Methods for improving the professional level of students majoring in information and computer science

Liqiang Fan

Langfang Teachers University
Langfang, Hebei, People's Republic of China

ABSTRACT: Through changing the traditional teaching methods, which only pay attention to underlying theory, several ways are suggested for improving the application and learning ability of students majoring in information and computer science. These advocate boosting the learning of students through methods, such as improving the specialty programme, improving teachers' teaching, appraisal mechanisms for the teachers, appraisal mechanisms for students and making use of multimedia-assisted teaching. These changes also advocate advancing the application ability of students by improving their practical assessment method, the teachers' practical teaching level and the practical teaching system itself.

INTRODUCTION

At the end of the 20th Century, with the fast development of communication, network and computer technology, the information-related degrees were enhanced globally and the society's demand for information science talent increased day by day. Against this background, information science, computer science, operational research and control science overlapped and influenced one another and information and computer science emerged and developed [1].

Information and computer science (ICS) is based on mathematics. Students of this major not only need good mathematics ability, but also need to master the basic theories and methods of information and computer science. They should be able to use the theories and methods of information and computer science to solve practical problems. As well as this, they should be able to carry out research and application development in information-based industries.

As ICS is emerging major, colleges and universities can determine the development direction for it to best meet the needs of society and the economy [2]. Compared with the traditional mathematics majors, information and computer science focuses more on using theories, methods and techniques to solve practical problems [3].

Many students majoring in information and computer science often pay much attention to process and ignore the original background, because the basic theoretical knowledge is very abstract. Students, generally, do not take an interest in learning basic theories; when they do, the learning effect is unsatisfactory [4].

Also, because of a shortage of practical content in the curriculum, the application ability of the students is poor. Thus, they cannot meet society's demand for application-oriented talent. How to strengthen the professional skill training and how to improve the learning level and employment competitiveness of the students are important problems that need to be solved for the major of information and computer science.

REFORM OF THE TRADITIONAL TEACHING MODE

The traditional teaching method is inculcation-oriented. In class, the teacher teaches knowledge to the students in strict accordance with the teaching plan. The students listen to the teacher and take notes. The teacher dominates the teaching process and the students accept knowledge passively.

The classroom climate is relatively depressing. After class, the teacher assigns exercises and the students review the knowledge learnt in class through the exercises. Although the students can solve problems through a preview before class and a review after the class, their spirit of innovation is eliminated to a great extent in the learning process [5].

Influenced by the traditional teaching mode, information and computer science focuses more on imparting the basic theories and lacks practical teaching content. In order to meet the needs of society and the economy, there is a need to adjust the traditional teaching and curriculum provision to improve the students' practical ability and innovation. The obligatory and elective courses are shown in Table 1 and Table 2, respectively.

Although many colleges and universities have realised that students' learning can be improved by increasing practical courses, the practical teaching reform of the information and computer science major is lagging. The content and method of practical teaching is inadequate, the assessment method for practical teaching needs to be improved, the practical teaching system is imperfect and the hardware resources for practical teaching are inadequate.

Table 1: Obligatory courses.

	Course name	Credit	Theoretical class hours	Practical class hours
Basic courses	Mathematical analysis	8	136	
	Advanced algebra	4	68	
	C++ program design	6	64	32
	Data structures and algorithms	4	52	16
	Probability and mathematical statistics	6	96	
Specialty courses	Computer graphics	4	52	16
	Numerical analysis	4	52	16
	Foundation of information theory	4	68	
	Mathematical models	3	34	34
	Data analysis	3	34	34
	Parallel algorithms	3	34	34

Table 2: Elective courses.

		Course name	Credit	Theoretical class hours	Practical class hours
Elective courses		Digital signal processing	4	52	16
		Graph and image processing	4	52	16
		Computational intelligence	4	52	16
		Computing theory foundation	4	52	16
		MATLAB program design	3	34	34
		Software testing	3	34	34
		System modelling and simulation	3	34	34
Modular courses	Information analysis	Web information mining	3	34	34
		Market research and prediction	3	34	34
		Analysis of time series	4	48	20
		Information analysis	3	34	34
		Modern cryptography	4	52	16
	Data analysis	Design and analysis of algorithms	4	52	16
		Data mining	3	34	34
		Queuing theory	3	34	34
		Cloud computing theory	4	48	20
		Applied statistics	4	52	16

IMPROVING LEARNING

Improving the Specialty Programme

Reasonable teaching is the precondition by which to ensure students' learning. The course provision determines the knowledge of students. Reasonableness of the specialty programme is of critical importance in cultivating the learning and application ability of the students.

The curriculum plan, not only pays attention to basic theories, but also stipulates explicitly the class hours for theoretical and practical learning to cultivate the students' learning and application ability. Through increased elective and modular courses, the students' choice of direction has been widened and an enriched set of options provided.

Multimedia Technology

Multimedia-assisted teaching is an effective method for improving the learning by students. Multimedia-assisted teaching can involve various kinds of media, such as sound, characters, pictures and images, whereby, the students receive information. It has broken the traditional teaching mode and transformed the original, boring teaching content through vivid pictures.

Multimedia teaching focuses on the dominant role of students. The establishment of an autonomous and open teaching mode can realise the optimum application of multimedia teaching in class. Compared with the traditional teacher-dominant teaching mode, multimedia technology has the following advantages:

1. It can strengthen the students' mastery of knowledge through multimedia use of colours and sound.
2. The combination of multimedia teaching with blackboard teaching can deepen the students' understanding.
3. The combination of multimedia teaching with actual life can widen a student's horizon.

Improve the Teachers

The teaching faculty is an important factor which supports the teaching system. The teacher's professional level is very influential in determining the students' professional level. In the course, Advanced Algebra, matrix multiplication uses the following example (Equation 1):

$$MG = \begin{bmatrix} m_k & m_{k-1} & \cdots & m_1 \end{bmatrix} \begin{bmatrix} g_{11} & g_{12} & \cdots & g_{1n} \\ g_{21} & g_{22} & \cdots & g_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ g_{k1} & g_{k2} & \cdots & g_{kn} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 1 & 0 & 1 \end{bmatrix} \quad (1)$$

where *M* is the message source, *G* is the generated matrix, *MG* is the code of message source. But few teachers use these or similar examples.

In the course, Probability and Mathematical Statistics, few teachers use the destination information generated through the overlap of source information and noise in the information channel to introduce the distribution of sums of two mutually independent random variables, which are normally distributed. These examples show that many teachers of the information and computer science major lack knowledge of all the courses in the curriculum and lack an awareness of the interrelationships between courses.

In order to improve the learning of students, teachers are not only required to have deep knowledge and excellent professional skills, they are also required to have a comprehensive understanding of all the courses in the curriculum, and the interrelationships between courses, as well as to deliver a course in a vivid and lively manner. The specific methods to improve the teaching of the information and computer science major are as follows:

1. Teachers should study the curriculum carefully to understand the interrelationships between courses;
2. Actively communicate and co-operate with enterprises and other universities to investigate teaching methods;
3. Adjust the assessment of teachers in the faculty, in order to inspire the teachers;
4. According to characteristics of the major, the University should explore new techniques of industry, optimise the faculty and improve the teachers' practical ability;
5. Adjust the teaching of theory to add interest to the class.

Improve Practical Teaching

Practical teaching is an important method in improving students' application ability. In recent years, along with the deepening of practical teaching, the University has carried out an ongoing reform of practical teaching. For example, when students study the population growth model with two species, teachers introduce the process of modelling with the model (Equation 2):

$$\begin{cases} \dfrac{dp(t)}{dt} = k_1 p(t) - cp(t)q(t) \\ \dfrac{dq(t)}{dt} = -k_2 q(t) + dp(t)q(t), \end{cases} \quad (2)$$

where *p(t)* and *q(t)* are the populations of predator and prey at time *t*; k_1, k_2, *c* and *d* are parameters. When students study the Heun method (a numerical method for solving ordinary differential equations) they use the form given by Equation 3:

$$\begin{cases} y_p = y_n + hf(t_n, y_n) \\ y_c = y_n + hf(t_{n+1}, y_p) \\ y_{n+1} = \dfrac{1}{2}(y_p + y_c), \end{cases} \tag{3}$$

where h is the step size of the numerical method.

The numerical solution of Equation 2, given by Equation 3, with time step $h = 0.1$ is given by Figure 1, which is a graph of the solution.

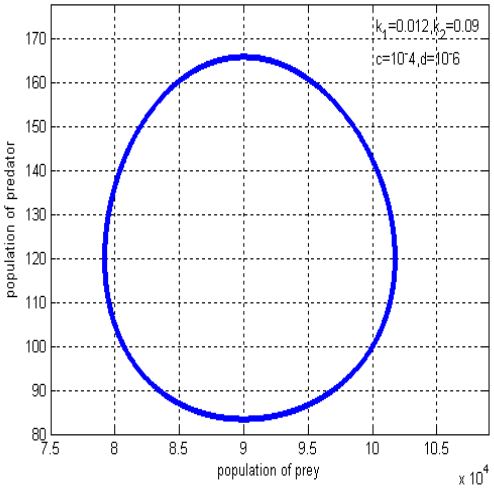

Figure 1: Numerical solution of the predator-prey model.

If students spend one class on programming of Model 2 by Method 3, they could not only master the model and the numerical method, but also produce the graphical display in Figure 1 and, hence, gain a better understanding of the relationship between predator and prey.

There are some other problems in practical teaching, such as the content of experimental teaching depends too much on theoretical teaching, there is a shortage of teachers in the faculty and there is no uniform assessment system for practical teaching. To address these problems, the following is suggested:

1. Divide the content of practical teaching into the following parts: basic verification experiments, comprehensive design experiments, research and innovation experiments, graduation internship and graduation thesis.
2. Improve the experimental teaching platform through establishing a laboratory and constructing a training platform.
3. Improve the practical teaching and the practical textbooks.

Improve the assessment mechanism - the purpose in carrying out assessments is to assess the students' learning. At the same time, assessments are also an effective basis for teacher introspection and teaching improvements to perfect the teaching. Assessment of students adds impetus to the further cultivation and development of the students' ability. However, the assessment of students should be comprehensive and diverse. Students should not just be assessed by the marks of the final examination. The following would improve the assessment mechanism:

- The summative assessment should be changed to a process assessment, and the daily assessment should be oriented to the learning and development of students. Assessment should continuously guide the students in correcting their learning direction and methods. Students should be guided by assessments in making course and module selections.
- The unitary assessment should be transformed into a diversified assessment. No matter what form the assessment takes (test paper, course thesis or practice), the assessment should be by more than one teacher.
- Quantitative assessments should be transformed into quality-dominant assessments. A student's marks should reflect completing homework, attendance, learning and practical work. Test papers allow the teacher to determine the students' mastery of the examined knowledge.
- The assessment should encourage student innovation. The assessment should recognise students who are creative in learning and practical work. The focus should be on the students' overall development, including individuality and capacity.

CONCLUSIONS

Methods for improving the learning of students are presented and discussed in this article. The methods cover the following four areas: influence of the teaching software and hardware on the learning of the students, influence of the teaching faculty on the teaching, influence of the assessment mechanism on learning and influence of practical teaching on the application ability of students. In this article, there is a division of the factors influencing student learning into subjective and objective, and methods are given by which to improve the objective factors.

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