INFORMATION TECHNOLOGY EDUCATION FOR PRIVATE UNIVERSITY STUDENTS: FROM SUMMER PRACTICE TO COURSES DESIGN

Yo-Ping Huang[1], Chi-Peng Ouyang[2] and Tsun-Wei Chang[3]

Abstract—*Each undergraduate student in our university has to take eight weeks practical training in the summer vacation for the past thirty years. Through this program, we hope that our students will work right and realize the industrial current development. As we know, the most important responsibility of private engineering-based universities is to teach their students to become the good engineers in the industry after graduation. Hence, the school has to be familiar with the future development of industry, evaluate courses contents every year, improve the learning environment, and supervise the study status of students. The IT (Information Technology) industry has flourished recently and dominates the world market. Based on the trend of IT, we design a program to help our students learn the IT related skills. Besides, we also set up an excellent wireless learning environment step by step, in which our students can learn anytime from any place. We will investigate the methodology of courses design and the training procedures for wireless network. Also, the relationship between summer practical training and courses design will be analyzed. We will evaluate and discuss the implicate impact from our specially designed programs.*

Index Terms—Courses design, summer practice, information appliance, handheld devices, wireless network.

INTRODUCTION

The web technology influences our life a lot in the past decade. Nowadays, the web service becomes part of people's daily life. Some terms such as browser, e-mail, e-generation, etc, are just as usual as TV, telephone, and fax. They are so frequently heard to us. People are used to the web service. It is easy to understand the concept of web, but the web-based applications are still not widely applicable to each field. For example, it is not so convenient to operate TV, telephone, fax, etc, through the web-based controller.

The most important way to access information will not only rely on PC but also on the handheld devices. The users are eager to get personal information in a simple and easy way. The PC plays a temporal role in lots of solutions so far. We have to find better solutions for people to get their personal information in substitute of PC. The researchers are trying to work out the web-based applications. We expect those products equipped with user-friendly interface, easy operation buttons, and interactive functions have acceptable prices soon. The IA (Information Appliance) comes out during this background. We can navigate the Internet not only by PC but also by TV, cell phone, refrigerator, oven, PDA, etc. It is an important issue how to help students learn related knowledge and skills both about office and home networking, and IA step by step in their college life.

The Ministry of Education in Taiwan is pursuing to modify the whole education system. There are more than 150 universities and colleges, most of them being private ones, in Taiwan. Those private university graduates play a very important role in the Taiwan's industry. Our institution is long-term sponsored by Tatung Company, which has an annually gross income over 6 billions US dollars. To establish a unique education-industry-integration program in the world, each undergraduate student in our university has to take at least eight-week practical training during the summer vacation in the past thirty years. This program is designed for students to gain more hands-on experience and to put theory into practice. We allow students choosing their own summer jobs. However, the job should be related to the student's major. Besides, one of our faculty must go to the working place to supervise the student at least once a month. Of course, most students are reluctant to participate this program because the program must be taken during the summer vacation. We make it to a required program. Every student must complete the practice before graduation. The summer practice helps students establish a preliminary understanding about IT (Information Technology) development such that students will realize the importance of college education after they are back to school. It means that through the summer practice students know their deficiency in what they have learned. As a result, they are willing to learn more before entering into the competitive job market.

Through the program of summer practice, most students not only can realize the trend of IT development but also choose their senior project topics with the help of practice course [5]. In our department, every student has to complete a senior project before graduation. Besides, to strengthen the career planning for students in the competitive IT industry, we created two special programs three years ago. Those two programs include office and home networking, and IA. The special programs are designed to train students putting

[1] Yo-Ping Huang, Department of Computer Science and Engineering, Tatung University, Taipei, Taiwan 10451 yphuang@cse.ttu.edu.tw
[2] Chi-Peng Ouyang, Department of Computer Science and Engineering, Tatung University, Taipei, Taiwan 10451 ouyang@mail.ee.sitc.edu.tw
[3] Tsun-Wei Chang, Department of Computer Science and Engineering, Tatung University, Taipei, Taiwan 10451 alan1107@ms5.hinet.net

intensive efforts on a series of specially designed fundamental and advanced courses before graduation.

COURSES DESIGN

We describe the rational concept of our designed courses as following: (1) In order to strengthen the career planning for students in the competitive IT industry, we created two special programs three years ago. Those two programs include office and home networking, and IA. The special programs are designed to train students putting intensive efforts on a series of specially designed fundamental and advanced courses before graduation. Students can also use the technology learned from the special programs to improve their senior projects. The experience from senior projects will in turn help students obtain the ability in system integration, design, and analysis to fulfill the requirements in the future direction of information technology development. (2) Since the public universities charge lower tuition fees, students' first priority is to enter the public graduate schools. We encourage students to continue their graduate study in our department. Based on the proposed programs, they can not only learn their own information technologies, but also receive both bachelor and master degrees in five years. (3) Moreover, due to the emphasis on the training of the second foreign language ability in our university, and with the oversea study program for students, students will be assured to have a better global vision after completing the designed program. Therefore, this paper presents our experience beginning with how we train the private university students to study the information technology, with special efforts in the programs of office and home network, and IA. Although some training materials seem very simple, we feel that without such training procedures most students cannot obtain the practical experience in the design and analysis.

The crises of higher education in Taiwan include the courses unmatched the requirements of industry, the low quality of student's ability, the low willingness of taking responsibility, the lack of self-confidence, etc. It happens very obvious in private universities. Those factors inhibit the development of higher education. They also influence the development of industry and reduce the global competition. Most of all, it will hurt our country's competition. In order to reestablish the university functionality, we have to figure out some modifications such as adjusting the course architecture to meet the requirements of industry, planning the application course schedule, and building up the professional courses systematically. By these procedures, we can promote the student's ability and establish their confidence.

According to the statistic data, the IA grows up to 63.3% as compared with last year. There is no doubt that the IA becomes a bright star for the industry. The MIC (Market Intelligence Center) of III (Institute for Information Industry), Taiwan, estimates that the office and home networking marketing production will be over that of the telecom in 2004. The application field of IA is very wide. Generally speaking, it includes medical, home-stay nurse, security, fast delivery, audio entertainment, engine monitor, home electronic controller, and downloading information. Of course, it is not pretty fair to analyze the home appliances only, while the truth is that the home appliances are the most living productions for our daily life. The good home network appliances make the home networking system successful. Lightness, thinness, convenience, at hand, and dedicated design are the key points of home network appliances. To achieve the goal of home network appliances, a web page can be a good control interface.

We offer some programming courses to help students learn home network appliances in this project. Students are able to design a web page control interface of all kinds of home network appliances. We suppose that every home network appliance has its own network controller. This controller generates digital signal for the accessing of each unit. We design a homepage interface. It is easy to read the status of home network appliances, and encode it as an analog signal. After the transformation, the results will display in common graphic interface. The users can control the home network appliances by standard homepage. All the access will follow the security standard of Java 2. The specially designed programs are illustrated in Figure 1 and Figure 2. Each track includes three major steps for students to take the courses.

Some special features of our programs are using advanced equipments to teach job-oriented technology, emphasize the courses' contents, and then evaluate students' performance based on their achievement. We hope to build up a standard as high as the need of enterprise. We open primary courses as theory introduction, and advanced courses as their extension. Both form a mixture prototype courses. For example, to emphasize the importance of network security, we will offer introduction to network as premier course, which help students learn the network protocol, theory and system architecture, and network security as advanced one. Students can know principle of networking, the hackers attacking route, and management of network from these serial courses. To establish a unique education-industry-integration program in the world, we integrate lot of courses as a systematic program, such as the networking technology.

To encourage students learning motivation, we insist that our students have to participate summer practical training. It is a good way to help students understand their future goal when they participate in real operation, management, production, and research of enterprise. After the summer practical training, our students will make a decision of taking which courses to enhance their senior projects. It is also helpful for them to choose their senior project topics and use the knowledge they had learned before. They will become more and more experienced in integration, analysis, and design. Students can focus on the experiments that are related to the development of enterprise. This method can not only improve their ability and confidence but

also increase country's competition. We believe the whole procedure will be beneficial to their career.

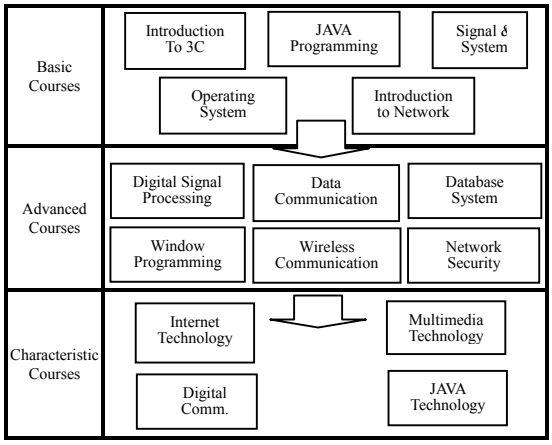

FIGURE 1
THE SERIAL COURSES OF OFFICE AND HOME NETWORK

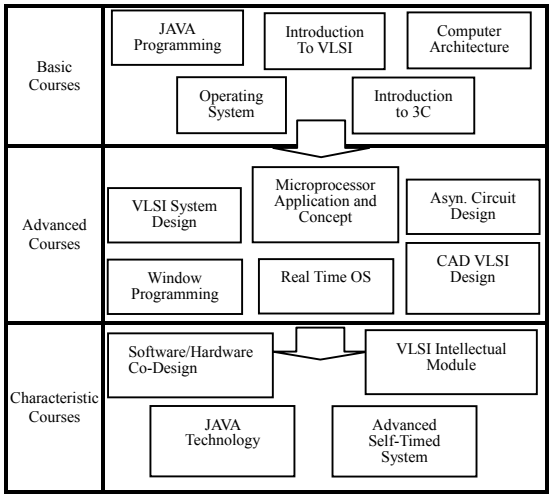

FIGURE 2
THE SERIAL COURSES OF INFORMATION TECHNOLOGY

Another purpose of our program is to encourage outstanding students to continue graduate study in our department. Since students have learnt more specific IT technologies through implementing their senior projects, if they can continue their graduate study in the same department, they can complete their theses soon. Students can waive the credits of the required graduate courses that they had taken in undergraduate (except for thesis). But we only allow at most six credits of graduate courses being waived, if these credits have been admitted as undergraduate credits.

Taiwan has become a member of WTO this year. The chained influence will cause local enterprises to be international ones. The internationalized talent human is the key factor of promoting competition of enterprise. The university plays a turning role under this background because students will succeed or not is depending on the internationalized degree of university. We improve internationalized degree and increase student's international view by emphasizing the second foreign language training. To achieve this goal, for example, we open a series of distance-learning courses by cooperating with a space expert in NASA. We also ask some instructors use English to teach courses from the fall semester of 2002.

To better understand what the fundamental skills the enterprises need from our graduates and to keep on improving our courses contents, we put all the contents on web page and email to our alumni. By this strategy, we provide a complete learning chance and receive more feedback from alumni and the Internet friends. Those suggestions will help us adjust our course contents.

Therefore, this paper presents our experience from how we train the private university students to study the information technology, with special efforts in the programs of office and home network, and IA. We emphasize that:

(1) For undergraduate students: they should establish the ability of system implementation. For example, students are expected to use the Lonwork to set up a wireless control system to switch on/off a PC, server, or household appliance. We hope this kind of training can attract the students' interests in learning implementation skills and then to pursue deeper research in IT in graduate school.

(2) For graduate students: they should have the ability in system integration, design, and analysis. If students' research topics can catch up with the trend of IT development or if they are participating a joint project with a company, they may receive a job easier after graduation.

(3) Two proposed learning programs: students can complete either the office and home networking, or IA program without difficulty.

(4) A five-year program for students to complete both bachelor and master degrees has been launched. Previously, students have to spend at least six years to receive their degrees. Now just following the learning steps of the program, they not only can receive both bachelor and master degrees in five years, but also can learn his/her own IT knowledge, with expertise either in office and home networking, or IA. After graduation, students can enter into the job market without difficulty. This can reduce both the training cost for employees and the complaint from industry.

(5) Due to the emphasis on the training of the second foreign language ability in our university, and with the oversea study program for students, students will be assured to have a better global vision after completing the proposed program.

(6) The fulfillment of lifetime learning program. The course contents are posted on the web and are also e-mailed to alumni and the general public. As a result, our department not only can provide the lifetime learning program, but also can receive the suggestions from the

alumni for adjusting the course contents to meet the requirements of the changing industry and to assure the quality of the engineering education.

LEARNING ENVIRONMENT

Even the world is changing rapidly, the educational functions still remain the same as usual. But the impacts from sociality in the world, the teaching media and tools are tending to technology. The information passages are more and more rapidly. The educationalists are changing the teaching skills, tools, and models to close the sociality purse in past, now, and future [1]. The teachers have to adjust some skills such as intellectual skills, cognitive strategies, verbal information, motor skills, and attitudes. Siegmann stated that [2]: "in the future individual student laptop computers will replace the immovable desk computers in the laboratories. Then, courses will be able to be structured to make use of more portable and pervasive capability. Simple ways to get started, including a road map of possibilities for each step, will be presented." Now, it is the time to develop a handheld device plus wireless environment to construct an e-learning community. In the Internet and wireless world, it is important to build up an interactive learning environment anytime from any place. We have a responsibility to guide students using information technology to catch up the rapid change of sociality. We hope these active courses can attract the students' interests about learning.

Under the wireless environment, we construct a simple content-based information retrieval mechanism. The developed pattern retrieval system can provide an easy way to search the plants' names, browse the plants' images and their descriptions. The students can learn how to use the system and then learn how to design a similar system such that they can enhance their designing capability. The users can store e-book or image files in the image library. The students can take examinations through the Internet by handheld devices. When students cannot answer the tests correctly, the system will link to the place where the correct answer locates. As a result, students can read again to understand the contents of related materials. The purpose to create this project is to teach students how to use the handheld devices to implement a pervasive computing under the wireless network. The operation functions on the proposed pattern retrieval system are illustrated in Figure 3 as follows:

(1) Figure 3(1) is the designed interface for users to click and enter the system. After entering the plant retrieval system, the users can choose the specific features on the top right corner. And the left zone will display the possible choices for users. Then the users can compare the popped up image with the plant displayed in front of them and click the most possible pattern to search as shown in Figure 3(2).
(2) If different plants' names have been found, users can click the plant's name to retrieve full image and description as listed in Figure 3(3).
(3) The detailed description of plant is given in Figure 3(4).
(4) There are several sections in the display area that include the icon for the plant image, the icon for the return button, the icon for reentering the features, and the icon for the detailed descriptions about this plant.

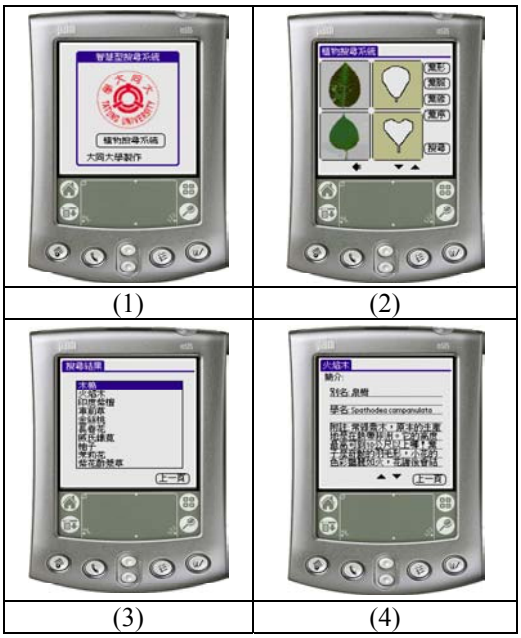

FIGURE 3
THE OPERATION OF PLANT RETRIEVAL

Once the users cannot find the solutions, but they want to know the answer immediately, they can use short message service (SMS) or email to teachers via wireless network. By this interactive learning method, our students can have more fun in learning new knowledge. Same situation, if the students take an outdoor course or do an experiment, the instructors want to give a test, they can proceed this examination by using PDA or other handheld devices under a wireless environment. For students to be familiar with the wireless technology, we also teach students how to set up the handheld device to connect to the Internet. The operating procedures are illustrated in Figure 4.

- Figure 4(1) shows that we can click the "network adaptor" to set up the PDA.
- After selecting the wireless network driver, for example Orinoco driver, we can check the contents as given in Figure 4(2).
- We then click the "assigned IP address" icon and input the IP address as depicted in Figure 4(3).
- After inputting the required information, we can click "ok" and turn the power off. When a wireless card is inserted into the PC card expansion pack, we can start using the wireless network as shown in Figure 4(4).

The following describes some remarkable characteristics from using handheld devices under the wireless environment:

- instant response: Our students can download quiz and answer all the questions on the PDA. When time is up, the server can score students' answers. The instructors can correct the errors, know the bottleneck of learning, and supervise students' learning.
- racing answers: When the test begins, students can compete to answer the question. Only the first correct answer received, the system will proceed to next question. Also the system will display the student's name and seat number who proposes the correct answer.
- assigned answers: Some students are too shy to ask questions. Using handheld devices like PDA can allow them to express what they want to ask. Also, teachers can assign a specific student who did not often raise hand to answer the questions. Encouraging such students can activate the class atmosphere.

The Ministry of Education is planning e-learning courses in Taiwan. The information director of Taipei education bureau announces that some of Taipei primary schools will use the web pad instead of paper books in the class. It is not necessary for students to carry satchels with them every day. The teachers can store their handouts in the server or handheld devices like PDA beforehand. They can create a high-interactive atmosphere at school. Instructors can concentrate on explaining the contents, and students could study the related materials immediately.

SUMMER PRACTICE

We have set up the summer practical training course over thirty years. Now, the information technology becomes more and more important, we expect to evaluate this course from the students' perspective. We investigate the effectiveness of summer practice through questionnaire design. We design two different types of questionnaires. One is the job-related questionnaire including the relationship between practice and their knowledge. Both undergraduate and graduate students have to answer fifteen questions on this sheet. The other is the environment-related questionnaire including comfort, security, and colleague relationship. There are 15 questions in this questionnaire. The satisfaction is classified into 5 degrees ranging from 1 to 5. Number 1 is the lowest satisfaction while 5 is the highest one.

The statistics from the questionnaires answered by students practicing in the sponsored company are listed in Figure 5 to Figure 7. Based on the results shown in the tables, we found:

(1) The satisfaction degrees from the freshmen and sophomores who have not participated the summer practical training are lower than last year. This is due to the fact that Taiwan's economic recession is a serious problem in recent two years. It is a nightmare for people to look for jobs. Most students really worry that it is not easy to find suitable jobs and are pessimistic for the future. The results reflect in the low satisfaction degrees.
(2) The juniors and seniors who practiced in Tatung Company gave higher satisfaction degrees than last year. It implicates that the designed serial programs are highly relative to the jobs in company. It means that the students can verify what they learned from our special programs.
(3) Students practicing at other companies also show higher satisfaction degrees in questions 1 and 2 as compared with last year. It implies that the serial courses are good for them. They are depressed about the job contents because the jobs did not meet their original expectation. The reasons are somehow relative to the economical recession.

Besides, we state the results regarding working place and environment from Figure 6 and Figure 9 as follows:

(1) In average, most of the students who practiced at Tatung Company express higher satisfaction than that of last year. The students feel better in working atmosphere (question 1), working hours (question 2), the manager's attitude (question 4), the comfort in working place (question 5), and the security problem (question 6).
(2) Those students who worked at other companies also show higher satisfaction than that of last year. This implies that the whole situation is turning better not only in working place but also in the relationship between manager and employee.

CONCLUSION

In this paper, we illustrated how to help the engineering students learn the basic skills from the required fundamental and advanced courses. The proposed program and summer practical training in enterprise, which will help them understand the spirit of enterprise and the required technology of the future, will make students know what they are short for. Based on the learned fundamental courses and their future goals, students can select more appropriate senior projects. Each team member can integrate his/her knowledge into senior project through detailed plan and analysis. They can improve the performance of the prototype model and construct a new system. The final project can meet the requirement of enterprise and improve students' confidence.

In this paper not only the training procedure of the proposed program was illustrated but also the comparison of learning performance from participating and non-participating students was made. A positive feedback about our graduates from enterprises and/or students getting jobs easily after completing the designed program may allow us to claim the success of the whole program.

ACKNOWLEDGEMENT

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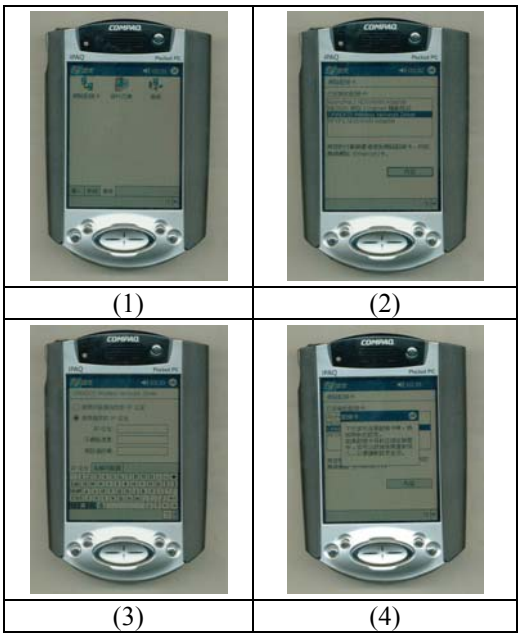

FIGURE 4
THE OPERATING PROCEDURES TO SET UP A PDA CONNECTING TO INTERNET

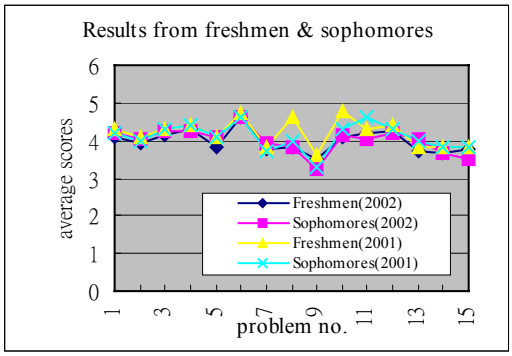

FIGURE 5
STATISTICAL RESULTS FROM WHAT FRESHMAN AND SOPHOMORE EXPECTATION IN THE SUMMER PRACTICE

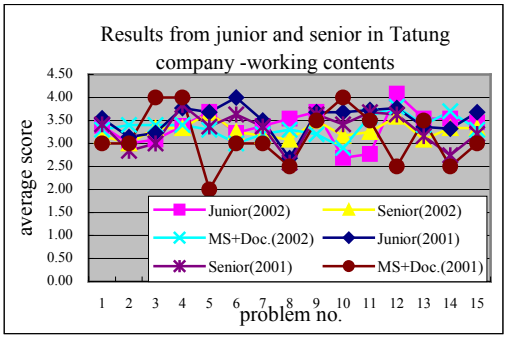

FIGURE 6
STATISTICAL RESULTS ABOUT WORKING CONTENTS FROM STUDENTS HAVING COMPLETED THE SUMMER PRACTICE IN TATUNG COMPANY

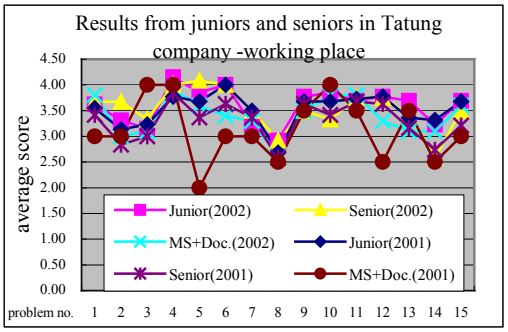

FIGURE 7
STATISTICAL RESULTS ABOUT WORKING ENVIRONMENT FROM STUDENTS HAVING COMPLETED THE SUMMER PRACTICE IN TATUNG COMPANY

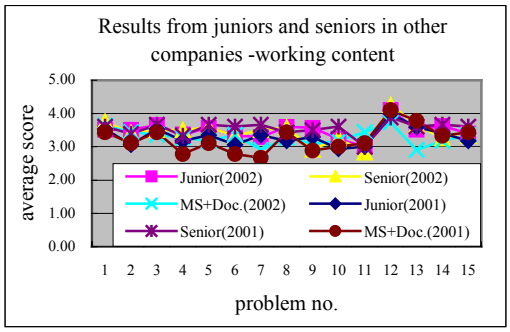

FIGURE 8
STATISTICAL RESULTS ABOUT WORKING CONTENTS FROM STUDENTS HAVING COMPLETED THE SUMMER PRACTICE IN OTHER COMPANIES

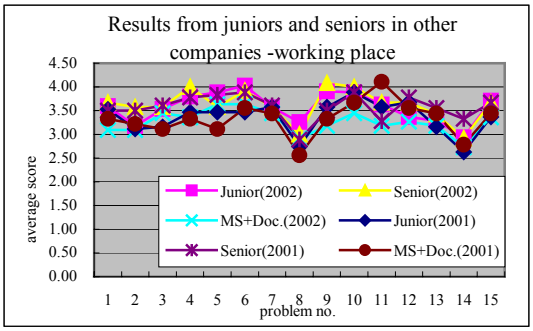

FIGURE 9
STATISTICAL RESULTS ABOUT WORKING ENVIRONMENT FROM STUDENTS HAVING COMPLETED THE SUMMER PRACTICE IN OTHER COMPANIES