Exploration and Practice on Class Field in Information Engineering

http://dx.doi.org/10.3991/ijet.v11i06.5458

Zheng Kun, Zhou Jing, Yang Chang-yong and Sun Guang-min
Beijing University of Technology, Beijing, China

***Abstract*—The lack of student knowledge practice is a problem under the influence of the concept of traditional teaching and traditional classroom. And the proportion of knowledge inheritance is far more than that of knowledge innovation. To improve students innovative design ability, considering the existed problems, this article puts forward the thinking about building a new experimental teaching method of Information Engineering experiment. Based on "Class Field", the method is designed to guide the innovative practice. The six steps of the method is introduced to create the Class Field, including real time tracking and evaluation of process model, etc. The six years' data in the process of new teaching has been analyzed and the result reflects that the method is effective in improving the students' innovation ability.**

***Index Terms*—Class Field, Innovation practice, Scenario design, Information Engineering experiment**

I. INTRODUCTION

Developing students' ability of cultural inheritance and cultural innovation has been raised to the national strategic position in China [1]. Some authors [2] believed that local colleges should take specialty on the tread, practice and application as the main body. The local colleges should support the development of local economy and provide relevant services [3].

The main function of traditional teaching concept is the transmission of knowledge and culture. The main task of students is to inherit the existing knowledge and experience. But the significance and value of life accepted by modern society are not only reflected in the general work, but also embodied in the creative work and creative life [1]-[4]. The important function of teaching should include the creation of culture and creation of life. The main task of the students should include getting the ability to create culture and create life through knowledge and experience [1,3].

Through independent learning method, knowledge can be deeply rooted in students' mind. At the same time, students' comprehensive ability also can be improved. A generally accepted formula is (1).

$$\text{Teaching Effect} = \text{Willingness to Learn} * \text{Teaching Method} \quad (1)$$

As can be seen, no matter how reasonable the teaching method is, if there is no learning willingness, the teaching effect is zero. The most important thing is pointed out in this equation (1), that the learning willingness plays a very obvious and prominent role in study.

In this paper, a new teaching method is introduced in Information Engineering experiment.

II. PREVIOUS WORK

It is generally accepted that IT professionals must acquire a broader set of skills labeled "soft skills" beyond their traditional technical skills [5]. [6] clearly puts forward that some problems should be solved for the engineering training including the adaptation of society demand and establishing the idea of large-scale engineering. Consequently, some approaches are introduced in education on software engineering projects, such as the meetings-flow (MF) in [7].The results revealed that MF enhances a team's communication and coordination by giving mutual support and effort.

For the creation of self-study environment in networked courses, [1] constructed a systematic model. It probed into the realization of six supportive functions including learning support, direction support, interaction support, activity support, evaluation and feedback support and resources support. In the network curriculum, based on goal oriented, the course design in [8] and [9] includes choice and organization of the curriculum content. It determines the organization of the content, structure design of network course and planning activities of teaching and learning in network course.

[10] presents an empirical study of the Information System for competition, based on problem solving in Education.

But above all, knowledge transmission is not just a one way flow, especially in engineering education.

In order to help the students learning autonomously, teachers should stimulate the students' interests in studying, and get the students' innovative consciousness and their implementation. Then they need to provide the most appropriate scenario design scheme. So in the new concept "Class Field", the teaching process should be implemented extending traditional classroom to outside. For designing and practicing the teaching situation, more conclusions and further explorations in practice would be needed.

III. CLASS FIELD

From the formal point of view, the traditional classroom practice in China is limited to three aspects: time, space and knowledge flows. Firstly, the most time of practice are designed after the theoretical part, finite and fixed. Secondly, the classroom practice arrangements are mostly in the laboratories with a small number in enterprises. Thirdly, practice teaching in most cases is simple one-way to instill from teachers to students or from books to the students. The first two points facilitate the teaching man-

agement and quantization and the last point is conducive to the implementation of teaching.

From the view of content point, the current practice of network was mostly designed to inherit the culture about experience and knowledge. On one hand, due to the development of communication network technology so rapidly, the knowledge is renewed very quickly. On the other hand, many students are so excessive dependent on the transmission of knowledge that they do not or unwilling to exercise their ability to innovate.

Based on the factors above, it is necessary to put forward "Class Field" model and its implementation to make up for the deficiency of the traditional classroom model.

The Class Field is composed of two poles, the teacher and the students. In class field, the two poles use necessary technical means (situation) to establish the model of learning with opening time, opening space, and open content in order to attract students' interests in study. This learning model, Class Field, is not only limited to impart knowledge, but it also gives more emphasis on the innovation and more emphasis on knowledge feedback and update.

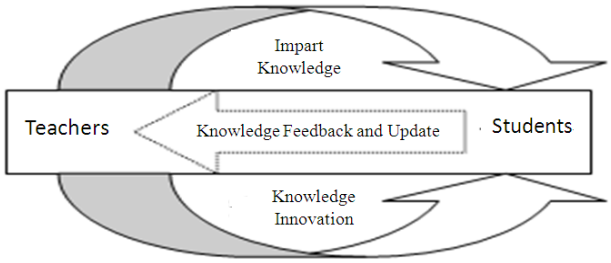

Figure 1. Class Field

IV. "CLASS FIELD" SITUATION DESIGN

The network as an example, "Class Field" situation design was introduced as follows:

Firstly, selecting the suitable teaching contents in the network curriculums. The contents should also be typical cases and be used widely in industry. Most importantly, these cases should occur in the students' around, so the cases can be easy to create the interests of students. "Video surveillance" contains such characteristics.

The knowledge point of "Video surveillance" relates to Digital Image Processing, Digital Signal Processing, Network Security, Computer Network, Data Structure and Algorithm, Object Oriented Programming, Software Engineering Curricula, etc.

In the subjects above, the process is carried out with Software Engineering thought. And it is driven by the task of "video surveillance".

Secondly, using "six steps" to create "class field". At the same time, designing and providing the most direct and detailed practical teaching resources. Scenario design for Class Field requires a lot of energy of teachers. And its quality, determines the final effect directly.

The first step is preparation stage. It is to design and realize the "single task with multi technology route"

In the content design, the video surveillance as an example, 9 technology routes were designed and passed the actual validation check.

In the formation of design, based on the traditional websites and the interaction, new technology means were added which also could stimulate students' interests, such as pocket server, Bluetooth voting machine etc.

Pocket server itself is an interesting project for students and the students can independently complete the design in a certain time.

The process is that, teachers release teaching interactive content on their own mobile phones and students with WIFI mobile phone can login to participate in classroom interaction. The system can support 30 students online at a time.

At present, it has been used in the traditional classroom and the development process.

The second step, the implementation stage. The prototype learning method is designed as "Reading Codes, Analysis Framework, and Refinement Module".

Students should read a lot of codes and documentation. After fully understanding the premise of development project, the students can easily enter their engineering roles.

So the prototype learning method is proposed that "Reading Codes, Analysis Framework , and Refinement Module ".

Teachers give students some refinement prototype modules. Students read and note the prototype codes, and analysis the process. Basis of above work, the students can put forward to design and develop. According to rough statistics, in the practice of network course, the average amount of the reading codes is about 1500 lines, the average amount of the notes is about 200 lines, and the core code is about 300 lines.

After four rounds application of this teaching process, this method is proved to be very effective. The effect has been reflected especially from the students' reports.

But this method put forward higher requirements to the teachers. The codes of the classic prototype system and the standard of developing document belong to the corresponding technical route, must be ready in advance for students. Students' reading and understanding ability is the main evaluation criteria.

On this basis, teachers design how to guide students in self-learning process in question and hypothesis. Then students design their own solutions.

Based on the guidance learning, the first stage is to make complex problem into simple one. The emphasis is given to refine and solve the core problem (Inheritance).

Based on the research study, the second stage is to make simple problem into complex one (Innovation)

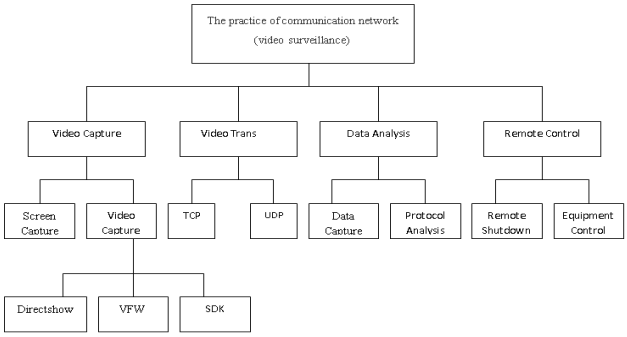

Figure 2. The knowledge structure of Video Surveillance

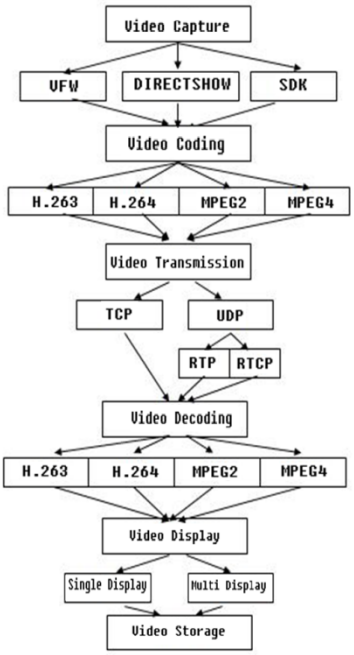

Figure 3. The technology routes of the Video Surveillance

Schemes only provide key description. According to their interests, students could select the specific technical route to study and complete independently. It includes understanding and researching in the technical route and details, which is uncovered before. After the students' practice in learning and participating in the design, the technology routes of video surveillance have been raised from 9 to the current 13. And these routes have been important reference to the next round inheritance study for students,

On this basis of the next round of study, the students could continue innovation in the practice with the introduction of new methods.

Finally it is realized that the benign development in innovative practice is based on "Practice - Theory - Practice".

The third step, evaluation. The evaluation stage adopts tri-variate evaluation method.

The tri-variate evaluation method includes teachers' evaluation, students self-evaluation and the experts' evaluation.

Based on the scheme degree of difficulty and the difference in the amount of code comments, more scientific and simple technical assessment standard should be designed for students to choose. The Evaluation coefficient is determined by the knowledge points and the degree of difficulty. The growth point is determined according to the quality of students learning.

In the teaching process, Pareto map is designed and observed to check students' cumulative workload and to observe the state of learning in real time as shown in Fig 4. With the increase of students work, the contribution of every team member changes in ranking.

To provide the scientific basis for a more objective evaluation, the model as a mathematical tool could be used to analyze the status of students and classify to show differences in different learning states.

The modeling process includes the following steps.

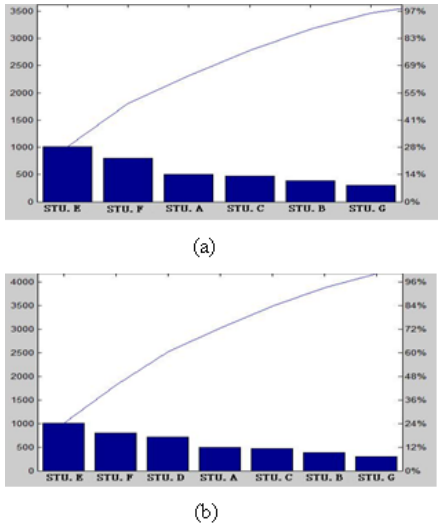

Figure 4. The dynamic tracking and real time evaluation of student work and contribution

First of all, classify the learning state. In the model, Expectation (Ex) means "learning effect" which is used to express the habits differences between the actual learning process and the program. Entropy (Ex) means the effect difference. Hyper entropy (He) is an uncertainty metric of Entropy, corresponding to "state retention". Secondly, parameterize the learning states. Thirdly, sample the learning states. Finally, modeling and comparing.

The fourth step is to get the feedback from students and reconstructing class relationship from the traditional classroom to class field.

The teachers guide the students to evaluate the level of completing the target of knowledge and skills to reflect on their own ideas and methods mastered in practice. Students could experience the joy of success from self-exploration, research learning and should cherish practice learning achievements.

The feedback process itself is expanding and updating to the teachers' experience and knowledge. The process of competitive examination fully reflects this point. Especially, the students, who design their own technical route and finally complete the task, leave a deep impression to the teachers. Many practical processes also enrich teaching cases and bring positive feedback to the teachers. The teachers and the students really get rid of the traditional relationship which is described as "big circle and small circle" by the ancient Greek philosopher Zeno. The new relationship between the teachers and the students calls class field that is more suitable for the modern social knowledge requirements and characteristics of the course.

The fifth step is to get feedback from the teachers. The teaching plan is revised and the teaching content is enriched.

First, is the revision and perfection of curriculum itself. In some traditional courses, under the conditions of completing the basic teaching task, some more practical knowledge is added. For example, in the "Object Oriented Programming", teachers have strengthened the MFC learning.

Second, establish a task driven teaching system in autonomous learning process. Each course, according to their own characteristics, should strengthen their own roles during the "task".

In this system, the task is driven rather than objective. For example, the "video surveillance" sub task design is added to the teaching of object oriented programming, computer network, network programming, software engineering and graduate design. And it has provided examples and enriched the practice for the course teaching. The communication between theory and practice has also been strengthened. In turn, each teaching link provides theoretical and technical support differently for the specific task.

Third, revise the teaching plan and syllabus. Some knowledge is enriched which is not reflected in the original syllabus but has played an important role in the realization of the task.

The sixth step: designing and realizing the multi task with multi technology routes. Both teachers and students participate in the reconstruction to design and realize the multi task with multi technology routes.

At present, on the basis of video surveillance, a number of projects are derivative, including the actual project and the title race. The design situation has been formed with multi task by multi technology routes.

V. ANALYSIS AND EVALUATION

The class field has been applied to network course experiment, the network curriculum design, the digital signal processing curriculum design, software engineering design etc. The students study in “Class Field” mode and have made the preliminary results. The “Class field” further reduces the gap between the course content and the universal demand of the actual development.

In the past four years, the teachers have applied thirteen software copyright and three patents by "Class Field". Most important, according to a survey last year, that 82.6% of the students of computer specialty from 2009 to 2014, are able to take the initiative to learn, and bring the fun to them. And 26.2% of them can provide positive feedback to the teachers that enrich and expand the teachers' teaching and research areas.

The students' self-study time increased with the innovative behavior and the enthusiasm has been effectively mobilized. Figure 6 shows the situation about the students on the selection technology route and the task execution. 35% of the students are willing to design their own new way to complete the task. But the risk of failure is high. There are 34.3% of the students, who design their own way, fail to complete the task. 65% of the students choose to finish the task according to the existing methods, which increases a lot of the probability of success, reaching 93.8%.

The main reasons have been analyzed and concluded as following. Firstly, the students don’t achieve task requirements in terms of the time, but the process and workload eventually reach the expected. Secondly, the students are not to achieve task requirements in terms of time, but basically don’t invest into study and workload not shown. Thirdly serious plagiarism. Fourthly, other reasons including dropping out, going abroad etc.

The participating students are more than the students who are recognized as contributed to the task. It is believed that the following several reasons are mainly included. One is, the students learn the relevant knowledge and do some work, which is just inherited. They do not think so deeply as to reflect the creativity, novelty and

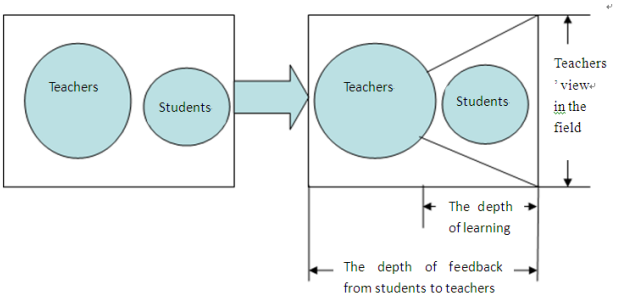

Figure 5. The relationship between the traditional classroom and Class Field

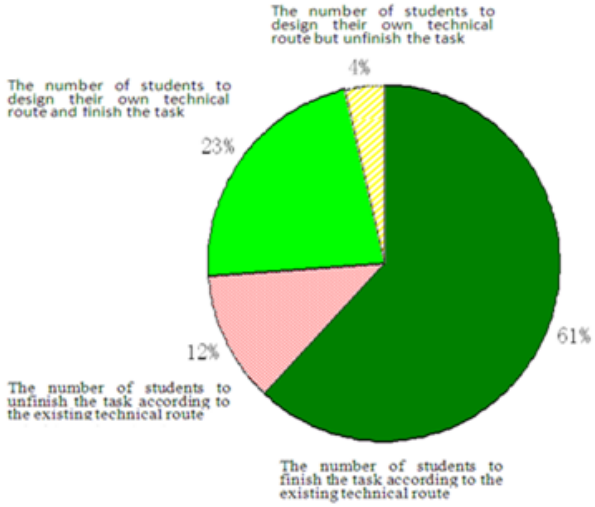

Figure 6. The technical route selection and completion2009-2014

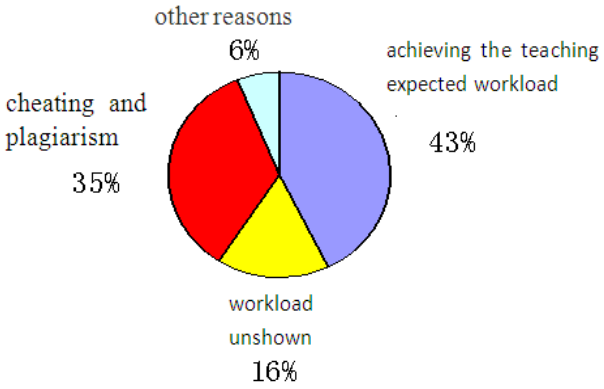

Figure 7. Analyse the causes of “Failure”

practicability. Although no contribution to the subject this kind of student is also to achieve the basic goal. Second is, 20 percent of the students do not complete the basic task by giving up halfway for various reasons. Third is, the sub task allocated to them are too simple because their purpose is just want to get the credits.

Students' overall contribution to the final achievements is shown in Figure 9.

The relationship between the course content and students' contribution rate is shown in Figure 10. Students make a contribution to 4 projects outside the teaching content which shows the students having strong learning ability and creative ability. The knowledge of the existing achievements needs interaction of courses.

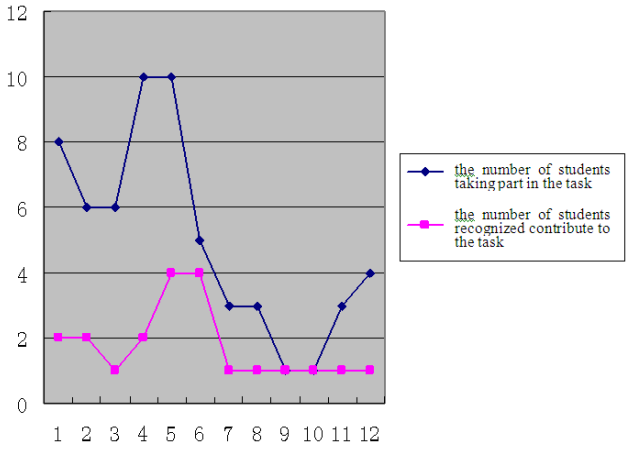

Figure 8. Comparison between the number of students taking part in and the number of students contributing to the task

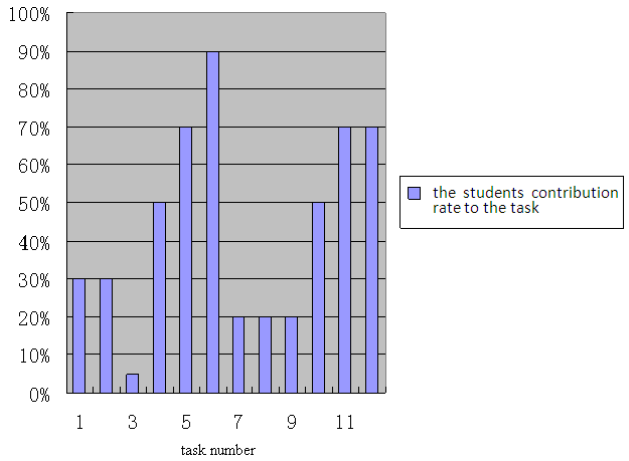

Figure 9. The students contribution rate to the task

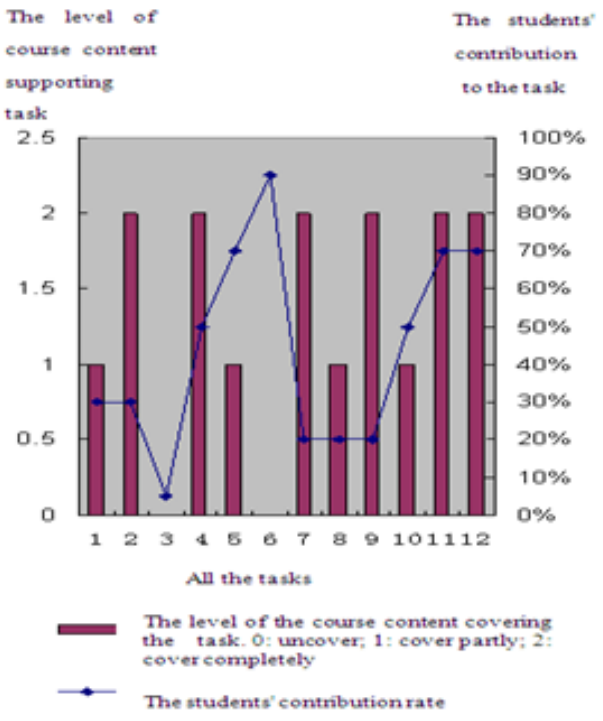

Figure 10. The relationship between the course content and students' contribution rate

The teachers are very glad to see a lot of this phenomenon. Because, it is just only a specific interpretation of restructuring the relationship between teachers and students.

VI. CONCLUSION

Firstly, it is the improvement of the learning model from "inheritance" to "innovation". It is clear that the network curriculum practice is designed as "inheritance + innovation with an emphasis on innovation", transferred from "inheritance study is given priority to" learning model. Innovation mainly takes the application layer as the breakthrough point, emphasizing "stimulating students' interest, solve the problem". The first stage is on the basis of the guiding learning "the complex problems to simple", emphasizing that the core problem is extracting and solving (inheritance is more important).The second phase is complicating simple question on the basis of the research learning, emphasizing on independent inquiry learning (innovation is more important).

Secondly, it is the improvement of study way from "classroom" to "class field". By using modern information technology means, the limitation of traditional "classroom" can be broken and put forward in the form of "field" practical learning environment for students. Technical means for the construction of "field" is absolutely not just relying on a traditional sense of the course website. It needs to introduce more update technology, so the teachers can also attract students' interests in the application of the technology elements. For example, Pocket server, Bluetooth voter (soft), remote video monitoring, interactive software etc. These are innovation research in the application level that students participate in and develop independently. At present, fixed time and fixed school course has been completely unable to meet the needs of students, Therefore, interests driven active learning is the main study way.

Again, it is the improvement of teaching, from "meeting the needs" to "leading the future". On the basis of passive adaptation for the enterprise needs, teachers should try to take the initiative to predict and guide the future demand of the enterprise. On the premise of emphasizing the application layer innovation, the design of the practice will not only meet the current some actual needs from companies but also predict and guide the future in some fields.

Finally, the existing problem is the real workload of teachers and that cannot be reflected in the traditional teaching mode. So, of course, it will affect the enthusiasm of teachers' participation in further development. And it needs to be solved emphatically in further researches.

REFERENCES

[1] Chen Lai, "The strategic significance of cultural heritage of innovation",*CHINA HIGHER EDUCATION*, no.20,pp9-10. 2011.

[2] Pan Mao-yuan,"Strong Local Undergraduate Colleges and Universities -Study the location of local universities", *China Higher Education Research*, no.12, pp.15-18. 2009.

[3] Yang Xing-lin,"The Study on practical Talents and the Fostering Models",*HEILONGJIANG PESEARCHES ON HIGHER EDUCATION*, no.06, pp.164-167. 2007.

[4] Wang Yan-li,Cheng Yun, "The Creation of Self-study Environment in Networked Courses," *MODERN DISTANCE EDUCATION RESEARCH*, no.2,pp. 35-38, Feb.2007.

[5] D.Joseph, S.Ang, R.H.I.Chang, S.A.Slaughter, "Practical intelligence in IT: Assessing soft skills of IT professionals," *Commun.*

ACM, vol.53, no.2, pp.149–154, 2010. http://dx.doi.org/10.1145/1646353.1646391

[6] Zhang Bing-sheng, "Study on the relationship between cultivation target, specification and model", *China Higher Education Research*, no.06, pp.38-39. 2006.

[7] Chen Chung-yang, Hong Ya-chun, Chen Pei-chi, "Effects of the Meetings-Flow Approach on Quality Teamwork in the Training of Software Capstone Projects", *IEEE TRANSACTIONS ON EDUCATION*, vol. 57, no.3, pp. 201-208.Aug 2014. http://dx.doi.org/10.1109/TE.2014.2305918

[8] Wu Fa-ti, "Target oriented curriculum design of network course," *China Educational Technology,* no.4, pp. 78–81, Dec. 2006.

[9] Zheng Kun, Liu Xu-dong,"Integrated Experimental Platform Construction of Network Course", *Computer Education*, no.10, pp141-143. 2010.

[10] Pedro J.M., Manuel F.M., Mario M., Carlos D.K., "Motivation and Emotions in Competition Systems for Education: An Empirical Study", *IEEE TRANSACTIONS ON EDUCATION*, vol.57, no.3, pp182-187, Aug. 2014. http://dx.doi.org/10.1109/TE.2013.2297318

AUTHORS

Zheng Kun was born in Baoding, Hebei, in 1977. He received the M.S. degrees in Software Engineering from the Beijing University of Technology, in 2006. He is currently pursuing the Ph.D. degree in Electronic Engineering under Beijing University of Technology. He is the author of three books, more than 20 articles, and more than 10 inventions. His research interests include image processing, network and information security, driver-assist. Affiliated to the Department of Information Engineering, Beijing University of Technology, Beijing, China. (zhengkun@bjut.edu.cn)

Zhou Jing was born in Harbin, Heilongjiang, in 1981. Her research interests include fuzzy synthetic evaluation, international economics and trade. She is the director of the International Trade Research office of the Pilot College of Beijing University of Technology. Affiliated to the Department of Economic Management, Beijing University of Technology, Beijing, China (ansong_23@163.com)

Yang Chang-Yong is a professor of Education at the Department of Economic Management, Beijing University of Technology. (gmsun@bjut.edu.cn)

Sun Guang-Min is a professor and doctoral adviser of Electronic Information at Beijing University of Technology. Affiliated to the Department of Electronic Engineering, Beijing University of Technology, Beijing, China (gmsun@bjut.edu.cn)

Submitted 02 February 2015. Published as resubmitted by the authors 25 March 2016.