Innovative Network Engineering Practice based on Multimedia Education Scheme

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Abstract—Multimedia techniques have important influence on education of computer science and engineering. In order to improve the innovation ability, this paper proposes an improved multimedia-driven curriculum system of network engineering, which concentrates on the practical training and innovative learning and applications. Project-oriented software, hardware design and development abilities of students are improved based on the proposed multimedia-driven curriculum system, which include major curriculums related to internet of things, computer networks and software engineering. Detailed results show the effectiveness of the proposed scheme.

Index Terms—Multimedia Technique; Network Engineering; Innovation and Practice

I. INTRODUCTION

With the development of information science and technologies, many institutions and companies like to employ innovation-aware graduates [1]. Such case lead to the existed education scheme in universities is not suitable to the actual requirements and situation, especially in the major of network engineering [2]. And network-related curriculums, such as computer networks, sensor networks, wireless communications, are the application of computer science courses required of students in the rapid development of computer networks [1, 2]. Since multimedia impact usually focuses on the practical impact of multimedia learning and education on information technology, multimedia education has quickly entered classrooms and offices providing tutorials and lessons on many different topics [4, 5]. Multimedia education, in essence, involves a multimedia information system which, in interactive communication with the user, simultaneously uses various forms of information. With the practical application of a higher demand on the information technology and all areas in the national economy more widely, more and more online course uses the Digital Video Jockey-Version 2 (DVJ2) educational multimedia system, and then discusses the learning needs and expectations of different personality type characteristics. The multimedia also used for education to support of biomedical engineering in [4], which introduced the methodology of creation multimedia education materials from beginning to final distribution.

A synthesis of information technology, educational and environmental factors was done in [5], which explored interfunctional connection between above mentioned factors, elaborating a comprehensive model of IT support for environmental education of students in vocational schools in a multimedia surrounding. An interactive educational service was proposed in [6], which exploits the inherent benefits of broadcasting services and a Web-based education system to support the service.

In order to reveal an integration of problem based learning (PBL) with encouraging students' motivation, the authors in [7] proposed the combination scheme between the PBL approach and encouraging students' motivation assisted the students to work enthusiastically throughout the project with the better classroom environment and the high quality of work, which declares that encouraging motivation along with the PBL approach is needed in doing the film production project. In order to support a smooth transition from conventional to multimedia item creation, a multimedia item generator (MIG) is proposed for educators, which has the characteristics of portability, reusability, scalability and interoperability [8].

To investigate the influence of group teaching with multimedia materials on wound care skills of surgical patients, the work in [9] studied four surgical wards in a medical teaching hospital, where test groups received multimedia teaching compiled by the researcher, and control groups received traditional nursing instruction. The results show that wound care nursing guidelines with multimedia materials really enhance the wound care skills of patients and family members. In medical education, pedagogical agents are widely used by computer learning to complete a curriculum adjusted to their knowledge level using computer adaptive testing.

In [3], the authors explored the reasons why some students may enjoy learning using computer-based educational delivery systems while others may have absolutely no enthusiasm for this type of learning, which uses the Digital Video Jockey-Version 2 (DVJ2) educational multimedia system, and then discusses the learning needs and expectations of different personality type characteristics. The multimedia also used for education to support of biomedical engineering in [4], which introduced the methodology of creation multimedia education materials from beginning to final distribution.
systems to simulate tutors and/or mimic tutoring interactions. General purpose pedagogical agent architecture was proposed in [10], and implemented in the multimedia medical simulation Web-based learning system to further facilitate students’ learning. Sex education in Islam provides guidelines in manners related to what is allowed and forbidden, and stresses the faith towards the religion. An Islamic Sex Education (ISE) interactive courseware is proposed in [11], which also attempts to change the parents’ motivational level in encouraging the awareness towards Islamic sex education. Some examples of multimedia and games for testing are reviewed in [12], which uses an intelligent tutoring system for computer games based on Bayesian networks and a multi-level tutoring model.

The usability and acceptance of a multimedia web based education among children is evaluated in [13], which has been developed based on sound theory in teaching and learning, pedagogical and multimedia concept. The research involves ethnography field testing. Multimedia support, a professional courses, presentation are involved in all virtual learning systems [14]. An extensive user requirements study was carried out to define the scope of functionality for the applications of m-learning with the potential to enhance the student performance and experience within the BSc multimedia technology and design (MMTD) course at the School of Engineering and Design, Brunel University, United Kingdom [15], which outlines the scope of functionality for m-learning in the context of education of multimedia technologists and designers at the university level.

Although those work mentioned above can improve the education performance to some extent, the multimedia-based education scheme also faces many challenges: single teaching method, out of date teaching content, simple assessment methods. Such factors limit the learning performance. Another issue is scientific and technological development and innovation need a lot of perspective and ability to highlight the computer expertise, which not only requires students to master the principles of computer networks, wireless networks and related advanced technology and latest development trends, and needs to have good practice and innovation. Training college as the main body of the advancing network professionals must have good teaching methods. Based on our previous investigation, the questions include three aspects: teaching method of the teacher, teaching content, and assessment method. And the key issue is the curriculum system of network engineering.

In order to improve the innovation ability, this paper proposes an improved multimedia-driven curriculum system of network engineering, which concentrates on the practical training and innovative learning and applications. Project-oriented software, hardware design and development abilities of students are improved based on the proposed multimedia-driven curriculum system, which include major curriculums related to internet of things, computer networks and software engineering. The proposed scheme employs multimedia education technologies, such as slide, video, virtual reality, and simulations to train students in practical and improve their innovation ability, which focus on students and enhance the creative ability, emphasizing the students are the main body of the teaching process, students around the play method of teaching the subject of reform.

II. PROPOSED SCHEME

A. Multimedia-driven Curriculum Category

Perceptually inspired curriculum using multimedia content connects students to subject matter and deepens their understanding of abstract concepts. Hence, multimedia-driven curriculum is needed to improve the learning motivation and effectiveness. Multimedia-based teaching approach has become increasingly attractive in education. Because multimedia content can arouse students engage through interactivity and immersion. In our proposed scheme, the network engineering courses are classified into three types as shown in Table I: foundation theory, theory and practice, and practice courses.

| TABLE I. CATEGORIES OF NETWORK ENGINEERING COURSES |
|---------------------------------|--------------------------------|
| Category                        | Course                          | Description                                |
| Foundation Theory               | Principle of Communications     | Introduction on related knowledge          |
| Practice                        | Web design, Project design, etc. | Improve innovation and skills              |

As shown in Table I, the foundation theory courses includes some basic knowledge of network engineering, such as principle of communications, information theory, etc. Those curriculums are very abstract and boring. Traditional education method cannot make students understand them thoroughly. Especially in the interactive teaching, heuristic teaching and practice of energy and innovation of teaching methods fall short. And network related courses involve the hardware, software and communications, which is a complex system. Hence computer network teaching should not only verify the theory, more importantly, through multimedia-based teaching, analysis, design, management and application of skills, will deepen their understanding of theoretical knowledge. Hence, multimedia-based education schemes, such as video, slides and cartoons will help both teachers and students effectively.

The second kind of courses is theory and practice, which includes Computer Networks, Internet of Things, Software Engineering, Database Principle, Wireless Networks, etc., which need practice and experiments to enhance the understanding. In the experimental teaching, as space, equipment, supplies and other restrictions on the issue, most colleges do not set up experimental classes. Fewer opportunities to students in hands-on, in addition, the lack of closely matching the theoretical teaching lab courses, it is difficult to abstract the agreement of theory and practice linked to the network environment. Another issue is the content of current teaching relatively old, could not quite keep up with the rapid pace of
development disciplines, timely new knowledge is difficult to impart to students, of students adapt to social needs. However, multimedia-driven education and learning scheme can push practice efficiently.

The third kind of courses is practice oriented, such as Web design, project design, which will improve innovation and skills of students. And in the project-driven education classes, software is tested for its functionality, usability, completeness and also the acceptance. We evaluated the usability and acceptance of a multimedia web based education among students. The website has been developed based on sound theory in teaching and learning, pedagogical and multimedia concept.

B. Multimedia-based Practice Education

In order to improve the students practice and innovation, multimedia-based practice education scheme is employed. And the teaching of knowledge is divided into three parts: First, theoretical knowledge of the network engineering, which is the basis of theoretical knowledge of the course. If the course of the network architecture, communication of classified and other layers of the agreement; the second is practical ability of the network-oriented experimental knowledge, to knowledge-based theory, focusing on practice and practical ability, such as network topology design and configuration, routing design and practice, the configuration of wireless LAN experiments.

For example, in the wireless network education class, the students will setup simulation platform based on Network Simulator 2 (NS2) as shown in Figure 1.

And if the students can setup the software successfully, they can verify it based on call the network animator as shown in Figure 2. This kind of experiment needs students enhance the comprehensive use and innovative ability to solve practical problems, such as building a practical network, departmental LAN or wireless LAN, through the appropriate way to improve network performance.

Another example is configuration of router based on routing information protocols. And the topology is shown as in Figure 2.

In order to setup the routers successfully, students first should understand the topology clearly, and then need to configure the IP address and clock frequency of serial interfaces, and then setup the interface serial 0. And the pseudo code of first step is shown as follows.

**Step 1:**
- Router1(config)# interface fastethernet 0
- Router1(config-if)# ip address 172.16.1.1 255.255.255.0
- Router1(config-if)# no shutdown
- Router1(config)# interface serial 0
- Router1(config-if)# ip address
- Router1(config-if)# clock rate 64000
- Router1(config-if)# no shutdown

Then, students can evaluate the status of the routers immediately as shown in the following:

- Router1# show ip interface brief
- Interface IP-Address OK? Method Status Protocol
- FastEthernet0 172.16.1.1 YES manual up
- FastEthernet1 unassigned YES unset administratively down
down
- FastEthernet2 unassigned YES unset administratively down
down
- FastEthernet3 unassigned YES unset administratively down
down
- Serial0 172.16.2.1 YES manual down
down
- Serial1 unassigned YES unset administratively down
down

In the second step, we should configure the RIP V1 protocol on Router 1. The program focuses on student’s practical and creative ability and increased emphasis on teaching students the process of the subject to play around the main body of students to teaching methodologies. To develop students awareness of innovation, practical ability and analytical and problem solving skills, knowledge of the program of courses, teaching methods, assessment methods and the organic integration of four systems of student ability, teaching methods to three-dimensional, multi-faceted assessment methods to improve students practice and innovation ability, training and practical talents as the goal. And the pseudo code of second step is shown as follows.

**Step 2:**
- Router1(config)# router rip
- Router1(config-router)# network 172.16.0.0
- Router1# show ip route
- Codes: C - connected, S - static, R - RIP
- O - OSPF, IA - OSPF inter area
- E1 - OSPF external type 1, E2 - OSPF external type 2
- Gateway of last resort is not set
- 172.16.0.0/24 is subnetted, 2 subnets
- C 172.16.1.0 is directly connected, FastEthernet0
- C 172.16.2.0 is directly connected, Serial0

In the third step, we should configure the parameters of Router 2, and then test it. To enable students to visually understand the course content, teaching can also increase the amount of information, which multimedia teaching mode instead of the traditional “chalk + blackboard” teaching model, which greatly improve teaching efficiency and teaching the quality of teaching content has multiplied. In the experimental class, we should employ the LED and multimedia tools efficiently, which will improve the teaching effectiveness greatly.
Step 3:
Router2(config)# interface fastethernet 0
Router2(config-if)# ip address 172.16.3.2 255.255.255.0
Router2(config-if)# no shutdown
Router2(config)# interface serial 0
Router2(config-if)# ip address 172.16.2.2 255.255.255.0
Router2(config-if)# no shutdown

Testing:
Router2# show ip interface brief
Interface IP-Address OK? Method Status Protocol
FastEthernet0 172.16.3.2 YES manual up up
FastEthernet1 unassigned YES unset administratively down down
FastEthernet2 unassigned YES unset administratively down down
FastEthernet3 unassigned YES unset administratively down down
Serial0 172.16.2.2 YES manual up up
Serial1 unassigned YES unset administratively down down

(a) PC1 ping PC2
(b) PC2 ping PC1

Figure 4. Test results of network connection

After successful configuration, then we can get the test results as shown in Figure 4 (a) and (b). During the education, experimental teaching is no longer attached to the theoretical teaching, independent assessment. Experimental teaching of wireless networks objective is to improve the quality of the students experiment, culture of innovation and engineering practice. Teaching task and experimental results is based on setting the number of experimental validation, design and research of the pilot project, students of network analysis, design, management and application of practical skills will improve their overall quality and ability. And theme designed by teachers and made according to the teaching task, the tasks have clear objectives require teachers to learn the overall objective of the framework, the overall goal into one of the small target, and to the content of each learning module for a detailed an easy grasp of the "task", these small "mission" to reflect the overall learning goals.

Multimedia based task teaching for applications in learning knowledge and skills so that students are clear learning objectives, student training to operate according to the steps so that students master the basic operations. According to our experimental conditions in schools, the main experimental set up and prepare for content creation: First, the network set up and configuration, such as twisted-pair production, the installation of network card and network protocol, VLAN, and set up the router configuration. Through these experiments to enable students to understand the network topology, the working principle of network equipment used to master the use of some commonly used Internet tools, the basic configuration of switches and routers. Second, Web services applications. In the Windows and Linux platforms are installed and configured DHCP, DNS, WEB and FTP and other network services. These experiments require students to master the major network service installation and configuration of these services through the experimental work to deepen understanding of the principles, and enhance application capabilities. Third, many practical network security and management experiments will be helpful. By learning and mastering a number of network management software and network analysis software, students with basic network analysis and network troubleshooting capabilities. Through the firewall configuration, enhanced network security awareness and understanding of network security related technologies.

III. PERFORMANCE ANALYSIS

In order to evaluate the performance of the proposed scheme, we performed the innovative network engineering practice based on multimedia education scheme in the last 5 years in the major of network engineering, computer science and technology, and software engineering. And the awards number, number of offered students are considered with/without using the proposed education schemes.

![Figure 5. Results of awards with/without the proposed scheme](image)

![Figure 6. Results of Employment with/without the proposed scheme](image)

Figures 5 and 6 show the number of awards, number of offered positions of students with and without the proposed education scheme. It can be noted that from 2009 to 2012, the number of awards almost keeps same without the proposed education scheme because those students cannot understand the education content without
the help of multimedia tools. At 2011, we observe that without proposed scheme as in Figure 5, the award number is only 28, though the number is increased slightly compared with the results in 2009 and 2010. However, the number is decreased to 22 in 2012. For the proposed scheme, we can see that the award number is increased obviously, in Fig. 5, the number increases to 46 in 2012 from 23 in 2009, which indicates that the award number increased 100%, and it also show the innovation and practical ability of students are improved greatly. At the same time, the results of number of employment are similar with the results in Figure 5. With the proposed scheme, the number of employment increases from 44 to 124 in 2012. While without the proposed scheme, we can see that the number of employment is only 91 in 2014, which is less than 32% of the proposed scheme. The results also indicate that based on multimedia education, students can grasp the knowledge more easier.

![Figure 7](image-url)

**Figure 7.** Employment of student with award with/without the proposed scheme

As shown in Figure 7, the proposed scheme and without proposed scheme can provide different number of positions. Experimental results on the students of network engineering assessment practices can be investigated through specific experiments. Assessment of student achievement is divided into several parts: experiment theory examination 30%, including experimental point of theoretical knowledge, experimental basic principles, the basic methods of experimental operation; basic skills assessment test, 50%, examination content, including lab reports, practical skills. Experimental reports should reflect the results of this experiment and experience, emphasizing on the experimental process and results analysis; In addition, 10% innovation, those found in the experiment, and adopted new methods for students to solve problems independently; In addition, 10% usually results. Assessment of students fails to be rebuilt. Through this assessment, students can pay more attention to computer network theory and the integrated use of technology to improve their ability to apply network technology to meet the needs of the community.

When the number of students increasing, the traditional education scheme keeps the number of international company constant for students cannot show their innovation clearly, while the proposed scheme can improve the practical ability, and the number of positions will increase to 27 in 2012, which is higher than that of without the proposed scheme clearly. This demonstrates that the proposed scheme is effective and improves the ability of students obviously.

**IV. CONCLUSION**

In order to overcome the shortcomings in advancing network engineering education and improve the innovation ability, we proposed an improved multimedia-driven curriculum system of network engineering, which concentrates on the practical training and innovative learning and applications. Project-oriented software, hardware design and development abilities of students are improved based on the proposed multimedia-driven curriculum system, which include major curriculums related to internet of things, computer networks and software engineering. The proposed scheme employs multimedia education technologies, such as slide, video, virtual reality, and simulations to train students in practical and improve their innovation ability, which focus on students and enhance the creative ability, emphasizing the students are the main body of the teaching process, students around the play method of teaching the subject of reform. The program merges curriculum knowledge, teaching methods, assessment methods and the organic integration of four systems of student ability to improve the students practice and innovation. For several years teaching courses in practical research and practice, the university practice teaching courses in advancing network achieved good results, for our school computer network courses raise the level of practice teaching, student ability, skills and innovation network capabilities play a positive role in promoting. From the data of last 4 years, more than 89% of students, with their skilled network technology and rich information knowledge, have got their satisfied jobs.

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