server (Windows Server)
Router	IP, IGRP, IPX, Serial, Apple Talk, Frame Relay, IP RIP, VLAN, RIP	IP, RIP, OSPF, BGP, VLAN
Network Monitoring Method	The actual system	Use by VMWare virtualization

At Cisco high school Curriculum (USA), LAN, WAN and the dial access service including IP, IGRP, IPX, Serial, Apple Talk, Frame Relay, IP RIP, VLAN, RIP, Etherner, Access List, etc. are installed and operated in a small scale network to acquire the skills related to Linux Server, MS Server, UNIX Server platforms and also to their troubleshooting.

On the other hand, in our Competence-oriented Social Multimedia Computer Network Curriculum, learners were able to master troubleshooting skills with the curriculum which cover the courses related to HTTP, DNS, Mail and Database. These courses are introduced in a small scale network established in the actual server using virtual computer. They can also learn about the routers with RIP, OSPF and BGP, etc. The curriculum is the one that can broaden learner's perspectives through overall network monitoring in a virtualized server.

IV. CONCLUSION AND DISCUSSION

In Republic of Korea, students first learn how to use computer for the sake of arousing the interest and the high school curriculums focus on overcoming the game addiction and internet misuses.

On the other hand, in US, UK, Japan and India, such problem is prevented by letting the students in elementary schools to realize that computers are the friendly tools to solve the problems and delaying the access to the contents that merely raise the interest only. They make it possible to enhance problem-solving ability and also to increase the understanding of computer principles through programming at the middle school level. High school level allows the students to choose the higher-level computer courses for the training. Thus, it seems that we need such curriculums for our high schools.

Comparative analysis was conducted between the curriculum proposed in this paper and the Cisco high school Curriculum recently preferred in US contemplating recent curriculums in US, UK, Japan and India, all of which are considered as the IT-advanced nations. By doing so, we've intended to verify the validity of the proposed curriculum by examining 2 practice courses(1 year course, respectively)of college students for a period of 2 years, as a qualitative research project.

For the qualitative study, 2 practice courses of 1-year term of college students had been studied for a period of 2 years.

The practice courses were distinguished as the 'Project Planning and Design' and the 'Project Implementation and Evaluation'. Both the effectiveness and learning satisfaction were analyzed after the courses had ended using the questionnaires and other means.

The results of validation showed that the proposed

curriculum has higher economic feasibility, effectiveness and learning satisfaction compared to the Cisco high school Curriculum that utilized the top-down method.

The Social Multimedia Computer Network Curriculum comprising internet requires high cost server computers and various network systems such as routers, software and etc. Also, there were many difficulties for the students to construct and operate Social Multimedia Computer Network Curriculums due to cost and environmental factors involved.

Especially, in the secondary education area, most of high schools do not cover practical training related to server construction and designing and configuration of network systems. While it is necessary to provide practical training related to such areas at schools for the students to be employed in cloud field, in reality, the problems regarding the lack of learning materials and limited environments must be solved and a new social multimedia computer network curriculum that help efficient and easy understanding of learning contents is needed.

Therefore, in this paper, we designed and constructed Social Multimedia Computer Network Curriculum that provided with virtual Computer (including commands); developed Social Multimedia Computer Network Curriculum with Bottom-up Method for easier understanding of the process and difficult network based knowledge leading to reduction of learning materials.

As of the second half of 2014, Competence-oriented Social Multimedia Computer Network Curriculum which enables low-cost (approx. 4,000,000 Korean won) construction of network education materials (which exceed value of more than 85,000,000 Korean won) has been developed using virtual computer.

The significance of this paper can be summarized as follows: First, in many cases, there has been a biased view that the contents related to virtual computers, Social Multimedia Computer Network Curriculum designing and construction are difficult for learners because they cannot easily approach such contents. Therefore, by arousing learners' interests and providing visual effects using virtual computers, help them to familiarize with Competence-oriented Social Multimedia Computer Network Curriculum. Second, after presenting method of inputting network commands and source codes in serial order with Bottom-up method, make it possible to efficiently construct servers using virtual computer leading to systematic leaning. Third, by presenting Bottom-up method that construct servers in serial order depending upon server types, made it possible to understand the process of construction and configuration in sequential manner. Fourth, by presenting the basic contents related to the conception and designing of the networks, made it possible to be referred.

Considering all of above results, the continuous tasks that need to be carried out by the future studies involve the followings: studies to verify learning effects when the educational system this paper proposed has been utilized in the classes by providing more segmented areas related to the server construction network designing and configuration, help students (e.g. using wire shark) to experience more accurate learning by include more methods of network design and configuration, make it possible to fulfill complete education through this Curriculum.

However, there are a few limitations in this study. First, since the types of Social Multimedia Computer Network Curriculum configuration designs vary, it is necessary to select most widely used type when designing and configuring the network, and also, virtual computers should be utilized during the network construction process.

Second, this study has limited the test subjects by targeting the people who are unfamiliar with Social Multimedia Computer Network Curriculum designing and implementation Third. because the target subjects of the study are the entry-level students, we have tried to provide educational effects by using the "Bottom-up Method" virtual Social Multimedia Computer Network Curriculum in order to let those who lack expert knowledge to reduce time and costs when they design and configure Competence-oriented Social Multimedia Computer Network Curriculum.

Third, the Competence-oriented Social Multimedia Computer Network Curriculum we've proposed in this paper was not applied to the high school courses. However, the top-down characteristic of the computer-learning curriculum has been reflected. For example, even 15 years ago, the course such as 'E-mail server construction and operation' was the curriculum that had been taught at the graduate schools in US and Republic of Korea but it's been adopted in high school curriculum now.

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