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Promoting practical teaching reform through innovative competitions in the context of "New Engineering"

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ABSTRACT. *Since the construction of "New Engineering" by the Ministry of Education, the practical teaching mode has put forward higher requirements for cultivating diversified and innovative engineering talents. Therefore, the reform of university experimental and practical teaching operation mechanism can't be delayed. This paper takes the construction of New Engineering as the background and academic competitions as the breakthrough point, discusses the outstanding problems in experimental teaching, proposes an operation mechanism to promote practical teaching by innovative competitions, and takes engineering students under the Chinese-foreign cooperative education model as the object of research, explores the practical teaching mode from the aspects of talent cultivation scheme, practical teaching, innovative competitions and innovative ability cultivation system, and realizes the practical teaching. Win-win teaching reform and innovation competition, thus helping to promote the construction of the "new engineering".*

KEYWORDS: *"new engineering", Innovation Competition, Experimental teaching, Laboratory management*

1. Introduction

Since 2017, the Fudan Consensus, the Tianda Action and the Beijing Handbook reached are the "trilogy" of the construction of new engineering disciplines, opening up a new path for engineering education reform. This has triggered a new round of reforms in engineering education in colleges and universities across the country, and has become a hot issue in the entire society and the field of higher education. "New Engineering" emphasizes the practicability, intersectionality, comprehensiveness and innovation of disciplines, and focuses on training a large number of diversified and innovative engineering and scientific talents [1]. Under this requirement, practical teaching and innovation competitions should also focus on practicality, crossover, comprehensiveness and innovation.

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Practical engineering education can better cultivate students' thinking and practical innovation ability to improve college students' hands-on practical ability, engineering application ability, teamwork ability and innovation spirit. Although various universities have various types of research and teaching laboratories according to the actual situation, they are more focused on graduate students in terms of open use. Teaching laboratories are generally large and comprehensive in service groups, and the degree of openness of the laboratories is not enough to meet the demand of undergraduate engineering students for practical engineering education. In recent years, although universities have successively implemented the project management mechanism of innovation competitions, the innovation competition cultivation model and the openness management mechanism of experimental teaching, many problems still exist [2]. Therefore, it is imperative to further optimize the operation mechanism of student innovation competitions, especially to provide a complete set of cultivation mechanism for students with international perspectives who are studying in Chinese-foreign cooperative schools.

Miami College of Henan University, as a Sino-American cooperative engineering college, introduces the high-quality educational resources of the University of Miami and provides advanced engineering education for students, aiming to cultivate international advanced engineering talents with global awareness and vision. However, Miami College of Henan University and even Henan University are not well known in the country at present, and besides some objective reasons, the opportunities for students to participate in international and domestic innovation competitions are few, the grade is low, and the gold value of their works is not high are also important factors restricting the improvement of popularity. Therefore, it is necessary to make full use of internal and external resources of the college to create a reasonable platform for the management of innovation competitions and practical experimental teaching platform for students, especially to take advantage of the external opportunities of cooperation with the University of Miami to provide more help for our students to participate in innovation competitions. Therefore, it is an inevitable choice to reform and innovate the operation mechanism of practical teaching and build an open and efficient mode of practical teaching reform to promote the construction of "new engineering" in universities. This article proposes the operational mechanism of promoting practical teaching with innovation competitions, which is to use innovation competitions as a breakthrough point to encourage and attract engineering students to participate in innovation competitions, combine the theoretical knowledge and practical skills they have learned, and stimulate students’ desire for knowledge and interest in learning. The established professional high-level competition, relying on the innovation competition, can provide an effective way and focus for the cultivation of engineering students' innovative ability under the mode of Chinese-foreign cooperative education.

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2. Problems in laboratory management

2.1 Insufficient openness in lab management

At present, most university experimental teaching courses by the school unified arrangement management, students under the guidance of the teacher unified time, unified teaching content for experimental teaching. In the class time period laboratory uninterrupted operation, while in other periods of time most of the laboratory and experimental instruments are in an idle state, equipment utilization rate is too low, can not play the maximum benefit of the laboratory, resulting in a great waste of laboratory resources. The more advanced lab reservation and opening management system is still not perfect, although major universities have been promoting trial, but there are difficulties in adhering to standardized management, the lack of corresponding systems, the results are not satisfactory and so on.

2.2 The teaching method is not new enough

Experimental teaching in college courses is mostly based on confirmatory experiments, and most of the experimental content has not changed for many years. It is seriously lacking in reform and innovation, lags behind the development of social production, and is not conducive to cultivating students' ability to think independently and solve problems.

The teaching method is boring and rigid. Normally, the teacher prepares experimental drugs, utensils and instruments. Students only need to complete the experimental steps in accordance with the experimental report. They lack a comprehensive and profound understanding of the experiment and deviate from the original intention of experimental teaching.

There is a lack of objective evaluation criteria for students' experimental results. The writing theory of experimental reports has become the norm, and the importance of standardized operation, serious thinking, and active innovation by students in the experiment process has been ignored, resulting in random manipulation, forgery of experimental data, and changes Phenomena of experimental results occur from time to time.

2.3 Insufficient reserve of scientific research and innovation

The phenomenon of experimental innovation over-relying on the tutor is serious, and the reserve force is weak. As a potential force for scientific research and innovation, lower-grade undergraduates have strong curiosity, but in most cases their professionalism is still limited to basic theoretical courses to absorb professors, and they have fewer channels to understand professional knowledge and expand knowledge. In addition, lower-grade undergraduates do not have a thorough understanding of various laboratory research projects and the research direction of

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their supervisors, which leads to incomplete understanding of themselves, and causes great difficulties in personal expertise and interest orientation choices. In addition, most of the students who conduct independent research in the laboratory are master students and doctoral students, while the lower-grade undergraduates lack opportunities and ways to communicate with teachers and senior students. In addition to the experimental teaching of the curriculum, they lack access to the laboratory to design experiments independently. The opportunities for operation and the opportunities for scientific research and innovation have led to a gap in experimental education between undergraduates and graduate students, and the research reserve is weak.

2.4 Insufficient awareness of scientific research and innovation

At present, the experimental platform of domestic colleges and universities is not open management. The cultivation of students' scientific research and innovation consciousness is limited to the established practical teaching links and experimental teaching courses [3]. The teaching content and mode are relatively fixed and single, which cannot fully stimulate students' enthusiasm and initiative in scientific research and innovation. Sex, restricting the cultivation of innovative talents. For most non-open laboratories, they repeatedly encounter bottlenecks in scientific research and innovation. The root cause is that the overall understanding of scientific research and innovation at this stage is insufficient. Scientific research and innovation promote development in the country and gain fame and profit in oneself. Experiments are the cornerstone of scientific research innovation. However, some students only regard experiments as their daily learning tasks, ignoring the importance of experiments in scientific and technological innovation. Undergraduate graduation projects and postgraduates' daily scientific research have some indulging in experiments and loyal to thesis writing. There is no external force to promote the two-way simultaneous development of students.

3. Promote teaching reform with innovation competition

University laboratories are important bases for conducting experimental teaching, conducting scientific research, cultivating innovation ability, and improving overall quality [4]. Traditional experimental teaching mostly passively completes the confirmatory test set by the teacher. Although it helps students to deepen their understanding of the theoretical knowledge of classroom learning, it ignores the importance of cultivating students' innovative thinking and practical skills, and inhibits students' Personality development. Open experimental teaching is a new type of laboratory operation mode. It no longer constrains on old knowledge, old theories, and old techniques that are immutable in books, but is based on cultivating students' innovative consciousness and practical ability, giving students autonomy. The right to choose and the space for free play enable students to improve their innovation ability and overall quality while storing basic knowledge. The innovation competition is a competition activity that is closely related to the curriculum and

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comprehensively uses one or several courses to design and solve practical problems or specific problems outside of the experimental courses. It supplements the deficiencies of classroom teaching and provides exploration for teaching reform Direction. In recent years, although universities have successively implemented experimental teaching open management mechanisms and innovative competition cultivation models, there are still many problems. It is imperative to further optimize the reform and openness of experimental teaching and the open management operating mechanism of the laboratory.

3.1 Experimental information management

The openness of laboratory information management refers to the open and transparent display of laboratory equipment information, equipment usage, teacher experiment topics and research directions in front of teachers and students, so that laboratory information can be found. Nowadays, there are many professional experimental projects and scientific research projects in major universities and departments, and the non-disclosure of relevant information directly leads to students not being able to clearly find the research direction they are interested in, unable to determine clear goals, and seriously affecting the future development of students, It also indirectly led to the confusion and complexity of laboratory management and difficult to form a system. For example, it is difficult and time-consuming to report equipment damage, and the time-consuming period for purchasing equipment and consumables is too long. Therefore, the openness of laboratory information management is the first step to optimize laboratory management. The specific implementation plan is shown in Figure 1 .

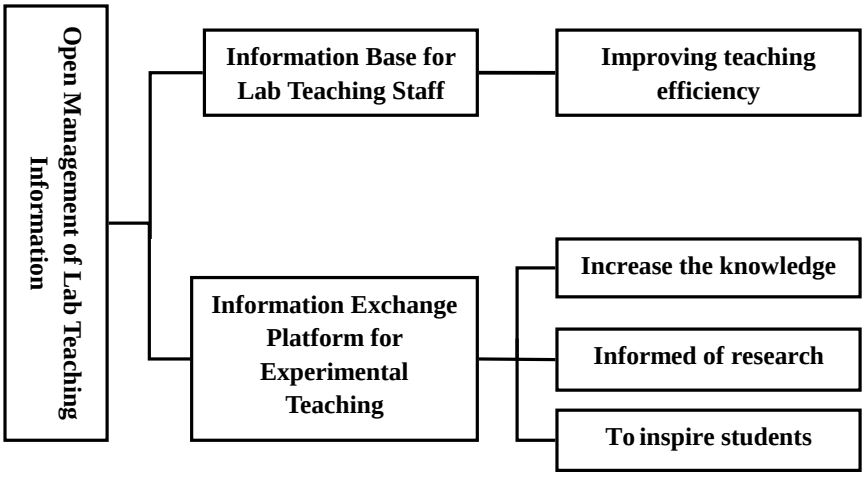

Figure. 1 Openness of laboratory teaching information management

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3.1.1 Establish an experimental teaching information exchange platform

Make full use of various media platforms in schools and colleges to continuously update and advertise experimental teaching information. Students can learn about the operation of experimental teaching, research projects in various laboratories, scientific research topics in various teaching and research sections and other relevant information through the network platform, effectively Help students familiarize themselves with the laboratory and the research progress of each subject. To enable students who are willing to participate in experimental scientific research tasks to independently choose experimental content based on the teaching content and their own comprehensive knowledge, choose suitable tutors, arrange experimental time reasonably, and fully increase the utilization rate of the laboratory. This can not only make rational use of resources, improve the quality of experimental teaching, reduce the waste of laboratory resources, and strengthen the connection between students and teachers; it can also stimulate students' spirit and enthusiasm for exploration and practice, courage to innovate, and make students' practical ability and innovative ability Be promoted.

3.1.2 Establishing an Information Database for Experimental

Teaching Staff In the traditional laboratory management system, the collection and management of basic information is mostly done manually or in the form of documents, which is not only prone to information leaks, but also prone to confusion and loss of information. In this case, because the experimental teaching staff cannot get the real-time information of the required instruments in time, a lot of research and development time will be wasted in the communication process, thereby reducing their work efficiency. At the same time, the management of experimental consumables is also subjective and lacks an objective and accurate evaluation system, so that the specific consumption of consumables cannot be well counted, and it is very easy to cause unnecessary waste. The statistical process of purchasing new equipment is complicated, which wastes a lot of working time and affects the progress of the experiment. Therefore, it is necessary to establish a laboratory information database, and enter all the experimental items, personnel, equipment, laboratory construction, log files and other information into the system, not only to ensure that the archived data is clear, but also to greatly reduce the deviation caused by human factors, and save It can greatly improve the work efficiency by improving the working time of the manager and the finishing time of the reviewer.

3.2 Open management of experimental teaching equipment

Experimental teaching equipment is a powerful assistant for scientific research experiments. The cultivation of students' innovative ability is first reflected in the scientific and effective use of experimental teaching equipment. To promote the effective use of experimental teaching equipment, we must first enable students to really get in touch with various instruments and learn how to use them. This requires

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open management of experimental teaching equipment. Under the premise of open management of experimental teaching equipment, strictly implement the registration system for the use of experimental teaching equipment and regulate the use of equipment. In terms of learning the use of equipment, the "old with new" model is adopted to encourage higher grade students to guide and teach lower grade students, so as to ensure that lower grade students can better master the use of equipment while reducing equipment damage.

3.3 Open management of experimental teaching carriers

Open management of experimental teaching carrier. The traditional talent training model has increasingly revealed its drawbacks under the increasingly severe social competition environment. Under new policies and new situations, the talent training model is in urgent need of reform. Taking the open management of experimental teaching as the premise, and promoting the cultivation of innovative talents with innovation competition as the carrier is based on the new requirements and new measures under the background of "double first-class".

3.3.1 Operation status of experimental teaching carrier

As an important link and an important carrier for the integration of intra- and extra-curricular practice teaching, innovation competition is a platform for college students to comprehensively use basic knowledge to solve practical problems and realize the transformation from theory to practice. It is a useful supplement to theoretical teaching.

Miami College, for example, relying on its laboratories, responds positively to the national call to improve students' innovation and entrepreneurship ability, builds a strong platform for innovation competitions and scientific research, and improves the quality of talent training. Over the past few years, Miami College has organized and participated in 3 national innovation competitions, 5 national projects, 22 projects of "University Student Innovation and Entrepreneurship Training Program", and won 9 awards in national and provincial innovation competitions.

3.3.2 Operating mechanism of experimental teaching carrier

Establish a competition selection and training mechanism(Fig. 2). Through the establishment of a leading group for innovation competition work, it is responsible for the selection, management, guidance, training and promotion of student innovation competitions. Participants in the competition can be selected from student groups such as low-grade students who are willing to participate and have innovative ideas, senior students with more mature experimental techniques, and graduate students with certain scientific research results. Based on the characteristics of different student groups, establish a complete competition training system, and carry out competition training in a systematic and targeted manner. Through

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comprehensive and multi-angle training, step by step, make up for shortcomings, and gradually improve students' scientific research ability and comprehensive quality.()

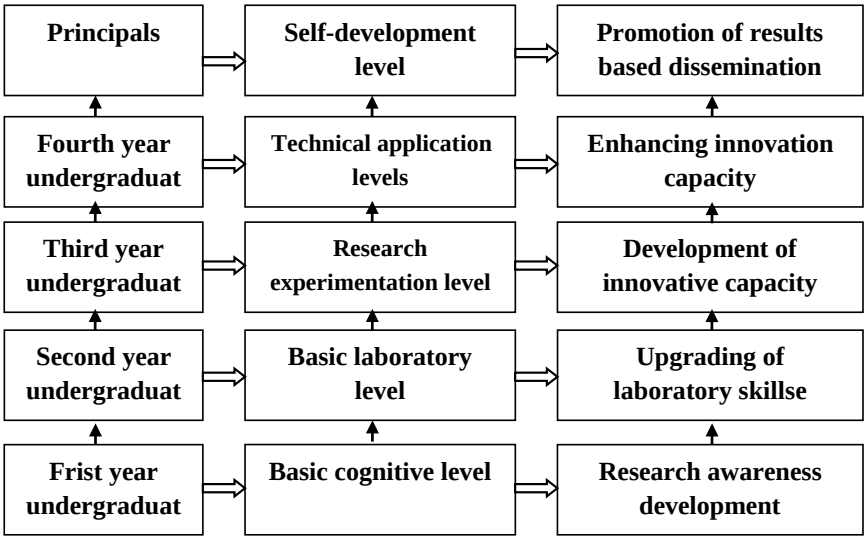

Figure. 2 Competition Training System

Construct an experimental teaching management operation model (Fig. 3), and establish an innovative competition team with student self-management as the mainstay and instructor management as the supplement. Based on the principle of student voluntariness, students are encouraged to form innovative practice project teams in a combination of new and old, with students as the main body, independently design and formulate scientific and reasonable experimental project plans to ensure that all members of the team can exert their strengths, cooperate closely, and complete together experimental project. The instructor will follow up and assist in the whole process, and provide theoretical support and technical support for the team in topic selection, project establishment, planning, and implementation without interfering with students' autonomous management [5].

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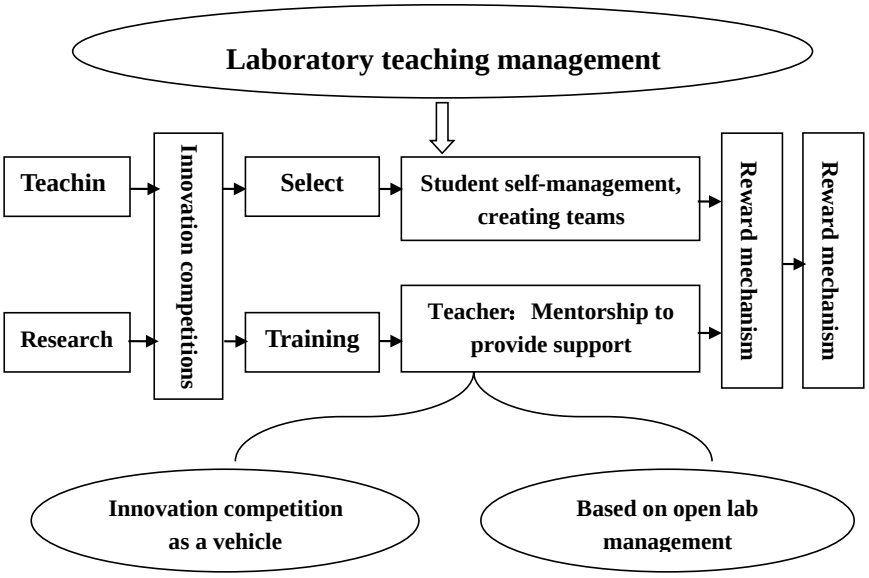

Figure. 3 Openness of laboratory teaching information management

Establish supporting policies and reward mechanisms. The establishment of a credit system for awards and innovations is the internal driving force for the continuous development of discipline competitions. Through a sound reward system, rewards for students' extracurricular training credits, scientific research support platform, and learning exchange opportunities are given to attract students to actively participate in innovation competitions and achieve the purpose of cultivating students' innovative ability [6]. At the same time, in order to further promote the inclination of teachers' work from scientific research to student training, in the implementation of innovation competitions, teachers are given a moderate tilt in the implementation of the workload of the instructor, the evaluation of professional titles and the evaluation of excellence [7].

Promote the formation of a good style of study. Strengthen the cultivation of the practical ability of college students by building a perfect innovative thinking practice platform; by creating a strong innovative cultural atmosphere, cultivate college students' sense of innovation. Combining the subject characteristics and professional characteristics, carry out innovative training practices, and make full use of the demonstrative and guiding effects of subject competitions to form unique innovative campus cultural activities, and stimulate and train students to learn by continuously extending the width and depth of the subject competition platform The enthusiasm and interest of the students have formed a good atmosphere with common value orientation and independent learning after class.

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Optimize the allocation of resources and establish an innovative competition linkage mechanism. With the cultivation of college students' innovative thinking as the core, optimize the innovative competition system, combine subject competitions with innovative activities, improve the multi-level and multi-type innovative education system and the practical teaching system that supports students' independent management and independent innovation; continue to explore deep levels, Diversified subject competition development new model, strengthen the association with society, industry, and enterprises, strive for more opportunities to integrate social practice, and gradually integrate with domestic and foreign student competitions. Actively explore innovative competition organization forms based on problems and fields, focus on improving students' creative spirit of exploration and practical ability to solve problems, and timely transform outstanding results and works of competitions to expand social and employment needs.

3.4 Experimental teaching methods to "three combination" change

The transformation of experimental teaching methods to "three-in-one" experimental teaching in colleges and universities should be supplemented by confirmatory experiments, with independent and open experiments as the mainstay. The experimental teaching curriculum should be transformed into three combinations of "teaching and learning, in-class and extra-curricular, process and result evaluation". Based on close integration with classroom teaching, consolidate students' basic theoretical knowledge and cultivate the ability to solve practical problems. Actively explore experimental teaching organizational forms based on professional knowledge and social phenomena, focus on improving students' creative spirit of exploration and practical ability to solve problems, and transform experimental results into application results in a timely manner to enhance experimental teaching effects. Through the experiment teaching reservation platform to carry out the three links of "experiment guidance, teaching demonstration and appointment experiment", students can clearly understand the precautions and basic operating rules during the experiment in a short time. Students can also predict the experimental links that are prone to problems in the pre-experiment process, and can communicate and answer questions with instructors, experimental teachers and students of corresponding majors online and offline at any time, and link up and down to enhance the effect of experimental learning.

3.5 Experimental teaching and human resources training linkage development

The joint development of experimental teaching and talent training is based on the traditional teaching guidance model, overall management, establishment of linkage and optimization systems, and exploration of innovative talent training models. Form the "Interest Group-Innovative Practice Project Team-Competition Team" innovative talent cultivation model to achieve the "three focus": First, focus on the initiative of the student body. Fully mobilize the enthusiasm of students, give full play to their initiative and potential, and realize the "independent management

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and independent innovation" of the activity system. The second is to focus on capacity improvement and broaden the room for growth. Through subject competitions and other new experimental teaching models, students will be more competitive in employment and provide greater choice. The third is to focus on the construction of conditions and improve the level of education. Strengthen the construction of innovative education platforms, actively create conditions, support and encourage students to participate in various university student discipline competitions at all levels with the help of innovative platforms, and initially form a “guide-cultivation-incentive-improvement” innovative talent training approach [7].

4. Conclusion

3 Conclusion Experimental teaching is a key link in the development of disciplines and the cultivation of innovative talents. At the same time, the development of disciplines and the cultivation of innovative talents promote the reform of experimental teaching.

First-class disciplines require a first-class experimental teaching platform, building an open management and operating model for experimental teaching, and promoting experimental teaching reform and innovative talent training based on innovative competitions can not only improve efficiency and expand influence, but also stimulate students' interest in learning and achieve a win-win situation. Only with innovation and thinking, with new methods and new thinking, can there be new results; with efficiency and responsibility, with new exploration and changes, can we deepen reform and innovation. The construction of world-class universities and first-class disciplines must rely on "first-class" standards to achieve a leap in the quality of experimental teaching management.

References

[1] Jin Shengju (2016). Promoting the development of "double first-class" with the construction of first-class laboratories. Scientific and educational literature (second issue), vol.8, no.1, p.51-52.
[2] Zhang Haifeng (2017). Research on the construction of first-class laboratories in the context of "double first-class" . Laboratory technology and management, vol.34, no.12, p.6-10.
[3] Fan Zheyi, Liu Zhiwen, He Bingsong, et al (2017). Exploration and practice of open laboratory teaching management model. Laboratory technology and management, vol.34, no.9, p.195-197.
[4] Liu Hongmei, Hu Rui (2017). Cultivation of practical and innovative abilities of mechanical students through academic competitions. light industrial technology, vol.33, no.4, p.166-167.
[5] Zhang Xiaofeng, Qu Kaige, Jie Xiaoqiang, et al. Reform of the open laboratory operation mechanism based on innovation competitions (2018). Laboratory technology and management, vol.35, no.1, p.262-265.

ISSN 2616-5767 Vol.3, Issue 7: 37-48, DOI: 10.25236/AJETS.2020.030705

[6] Ding Pu (2015). Interaction between academic competitions and practical teaching to promote the development of innovative talents. Modernization of education, vol.11, no.1, p.60-62.
[7] Xiong Jie, Fu Yanfeng, Duan Zhidi (2018). Construction of academic competition practice system for engineering students under the concept of innovative education. Journal of Cheung Kong University (Social Science Edition), vol.41, no.2, p.115-118.