An IT talent cultivation mode driven by actual projects - based on research using questionnaires and interviews

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ABSTRACT: This article presents an analysis of questionnaires and interviews of Information Technology (IT)-major students at the Wuhan University of Science and Technology (WUST), Wuhan, PRC, who participated in enterprise projects. The results indicate that the proportion of IT students who participated in projects is not high, although they are eager to take part in enterprise projects and put into practice the theories that they have learnt in school. The construction and development of project teams need to be improved; the selection and cultivation of talent should be enhanced; and the roles of teachers should be transformed. Building a system is closely linked to facilities, the network environment, communications platforms and development tools. Participating in projects provides a student with a professional responsibility emphasising good communications and organisational ability and, hence, enhances their employability. The cultivation of IT talent driven by real projects is proposed in this article. This involves building a practical platform for IT projects; establishing a highly qualified teaching team; and reforming project teaching.

INTRODUCTION

The IT industry is a knowledge and technology-intensive industry that provides an economic lifeline for the country and is a pillar of national security. Therefore, it is urgent to cultivate IT talent to master a variety of programming and development techniques and practical skills.

There are more than 850 universities in China that offer some IT-related specialties for undergraduates, such as computer science and technology, information management and information systems, software engineering and network engineering. However, most university graduates do not meet the demands of enterprise. This is mainly because students lack experience of engineering practice and of self-regulated learning and innovation [1].

Another reason is that practical teaching at universities (including traditional experiments, curriculum design and graduation design) is not relevant to the building of real IT systems in enterprises. The universities' practical teaching systems do not meet the changing needs of enterprises as they are simply based on limited and simulated scenarios, which aim to master theory instead of putting forward solutions to real situations in enterprises [2]. Hence, it leads to inadequate practical engineering capability among graduates of IT-related specialties.

Some university teachers have researched the cultivation of the engineering ability of IT students. For example, Lin Piyuan et al explored IT talent cultivation focused on problem-solving abilities [3]. Qin Zunyue et al implemented the CDIO (Conceive - Design - Implement - Operate) education philosophy to a Java language course [4]. Combined with market demand, Xu Yunqing et al discussed a kind of *plug and play* talent cultivation mode [5]. Fan Rongzhen et al put forward an IT outstanding talent cultivation mode based on actual project practice using the project teaching methods promoted by Nanyang Polytechnic, Singapore [6].

Nevertheless, these researches were conducted only from the standpoint of teachers regarding the cultivation of IT talent. Few further explorations have been made regarding the reform process itself, let alone from the point-of-view of project participants, i.e. students. Meanwhile, no further research has been carried out on project platforms, capacity development, team culture, role orientation, project experience, career planning, and so on.

This article is a report of the investigation of 205 senior students and graduates who participated in IT projects and majored in information management and information systems, computer science, electronic commerce, and so on. The research used semi-structured questionnaires and personal interviews. Four aspects were investigated: project participation, team building, supporting platform and project outcomes. The results offer further insights into the cultivation of IT in students and suggest some reforms.

THE QUESTIONNAIRE AND INTERVIEWS

Content Design

The survey was conducted by combining a multiple-choice questionnaire with personal interviews. The content covered the following four areas:

A. A survey about project participation by IT-related students. This covers education and background, effort and motivation for participating in IT projects, project types, roles, and so on.
B. A survey about the nature of project teams covering team culture and regulation, methods of selection, cultivation of talent, organisational structure, division of labour, external sources of information, the rewards and penalties system, and so on.
C. A survey about software and hardware platforms used in projects covering the work place, academic communication, development tools, common software used, results sharing, information exchange platform, and so on.
D. A survey about IT project outcomes covering the development of professional abilities, improvement in engineering ability and self-confidence.

Survey Method and Object

The questionnaires were submitted by every participant independently to ensure the objectivity of the survey results. Data were drawn from postgraduates and undergraduates from years 2005 to 2009. The students majored in information management and information systems, electronic commerce, computer technology, software engineering, and so on. Among the students, some engaged in the enterprise projects led by teachers, some took part in projects via IT technology associations and some undertook projects in the form of partnerships or on their own. The number of distributed questionnaires was 220, and 205 of them were returned. So, the return rate was 93.18%. The samples have a large topic coverage and long time span. The survey results fully capture the situation of student IT projects at WUST with high reliability.

QUESTIONNAIRE ANALYSIS

Survey of Students Who Took Part in IT Projects

Educational structure and professional background: there were 174 undergraduates, accounting for 84.88% of the total and 31 postgraduates, accounting for 15.12%. The student majors were divided as follows: computer science (34.15%), software engineering (32.68%), information management and information systems (28.29%), and electronic commerce (4.88%). They all took part in IT projects in enterprises. Student majors by year: Table 1 shows the proportion by major, from 2005 to 2009, of students who took part in enterprise IT projects. The data indicate that not all students participated in projects, due to some restrictions, such as shortage of teachers and project resources.

Table 1：Project participation status about IT major students, from 2005 to 2009.

Major	2005	2006	2007	2008	2009
Computer technology	9.14%	9.46%	8.23%	9.38%	8.89%
Software engineering	8.36%	8.96%	9.23%	8.76%	8.32%
Information management	7.67%	7.28%	8.01%	7.98%	7.85%
Electronic commerce	2.23%	3.24%	2.68%	3.09%	3.78%

Information about Projects

Motivation: in the multiple choice question - *What is your motivation for taking part in the project?* - 66.71% students responded that they want to increase their hands-on capability, i.e. they wish to apply textbook knowledge. The questionnaire results are shown in Figure 1.

Aspiration for choosing project types: in the question - *As a student, which kind of teacher-led projects do you want to participate in?* - 51.71% students wish to take part in IT projects designed to solve problems that are firm- or public institution-oriented, 34.17% students want to participate in natural science research projects at national or provincial level and which are led by their teachers, 8.23% of them prefer to engage in humanities and social science projects, only 5.07% students want teaching research projects about education reform.

The data indicate that most students prefer to work in front-line departments of enterprises or public institutions, and some students want to improve their research abilities in order to lay a solid foundation for their further graduate study.

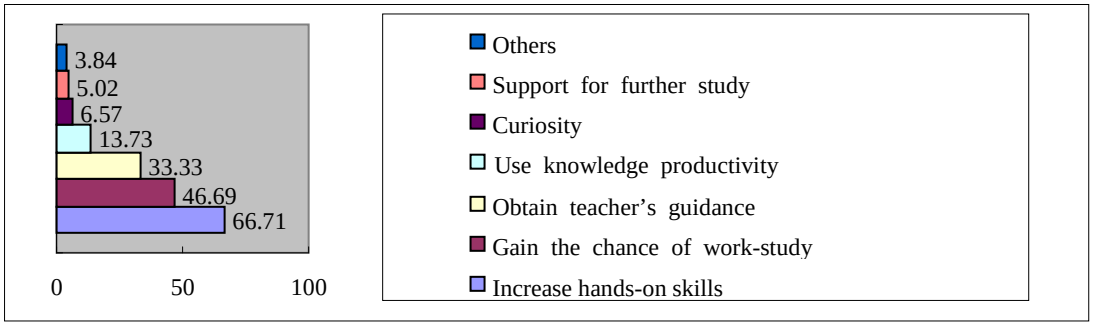

Figure 1: Motivation for participating projects.

Project Teams

Project team culture and regulation: a survey was carried out in respect of project team establishment, external information, internal management, and so on. Table 2 contains the results. According to the data, most project members support establishing special project teams, building a Web site for external publicity, establishing special QQ (Chinese On-line Messaging Service) community and setting up a return visit mechanism.

They agree to the establishment of an appropriate rewards and penalty system to motivate team members. A large number of students want to engage in academic exchanges about projects and welcome others in these exchanges. Also, they do not mind sharing their source code and other materials, including with lower grade classes.

Table 2: Culture and regulation of project teams.

Issue	Necessary %	Unnecessary %	Indifferent %
Building a special team for a project	94.14	1.46	4.39
Defining responsibilities in the form of rules	71.22	17.56	11.21
Building a special Web site for the team	81.46	11.21	7.32
Setting a uniform logo	65.36	28.78	5.85
Building a QQ community	87.80	4.88	7.32
Sharing codes and work	96.59	2.44	0.97
Awarding project certificates	50.73	43.41	5.85
Establishing rewards and penalties	50.24	43.41	6.34
Setting up a return visit mechanism	84.39	13.17	2.44

Selection and cultivation of talent: to the survey question - *Which methods do you think should be used in choosing outstanding talent for project teams?* - 58.05% students believe the best talent should be chosen by a programming competition to ensure the overall quality of the team. Also, exceptional students could be selected based on their course design work. The results are shown in Figure 2.

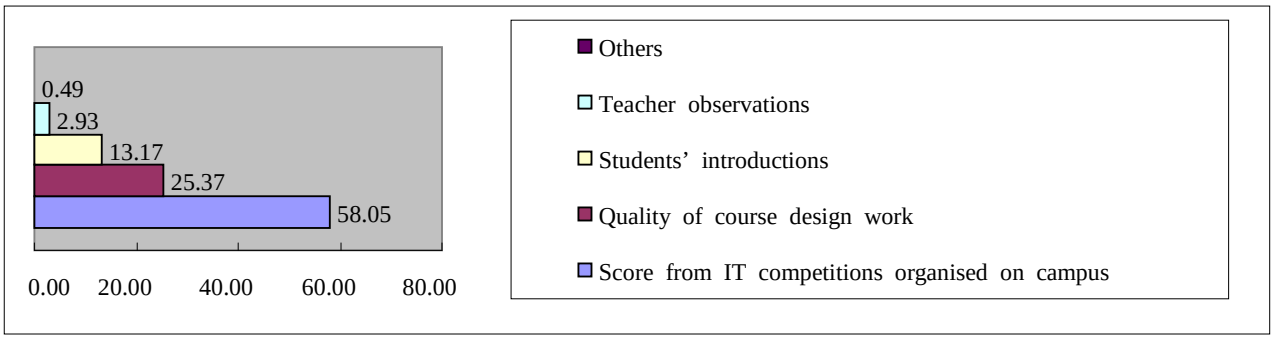

Figure 2: Talent selection.

When asked, *In which ways can a team member improve quickly on an IT project?*, many students would request advice from higher-grade students and also learn from the experience of finished projects. Hence, different educational backgrounds and qualifications are not relevant. The results are shown in Figure 3.

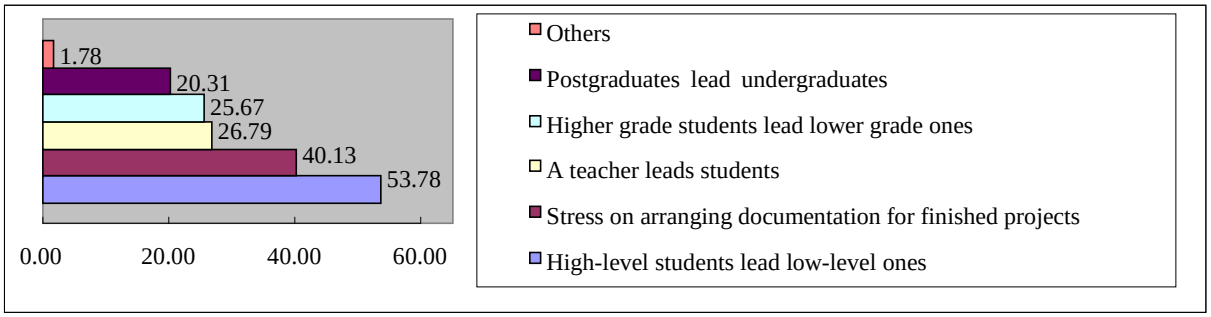

Figure 3: Cultivation of team members.

Organisational structure and the role of the teacher: Table 3 and Table 4 give the detailed results for the question, *What is the best organisational structure and what roles do the teachers play in a project?* The results show that a teacher first plays the role of spiritual leader in a project and, then, as a CEO. The interviews show that, for teachers, inspiring students and exploring their potential is more important than helping to overcome technological difficulties during the project. In the division of labour, it is better to allocate according to roles than modules.

Table 3: Organisational structure of project team.

Options	Proportion %
Teacher serves as president and project leader serves as CEO	48.78
Academic team led by teacher	32.68
The teacher acts as project leader	11.71
Students take charge; teacher responsible for quality and schedule supervision and cost control	6.83

Table 4: Teacher's role in the project team.

Options	Proportion %
Manage the team, motivate students' innovation	54.15
Control project progress	31.71
Communicate with clients	9.76
Organise the team to tackle technology problems	4.39

Platform Construction

Need to construct a software and hardware platform: mainly investigated were such aspects as computer software and hardware, the Internet, and academic communication, as shown in Table 5. The statistical data show that the team members prefer to apply for a special office. They hope to obtain quickly technical information and project development experience via many kinds of way, such as the Internet, information platform and academic communication; and they do not pay much attention to the availability of computer hardware.

Table 5: Software and hardware platform construction.

Issue	Necessary %	Unnecessary %	Indifferent %
Availability of special office premises	92.20	0.98	6.83
Availability of computers	11.71	65.37	22.93
Internet access	97.56	0.49	1.95
Construction of information exchange platforms	92.68	2.44	4.88
Provide training courses on development tools and common software	76.10	5.85	18.05
Holding lectures, presentations, system demonstrations on a regular basis	72.20	11.71	16.10
Invite engineering staff to make presentations	77.07	12.68	10.24
Academic communication open for foreign students	60.98	5.85	33.17

Information exchange platforms: responses to the question, *Which information communication platforms do you prefer?*, reveal that students pay a lot of attention to the practical value of software, such as Feiqiu, QQ. Results are shown in Figure 4.

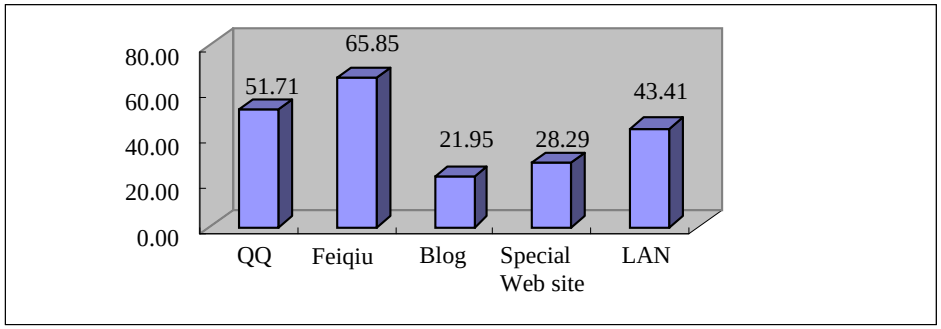

Figure 4: Information exchange mode.

Figure 4: Information exchange mode.

Tools and software needed when developing a project: to the survey question, *What are the required tools and software for project development*, the most popular answers were Java, PhotoShop and VS.net. Knowledge of these benefited from classroom teaching. Results are shown in Figure 5.

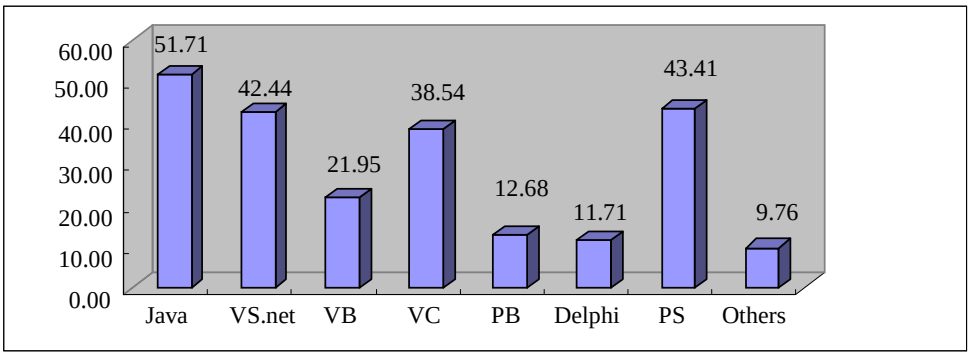

Figure 5: Tools and software needed when developing projects.

Project Outcomes and Experience

Cultivation of professional abilities: by participating in different IT projects, students realise the importance of cultivating professional abilities. To the survey question, *Assuming you are a system analyst or a project manager, rank the four types of abilities, from high to low importance* (as shown in Figure 6), all responses indicated that non-technical abilities, such as communication and organisational abilities, are most important during the implementation of projects. A considerable part of the required engineering can be mitigated with the help of timely and effective communication, which also reduces the expenditure on manpower and material. Organisational ability is also very important in providing for the rational allocation and integration of technical resources, and the support for key technologies. Organisation is important if a project team is to finish a project using the least resources and in the shortest time. The next professional ability is *learning ability*. Because of the urgency of projects, project members should be required to master new knowledge and technical documentation, for example, ETC, radio frequency identification (RFID). Last is the ability to program, using taught programming languages so as to meet clients' business demands.

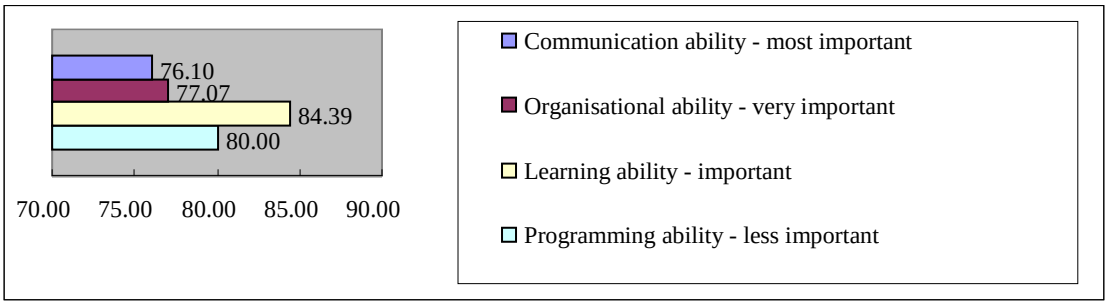

Figure 6: Professional capabilities and their importance for projects.

Project experience: in response to the multiple-choice question, *In which aspect have you made great improvements by participating in IT projects?*, the students responded with project responsibility (60.98%), software development ability (54.63%), analysis and design ability (53.66%), communications ability (47.80%), organisational ability (39.51%) and document management ability (14.63%). It can be seen from the above data that the biggest improvement in student abilities is not in technical skills, but in the awareness of responsibility, which cannot be cultivated in traditional classes. At the same time, it can be seen that students do not pay attention to technical documents because they are concentrating on seeking quick success and instant benefits.

To the multiple-choice question, *Which aspects will help you to find a job after taking part in a IT project?*, the students agreed project experience (71.71%), developing their specialty skills through the IT projects (63.41%), establishing a good relationship with the clients (25.85%) and establishing employment places (24.88%). From the data obtained in the survey, participating in projects provide precious engineering practical experience for students, and enhances their self-confidence in employment.

Summary of project outcomes. In the survey, *Which methods do you think can be used to summarise and publicise the project outcomes*, 78.54% students hoped to make the summary by videos. First of all, this method is vivid and visual, and can bring a deep sense of comprehension to developers, clients and lower grade students. Second, it was expected that project outcomes could be used as part of a graduation thesis and in academic articles. Results are shown in Figure 7.

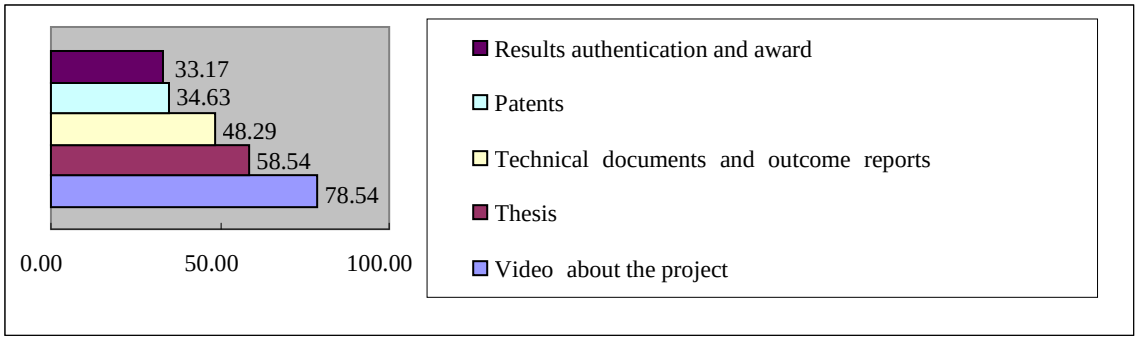

Figure 7: Methods used to summarise project outcomes.

Future plans: in response to the multiple-choice question, *Which role do you prefer to play in future IT projects*, 95.81% students wished to undertake system analysis and design jobs and 40.13% students were willing to engage in development. These demonstrate that they hoped to become system analysts in the future. The results are shown in Figure 8.

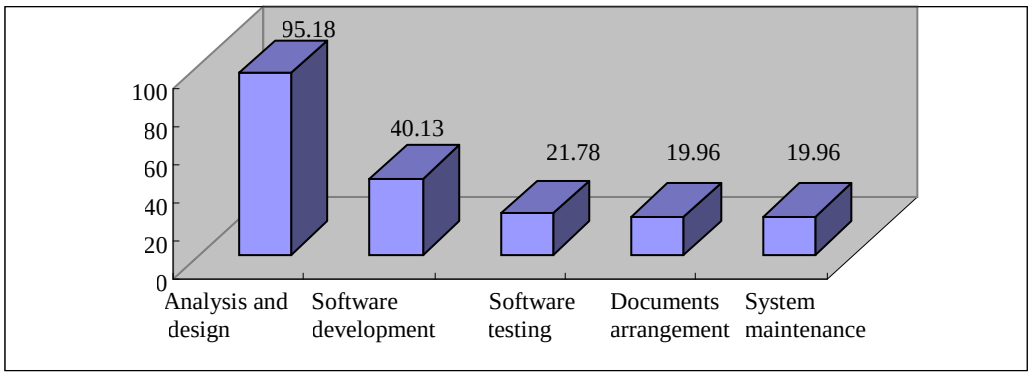

Figure 8: Preferred roles for students in future IT projects.

CONCLUSIONS AND SUGGESTIONS

Construction of an IT Project Practice Platform

From the statistical data obtained in the survey, students have strong aspirations to participate in enterprises' IT projects. However, teachers cannot provide enough IT projects to students because of insufficient connections with enterprise. So, it is crucial to build an IT project practice platform to cultivate IT-major students' practical engineering abilities. It can be carried out considering the following aspects: the first is to enhance the construction of a hardware environment; for example, offer laboratory or workshops for various IT projects; provide multimedia devices, such as projectors; provide Internet access; increase the number and types of books on IT technology, project management and electronics. The second aspect is to create an atmosphere of innovation and to build the soft power required by project

teams. The university can choose IT talent by way of scientific and technical weeks, computer design competitions, and so on and, hence, organise project teams. The practical project abilities can be quickly improved through case studies, technical communication and by sharing resources. The third aspect is to strengthen co-operation with enterprise to cover more platforms and projects. Universities should be encouraged to sign contracts with more enterprises to supply projects. Enterprises provide capital, the business platform and the IT project. On the other hand, the universities supply talent and technical support. Via such projects, theoretical knowledge can be translated into productive activities.

At present, there has been some success in establishing an IT practice platform at WUST. The University launched the students' science and technology innovation fund in 2007. Since 2012, the university has undertaken 100 national undergraduate innovative and business training programmes every year. To some degree, this makes up for the defects of the practice platform. Community activities, associated with schools, colleges and departments, are carried out vigorously. Examples include the Robot Soccer Association, ACM (Association for Computing Machinery) Club, Embedded Association affiliated to the Computer School, Computer Association affiliated to school organisations and Audio Studio. Teachers and Students Project Teams established by the Department of Information Management have undertaken over 160 IT projects for enterprise and public institutions. These include the Ministry of Water Resources, Wuhan Iron and Steel Group, and the Three Gorges Group. These implemented projects provide a good platform for IT students to improve their practical engineering ability.

Create a Team of Double-qualification Teachers

Teachers with engineering backgrounds and rich project experience are a resource to promote the project practice abilities of students. Universities should stress the development of such double-qualified teachers, i.e. qualified in engineering and projects. There are two aspects, the first is to go into enterprise. Many approaches may be taken to encourage teachers to enter into enterprise. There, they can participate in the development of projects in the enterprise, go deep into the front-line of IT companies and undertake specific IT project analysis, design and implementation. Thus, they gain first-hand management and project experience related to project management, team construction, technological problem-solving and project culture. The second aspect is to involve outside experts in the teaching. Information Technology enterprise system analysts and senior engineers can be introduced to enrich the teaching teams; hire the CIO and project managers in an enterprise as part-time professors in the university, aperiodically organise project analysis and technical communications for teachers and the project teams, and conduct training about engineering and project management for professional teachers.

Promote Gradual Project Teaching Reform

The teaching for IT-related majors must be reformed to improve the students' project practice abilities. Therefore, the teaching of theory to ensure the completeness of knowledge should be reformed and a project teaching mode introduced. This can be gradually carried out in three stages: the first is to study actual IT projects. The new project members can critique IT projects implemented in enterprises in many ways using; for example, system presentations, videos, and group discussion to cover project analysis, system design, mastering the technology, system implementation and risk control. All of these would improve technical knowledge and project experience. The second stage is the recurrence of IT projects, i.e. to redo projects already undertaken in an enterprise. Some students with a technology foundation compose a project team. On the condition that they delete any commercial secrets, the team will redo a project implemented successfully in an enterprise under the guidance of a project manager and teachers. The third stage is to develop new IT projects. Members who have good skills and project experience can take part in real projects led by the teachers and complete the whole project flow of demand analysis, design, system development, project implementation and project acceptance. This will cultivate the relevant professional qualities of IT students, such as communication abilities, teamwork, developmental abilities, and so on. In terms of the organisation of the teaching, project teaching can be regarded as a kind of practice class and assessed in the form of innovation credits. The assessment of student scores consists of three parts; namely, marks for the project team, mutual evaluation in the team and personal self-assessment.

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