A cognition practice teaching system of IT majors based on a lever model

Wenxia Li†, Jianping Yu† & Ruijun Zhang‡

Wuhan Railway Vocational College of Technology, Wuhan, People's Republic of China†
Wuhan University of Science and Technology, Wuhan, People's Republic of China‡

ABSTRACT: In an effort to resolve problems in cognition practice (practical experience) for IT majors at the Wuhan University of Science and Technology, such as lack of practice funding and practice bases, a new model has been put forward to realise an increase in the required practice. Described in this article, is the so-called *lever model* that takes a CDIO training programme as a pivot, organisational costs as the resistance arm, integration of school resources and college-enterprise cooperation as the power arm and the stimulated curiosity of students undertaking the practice as the power. The model has been developed on the basis of a questionnaire and interviews, and it has already been tested. Based on the results obtained in 2012, the practical experience model for IT majors at the Wuhan University of Science and Technology is successful, appropriate for IT majors and scalable.

INTRODUCTION

The rapid development of IT industries represented by big data and cloud computation has posed increasingly higher requirements on the engineering practice and innovation abilities of IT graduates. Accordingly, practice teaching has attracted attention from institutions of higher learning and has also been promoted to a strategic height by the Ministry of Education in China in the undergraduate quality and teaching reform project in institutions of higher learning [1]. As a key link to practice teaching and the first step to launch practice teaching, cognition practice plays a critical role in guaranteeing the smooth implementation of subsequent practice teaching. However, currently cognition practice has not been implemented well with IT majors and has not attracted adequate attention, which is mainly reflected in problems, such as the lack of practice funding, the lack of practice bases and a low motivation among teachers. As a result, practice quality has declined and the practice effect is not as good as it should be.

Some scholars have done a lot of research on practice teaching and practical experience. Huang et al compared the practice teaching of colleges and universities in several countries, such as the *Dual System* in Germany, cooperative education in the USA, competency based education (CBE) in Canada, *Qualification Driven* education in the UK and *TAFE* in Australia [2]. He et al suggested a *multi-level progressive* cognition practice system [3]. Zhang et al explored an IT talent cultivation mode driven by actual projects [4]. Furthermore, a continuous project study within the Russian system of higher engineering education was proposed [5].

The above research explored the practice teaching of some specific majors, but there has not been a comprehensive study on specific problems in the cognition practice of several IT majors. By conducting questionnaire surveys on the cognition practice of relevant IT majors at Wuhan University of Science and Technology, such as Information Management and Information System, Computer Science, Electronic Business and Software Engineering, this article offers an overview of the existing short-comings of cognition practice, demonstrates the design of a cognition practice teaching system of IT majors based on the lever model and suggests corresponding improvement measures.

GENERAL SURVEY ON COGNITION PRACTICE OF IT MAJORS

Method and Object of Survey

A survey based on a questionnaire and interviews was conducted. The questionnaire was in the form of Word document, and respondents were asked to complete and submit it at the site to ensure unbiased, independent thinking and objective survey data. The respondents included undergraduate students who were enrolled in the university in 2008 and 2009. Of the 180 questionnaires that were issued, 169 were completed, a collection rate of 93.9%. The proportions of respondents of each major were as follows: Computer Science 29.6%, Software Engineering 18.3%, Information

Management and Information System 40.8%, Electronic Business 11.2%. Interviews were conducted face-to-face, with the aim of obtaining correct information and relevant details. Tools, such as SPSS and Excel were applied and a confidence interval of 95% was set. A single factor method was adopted to undertake statistical analysis of the findings of the survey.

Main Contents of Questionnaire

The questionnaire consisted of 26 questions involving several aspects of cognition practice, such as target positioning, organisation form, links design, contents setting, and student assessment and achievement reporting. Due to space limitation, only the survey findings of several of the main problems have been presented in this article.

Knowledge of Cognition Practice

In the question - *Is it necessary to carry out cognition practice?*- 69.8% of the respondents answered that it was very necessary, 5.3% answered that it was not necessary, while the remaining 24.9% answered that it was necessary, but that it was not well-organised. The ratings of importance of cognition practice by students and their understanding of the practice objectives are shown in Tables 1 and 2.

Table 1: Ratings of IT majors on cognition practice.

Options	Rates (%)
Attach a great importance to, and actively participate in, cognition practice	37.3
It is enough to pass the test as a common practice course	21.3
If there is some change, they will actively participate	27.2
Put little stress on cognition practice	14.2

Table 2: Understanding of students in the objective of cognition practice.

Options	Rates (%)
To consolidate their professional knowledge	14.0
To enhance their learning interest	21.3
To practice their innovation abilities	11.4
To enhance their practice abilities	16.6
To get familiar with the professional knowledge and training programme	16.6
To understand the employment orientation of their major	20.1

The above data indicate that most students recognise the necessity of cognition practice, with the intention to participate. Their general understanding of cognition practice is relatively clear and definite. The data also expose the fact that cognition practice is not well-organised.

To the survey question - *Do you benefit from cognition practice?* - 34.3% of the respondents said *yes*, 42% answer said *so-so*, while the remaining 23.7% said *no*. The relative satisfaction survey is: 28.4% satisfaction, 62.1% so-so and 9.5% dissatisfaction, which shows that the teaching objective of cognition practice is not completely achieved and requires enhancement.

Links Design of Cognition Practice

With regard to the organisational forms of cognition practice, the survey findings are shown in Figure 1. The figure indicates that cognition practice depends on the organisation and guidance of the tutor, and also reflects the fact that there is a shortage of tutors.

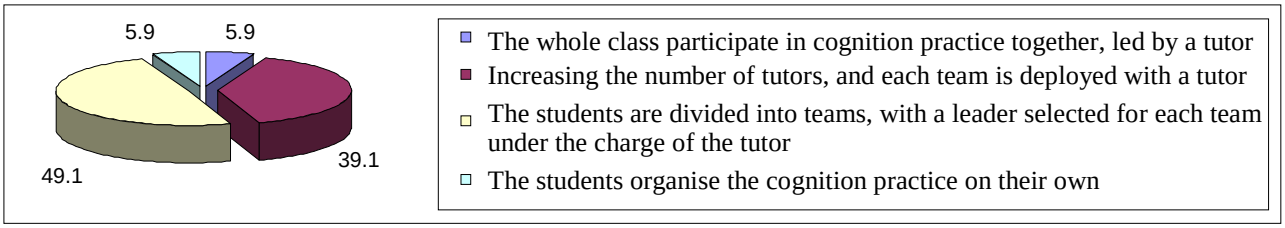

Figure 1: Proportions of different organisation forms for cognition practice (%).

In the contents setting of cognition practice, some students have made numerous good suggestions. Relevant statistical data are shown in Table 3. The data indicate that the simulation of business operations and visiting enterprises, which are strongly professional and close to the actual situation of enterprises, bring a great inspiration to students.

Table 3: Contents setting of cognition practice.

Options	Number of supporters
Visiting the digital resources of the school	33
Visiting IT enterprises	69
Summer holiday practice activities	54
Quality development activities	42
Simulation of business operation	80
Experience exchange with upper classmates	27
Lectures given by experts	23
Others	5

Regarding the digital resources of the school in which the students are interested, the responses obtained from the survey are listed in Table 4.

Table 4: Cognition practice resources of the school students are interested in.

Options	Number of supporters
Security monitoring system	37
Digitalised campus	61
ETC access control system	25
Academic system	43
Each news Web site of the school	38
Others	5

Achievements Exhibition of Cognition Practice

Through the survey, the project team found that as a practice course, simply writing a practice report cannot comprehensively and objectively reflect on the achievements of the practice. A number of students suggested several good forms of an achievement presentation as shown as Table 5. The findings indicate that video exhibition and team discussion are relatively popular among students, for they can objectively and comprehensively reflect on the full view of the practice.

Table 5: Forms of achievements exhibition for cognition practice.

Options	Number of supporters
PPT Presentation	32
System demonstration and video (DV) exhibition	53
Debate by teams on relevant focus issues	47
Dramas	13
Making a survey report	28

Data Analysis

Based on the questionnaire, the project team conducted interviews with students from each IT major, and visited relevant teachers and students of other colleges and universities. It was found that the main problems in cognition practice of IT majors are:

- There is a serious lack of resources for cognition practice. Due to several factors, such as the limited funding and space, the cognition practice of each major cannot be fully carried out and the purpose of professional practice cannot be completely fulfilled.
- The teachers are not highly enthusiastic. Quite a few teachers do not understand the actual production process in enterprises. Plus, there is a lack of corresponding incentive mechanisms, and the teachers are not enthusiastic about going deeper into the nature of enterprises.
- The cooperation between colleges and enterprises needs to be strengthened. The in-school students lack an understanding of enterprises' workflow. In addition, training requires meeting certain costs. The enterprises generally do not accept short-term intern teachers and students. Therefore, the schools need to strengthen cooperation with enterprises in other forms, such as project cooperation and tackling technical problems, so as to establish more practice bases outside the school.

THE LEVER MODEL OF COGNITION PRACTICE OF IT MAJORS

To solve the problems mentioned above, a *lever model* was constructed for use in the cognition practice of IT majors, as shown in Figure 2. A complete lever model consists of the following elements: a pivot, power, power arm and

resistance arm [6]. To move the target object, there are another two essential preconditions. The rigidity of the lever itself maintains the stability of the whole system; the friction caused by the lever is low. This model takes the implementation scheme of IT majors based on the CDIO concept as the pivot. Under the supporting force of the pivot, problem orientation and project driving are employed to enhance the curiosity of students and increase the power weight, with communication and feedback as the lubricant that tries to reduce friction in the cognition practice course. Through integrating the resources of the school, strengthening the college-enterprise cooperation and paying attention to cultivating the practical abilities of the tutors, it tries to prolong the power arm, so as to achieve a larger bearing capacity and better fulfil the teaching objective of cognition practice.

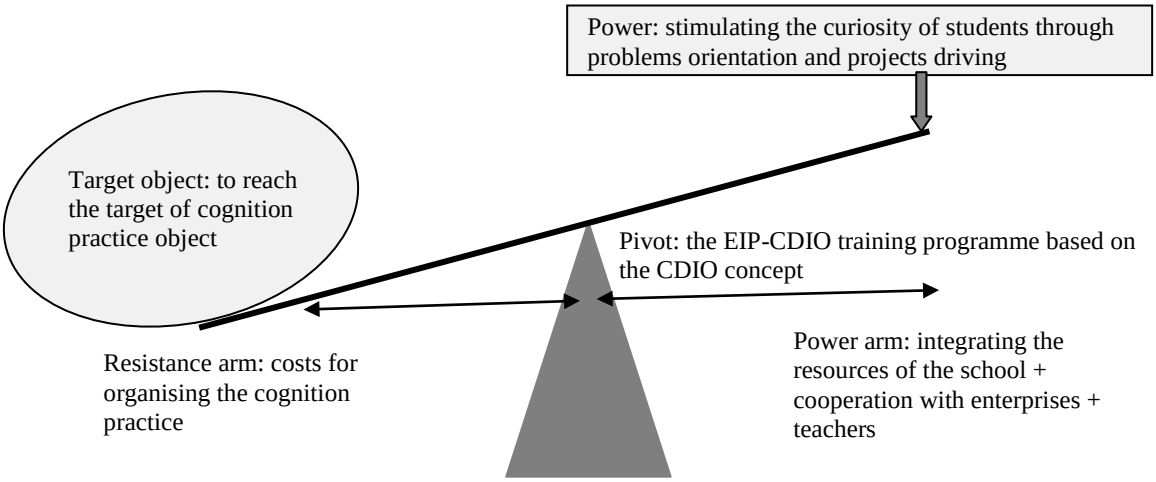

Figure 2: Lever model of cognition practice of IT majors.

LINKS DESIGN FOR COGNITION PRACTICE OF IT MAJORS BASED ON THE LEVER MODEL

To achieve the effect of broadening the students' horizons and promoting their engineering practice abilities through cognition practice, and moving the huge *target object* of cognition practice, one can construct a solid pivot, shorten the resistance arm, prolong the power arm and enhance the power.

Taking a Training Programme for Cognition Practice as the Pivot based on the CDIO Concept

CDIO stands for Conceive, Design, Implement and Operate. It is an advanced educational concept that integrates practical education and theoretical education. Its main theoretical basis originates from Dewey's *learning by doing* concept [7].

The cognition practice of IT majors can be carried out around the training programme and in forms, such as visiting IT enterprises, tackling technical problems and simulating business operations. The conception stage should be based on a study tour and provide mental stimulation for the implementation of the project; the design stage should be based on simulation of situations and role-playing; the implementation stage should be based on process experience and on-site practice; the operations stage should be based on achievements exhibitions and assessment, as shown in Figure 3.

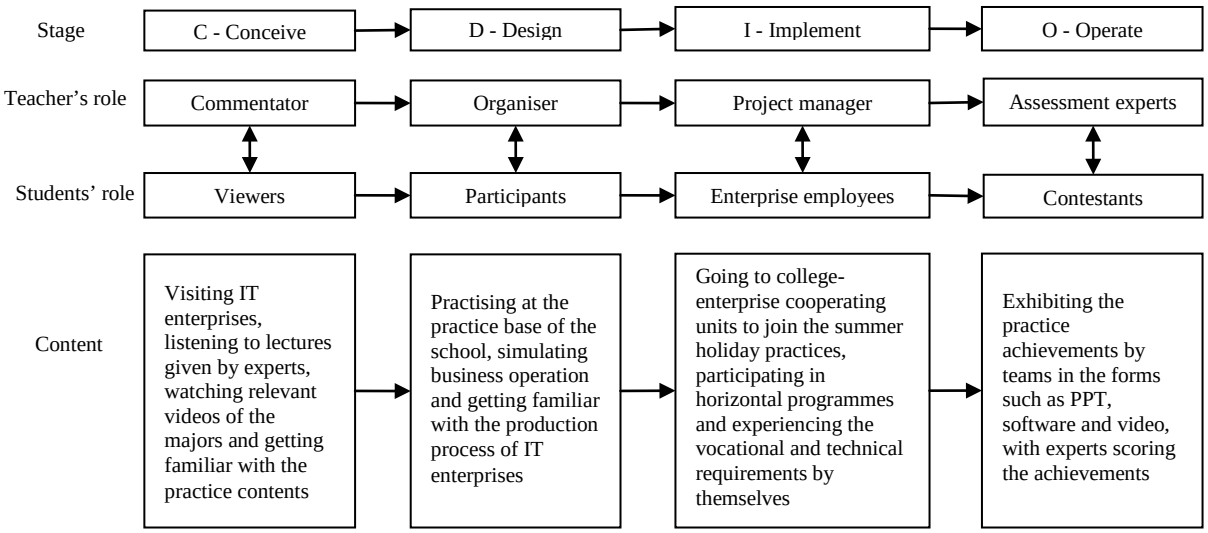

Figure 3: Training programme for cognition practice of IT majors based on CDIO.

In the four stages, the roles of teachers and students keep changing and interacting. With the rise of the teaching objective and requirements of cognition practice, the contents will be enhanced, while the roles will also transfer deeply level by level.

Strengthening the Power in the Forms of Projects Driving and Resources Integrating

By enhancing the power, one can make the lever display a higher rate of efficiency. Just like a lever, the school can take problems as the orientation, and use projects as the driving force to stimulate the students' curiosity and learning motivation, and make them actively explore, analyse and solve problems. Taking the students' Audio Studio club as an example, the students undertake projects in project teams, such as Web site construction and information system development from enterprises. This approach utilises the technical reserves of the clubs in previous years and with inter-college human resource advantages; it integrates the resources of libraries and laboratories, turns what they have learnt into a wealth of practice; this process leads the ascent from practice to theory and achieves a leap in quality. These projects are mostly constrained by the forms of a contract or agreement, the assessment mode of which is much stricter than for course assessment. The realistic nature of the projects can better stimulate students' learning motivation and extract their innovation potential.

Mining the Resources of the School, Strengthening College-Enterprise Cooperation to Prolong the Power Arm

Extending the power arm can enhance the bearing capacity of the lever. Therefore, the school can selectively open information resources with a relatively low safety coefficient and confidence level to the teachers and students as sharing resources for cognition practice, such as each Web site of the school, digital campus, access control system and monitoring system. It can strengthen communication and cooperation with students' clubs related to the majors (such as Audio Studio, Association of Programmers, and Association of Electronic Design). The principal of each major can often communicate with each other and achieve the sharing of teaching resources. It can also integrate these resources and basic teaching facilities of the school to establish a large, stable and interactive experimental base in the school. It can strengthen cooperation with various IT enterprises. Business experts can be invited to hold exchange meetings in the school regularly and introduce the development, implementation and operation status of information systems in the actual application of the enterprises, so that teachers and students can have a zero-distance contact to the information application, social demands and latest trends of their major. Meanwhile, in college-enterprise cooperation projects, teachers can seek opportunities for participation in actual projects for some students, so as to enhance their involvement to the largest extent, stimulate their curiosity and achieve *learning by doing* and *teaching by doing.*

Strengthening the Mechanism Construction to Reduce the Friction of Lever

When a lever is working, each part of it will contact and squeeze to produce friction and lower the efficiency of the lever. Similarly, in the course of cognition practice teaching, the teachers will unavoidably have certain problems in the practice contents setting, organisation management and evaluation. The communication between teachers and students and cooperation between the school and enterprises will be good for discovering and solving problems. Therefore, the school can strengthen the communication in the cognition practice, exchange of problems, experience sharing and feedback of teaching quality in the ways, such as micro-blog, WeChat, QQ group and BBS. For the problems encountered, teachers and students can form a team to work out a solution together.

Meanwhile, the school should also strengthen the construction of systems and culture. The school should lay down detailed rules and regulations for cognition practice, so that teachers and students have regulations to abide by and the management and organisation process can go on smoothly during the practice period. In the course of practice, the horizontal projects under the charge of the teachers can be exhibited in the form of videos or pictorials, which can play an exemplary role. The excellent works of students or teams can also be exhibited and the students can be granted the honour of being *Excellent Interns* to create an active and competitive cultural atmosphere in the form of incentive.

Increasing Income and Reducing Expenditure to Shorten the Resistance Arm and Enhance the Stability of Lever

The rigidity and stability of a lever might change under the impacts of gravity, resistance and power. Stability is the key to the existence of a lever system. Limited funding is usually the largest resistance arm for the lever system. To organise successful cognition practice, the responsible teacher should *increase income* and *reduce expenditure*. As to *increasing the income*, it can deepen the exchange with enterprises and increase the number of cooperating enterprises. It can strengthen college-enterprise contact in the ways, such as tackling technical problems, and can expand the source of internship units outside the school through channels, such as introduction by alumni or contact with the working units of graduate students.

As to *reducing expenditure*, that is, reducing the organisation's cost, it should obtain the greatest benefit with the minimum resources. It can share the resources of laboratories and research institutes of each major, integrate and utilise relevant information resources of the school and make the best use of the resources. Under limited resources and conditions, it can actively and fully enhance the effect and efficiency of the practice and achieve the maximum teaching efficiency.

PRACTICE EFFECT AND CONCLUSIONS

Since 2012, the Wuhan University of Science and Technology has carried out a substantial amount of work in the area of cognition practice of IT majors and has established a stable lever system of cognition practice.

In reducing the resistance arm and prolonging the power arm, it has *increased income* and *reduced expenditure*. In the former aspect, the functional departments, such as the School of Computer, the School of Information and the Information Management major under the School of Management have established nearly ten practice bases outside the campus with units such as Wuhan Iron and Steel Group, Xiangtan Iron and Steel Group, Dongfeng Automobile and the People's Government of Qingshan District, and have also established a good cooperative relationship with over twenty small enterprises, such as ShangJi Electronics, e-works, ID Technology and Genie Scales. Each year, they can receive 1,100 persons for study tours and, in summer, they can offer internship positions for nearly 100 persons. In the latter aspect, they have cooperated with the office of teaching affairs, the security office, the libraries and the information centre to integrate and share the information resources of the school, such as the system of teaching affairs, the system of campus security monitoring, the system of library access and the e-card system, and established a stable practice base in the school, which can receive more than 800 students of IT majors for visiting.

To enhance the students' motivation in professional learning, problems are taken as orientation while projects are taken as a driving force. For example, to solve the problem of existing isolated islands of information inside the colleges and departments, and that experimental equipment cannot be shared, the students' clubs are encouraged to develop Web sites and a reservation system for experimental equipment. To solve the problem that vehicles run about in the campus and disturb the teaching, the teachers and IT enterprises work together to organise student teams to develop an intelligent access control system for vehicles in the campus. Meanwhile, through the horizontal projects entrusted by enterprises, the school seeks opportunities for students to participate in actual projects. For example, teams of teachers and students have developed large information systems and decision supporting systems for the Ministry of Water Resources, as well as enterprises, such as Xiangtan Steel Group, like the *Nation-wide Mountain Torrents Control Programming Information System* and *Decision Support System for Ore Blending Cost Optimisation of Blast Furnaces*, which have greatly stimulated the curiosity of students and promoted their engineering practice abilities.

Cognition practice is the first step for students in IT majors to cultivate their working and practice abilities, which will lay down a foundation for their subsequent graduation internship and social practice. Currently, colleges and universities are commonly faced with problems, such as a lack of funding, lack of practice bases outside the school and lack of close cooperation between colleges and enterprises. Based on a questionnaire and interviews with individuals, and taking into account the features of IT majors and the actual situation of the school, the authors of this article established an initial teaching system for cognition practice based on the lever model and made some initial achievements.

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