

THE IMPORTANCE OF THE PERSONNEL TRAINING IN HEAT TREATMENT FOR PRECISION MACHINERY EQUIPMENT INDUSTRY

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Abstract: *Taiwan's precision machinery equipment industry such as machine tools possess great competitiveness all around the world; nevertheless, the confidence of users is often lowered by the poor reliability, stability, and life time of the products. This study suggests that once we can select appropriate metal material and execute correct heat treatment processing for the critical parts used in precision machinery equipment, the problems mentioned above will be cleared up effectively, thus enhancing the profit and global market share of Taiwan's machine tools. This study also focus on a discussion about the methods for training professional talent of heat treatment in the university, suggesting that the nurture of talent can be well done by the compilation of digital teaching materials, the promotion of the certificate of heat treatment, the introduction of the collaborative teaching by teachers and experts from enterprises, off campus factory visiting, and practical training in enterprises, and so on.*

Keywords: *Precision machinery, heat treatment, certificate, collaborative teaching, practical training in enterprises*

1. INTRODUCTION

Diversified teaching is particularly important for technical and vocational education, especially for industry Talented person demand-oriented to enrich the teaching content. Therefore, the curriculum plan of technical and vocational education should combine more teaching resources. Assimilate "implement the technician certificate system", "collaborative teaching by industry experts", "participate seminar and studying workshop", "factory visiting", "off-campus internship", "industry-university cooperation" and "hands-on practice and competition" into the teaching goals and curriculum plans of the related courses. As a result, not only make the students in vocational school develop suitably, but also prepare for getting jobs in the future, and then shorten the gap between theory and application. At the same time, the teachers of vocational school map out the contents of teaching courses with the guide of "industry personnel training",

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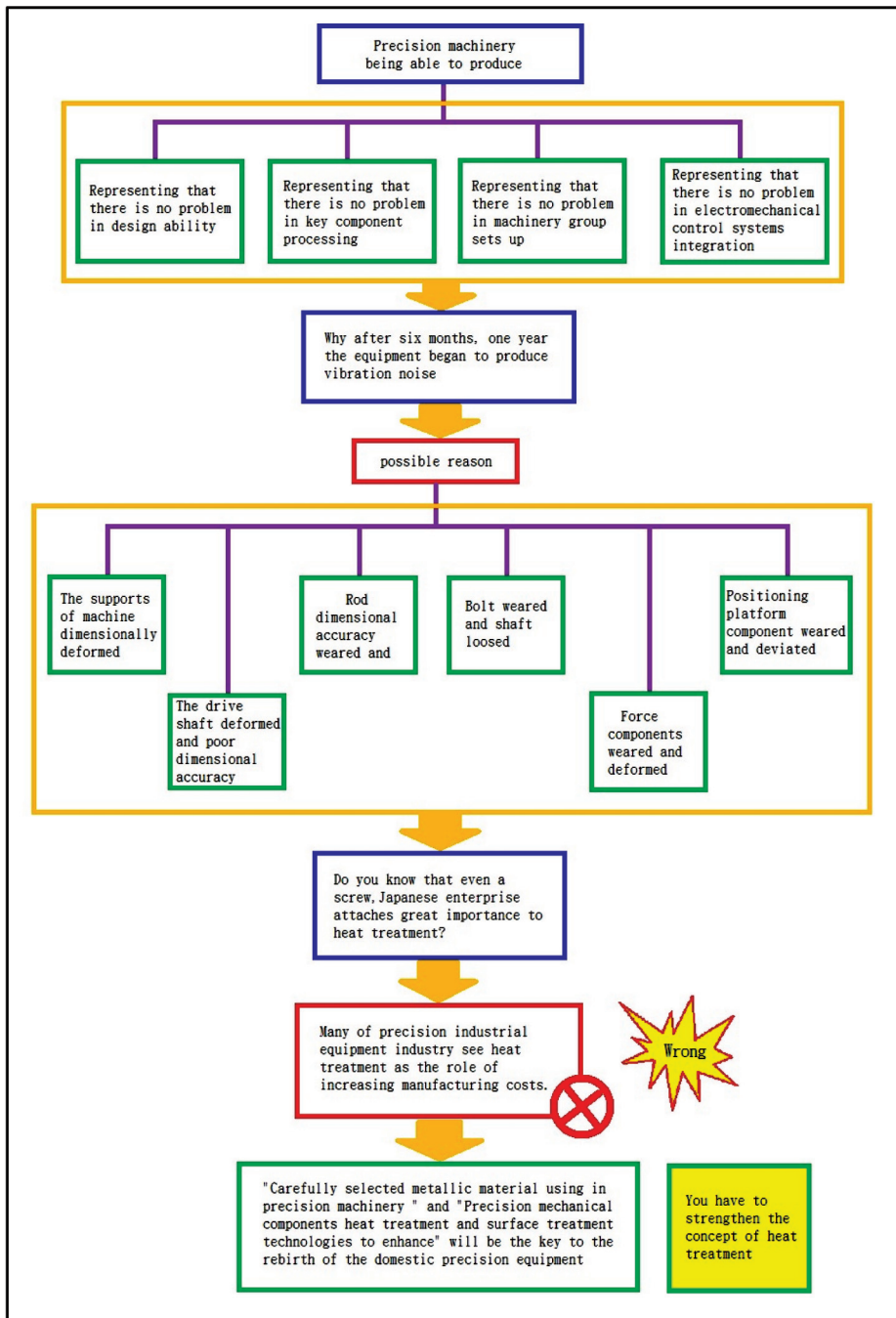
which can enhance results of industry-university cooperation and services. It can be said that the students, teachers and industrial enterprise will create a triple-winner mode.

“Metal Materials and Heat Treatment” can be divided into “metal materials” and “heat treatment” two items to introduce, respectively. For machinery applications, metal materials are the most important materials of all the engineering materials, which has high strength, good plastic deformation ability, diversified manufacturing technologies, possess good conductor of electricity and heat, bright metallic color and so on. Representative metal materials include iron and steel materials, aluminum alloys, copper alloys, titanium alloys and magnesium alloy, etc. After these alloys manufactured and formed to different kinds of products, many of them possess basically excellent strength and toughness. Therefore, metal materials have been widely used in machinery, aerospace, electronics, biomedical and structural elements of 3C products, which have become an indispensable element of daily life.

Heat treatment technology is the combination of “heating” and “cooling” processes. By heating the metal material to an appropriate temperature, maintaining an appropriate period of time and then cooling at different cooling rates, the microstructure of metal material changed, thus changing the mechanical properties of metal materials. When you use 6063 aluminum alloy as the iphone 6 smartphones case, you will feel the value of the metal case. You will be surprised that aluminum smartphone case can deformed so thin and delicate, but still retains excellent mechanical strength. Heat treatment is the indispensable unsung hero during the process of upgrading mechanical properties. Specially under the current policy trend of carbon reduction, if we can use heat treatment to enhance the mechanical strength of metal material, then we can effectively reduce the size of material and lower usage amount. Products with lighter weight can not only save costs and create profits, but also save power loads indirectly to achieve the effect of carbon reduction. Do you know that important devices ranging from screws and tools to mold and machinery components, are required to complete an appropriate heat treatment process to ensure the excellent combination of mechanical properties, chemical properties and physical properties in the daily life?

The importance of heat treatment can demonstrate Taiwan’s precision machinery industry to describe, as shown in Figure 1-1. Many Taiwanese companies are able to design and manufacture precision machinery to sell worldwide successfully. These devices have a good operating performance and precision at the beginning of the operation, but after a period of time, they often begin to vibrate slightly and the cause noise. What followed was the beginning of

Figure 1: The relationship between Heat Treatment and Precision Machinery Industry



precision deviation, the usage lifetime of precision machine seem not as good as the Japanese or German precision machinery equipment. Have you thought about what the reason is? Some scholars believe that the key problem is not the design, manufacture, assembly, electrical and mechanical control technologies, but should be caused by the reason that the mechanical properties and service life of precision machinery components does not attain the desired condition. Therefore, if the competitiveness of Taiwanese precision machinery industry wants to be excellent as Japan, Germany and other advanced countries in the future, it is a pressing task to upgrade and improve the reliability and service lifetime of precision machinery components. From each of the components of the precision machine to the main structure pillars, etc. should pay attention to the mechanical strength, abrasion resistance, accuracy and dimensional stability. Then the careful selection of metal materials using in precision machinery and the promotion of appropriate heat treatment and surface treatment technologies of precision machinery components will be an important factor for successful regeneration of the Taiwanese precision machinery industry.

Do you know that even a screw Japanese precision equipment industry attaches great importance to heat treatment technology? In Taiwan, many of precision industrial equipment company regard heat treatment as the role of increasing manufacturing costs. Perhaps this is one reason why Taiwanese precision machinery equipment does not attain the desired service lifetime and reliability. As a result, if Taiwanese company want to enhance the level and added value of precision machinery equipments, all employees should have the abilities of correct selection of engineering materials and appropriate heat treatment technology. This is the way to avoid deformation and excessive wear of equipment components, and improve the stability and service lifetime of precision machinery equipments.

2. TEACHING DESIGN CONCEPTS

Instructional Design Combined with Industry Personnel Training Policy

Although different courses have different educational objectives and teaching contents, the most important educational goal in vocational colleges is to nurture the technical persons needed in the industry. Therefore, the overall design of teaching concepts can still depend on “industry personnel training goal” to arrange teaching objectives and supplement teaching contents. Subsequently give different learning direction and target to students depending on the difference of courses.

The Mental Attitude of Serious Investment in Education

“Always keeping self-learning attitude seriously” is the only way to implement the instructional design and curriculum scheduled plans successfully. Author has taught for twenty-two years at Southern Taiwan University of Science and Technology. In recent years, from the teaching planning of courses to the student’s instruction and counseling, the author endeavor to promote the students’ academic essence and practice skills all the time. Author often refer to the proposal provided by industry advisory committees, and follow the developing trend of industry to revise course contents and schedule. We hope to train engineering staff meeting the demand of industry by reviewing the teaching content of required courses, offering elective courses consistent with the industrial trend, and providing a variety of lively teaching patterns. Therefore, from 2011 to 2014 the author not only absorbed other teachers’ teaching experiences and teaching skills from teachers’ professional development community, but also learned industry practical experience and the latest industry developing trend from collaborative teaching program with industrial experts. Furthermore the author directed the Talent Fostering Program for Advanced Industry Equipment supported by the Ministry of Education from 2011 to 2014, we observed other university teachers’ excellently teaching skills and students’ outstanding performance, and then promoted relative teaching skills into personal teaching courses. Fortunately, the author awarded two commendations for “2012 remarkable award on teaching materials” and “First prize on the 2014 The Excellence In Project Execution Contest” certificated by the Ministry of Education. According to the demand of counseling student’s technician certificates in the future, we will continued to finished the specific teaching materials about heat treatment technician certification of class B and class C skill category, including textbook and VCR digital teaching materials.

On the teaching design concepts, author stand on regarding each student as his own child to educate carefully. The specific educational philosophy are listed below^[1]:

- (i) course content combined with new knowledge in industry;
- (ii) well plan the contents of course and adequate preparation of teaching materials;
- (iii) investment in certificates remedial teaching program;
- (iv) enthusiastic teaching attitude;
- (v) teaching observing and promotion of teaching skills;
- (vi) caring students and good interaction;

- (vii) individualized education for different class and student;
- (viii) moral education and nurturing of work attitudes^[2].

Striving for More Teaching-Oriented Program Resources to Nurture More Industry Talented Person

To implement personal teaching concepts and goals, in addition to keep passion for education, self-efforts to improve the quality of teaching and teaching skills, strive to get more teaching-oriented program from the Ministry of Education, the Ministry of Science and Technology and other government agencies is also an important platform to bring personal teaching philosophy and promotion of teaching effect into full play. Based on the nature of these teaching-oriented programs and projects, there are no host fee or allowance for the program director, there is also no academic research papers could be published for promoting to professor position. Therefore most of teachers have No willingness to apply for this type of project. Project funds are mostly used in design of teaching aids, design and execution of teaching activities, held workshop and practice activities, topics lectures from professor and experts, factory visiting, Implementing competition, etc., and it takes a lot of time to plan and execute. However, these activities are attractive to college students. By having activities outside the classroom lectures, it is exactly making students in vocational colleges feel fresh and curious for learning, and also promoting significant teaching effects. Author also strived for various teaching-oriented program and applied project in recent years from different government agencies and listed below for education colleagues referring^[3-4]:

- (i) research project supported by Ministry of Science and Technology;
- (ii) personnel training program supported by The Ministry of Education Advisory Office;
- (iii) international cooperation and exchanging program supported by the Department of Technical and Vocational Education of The Ministry of Education;
- (iv) personnel training program supported by the Department of Technical and Vocational Education of The Ministry of Education;
- (v) the qualification examination of technician certificate project supported by the skill Evaluation center of Ministry of Labor.

3. TEACHING MATERIALS AND PLANNING

Depending on the Requirement of Engineering Certification (IIEET), Provide a Suitable Curriculum Planning for Our Students

The formulation example of syllabus of engineering materials:

- (i) With a group composed by teachers teaching the same course, invite teachers with relevant expertise together to convene curriculum planning discussion committee, and then develop a common syllabus based on students' qualification degree. After the syllabus was established, teachers could decide appropriate textbook, teaching schedule and teaching methods on their own style.
- (ii) Formulate learning goals and learning correspondence index according to the course syllabus.
- (iii) According to the teacher's class project, each teacher develops the syllabus of each class (including the unit topics and content outline), corresponding to the students' core capabilities, core capabilities achievement indicators and assessment methods, etc.
- (iv) With the course learning objectives, construct a holistic education learning environment, and encourage teachers to provide diversified Assessment methods.

According to the student ability and curriculum objectives, conduct the planning and design of teaching materials:

I. Planning and design teaching materials with the goal of course:

- (i) Select an appropriate textbook. Planning the emphasis of teaching material content and designing for teaching schedule based on course content and teaching hours.
- (ii) Edit the teaching slideshow content based on students' capability and Competent.
- (iii) With an internship or implement curriculum content, conduct the writing of supplementary teaching materials or the filming of VCR instructional videos, and then upload to teaching website for students to download and learn anywhere and anytime.
- (iv) Collect instructional videos to assist teaching activities, and it will significantly enhance students' learning interest and learning effects.

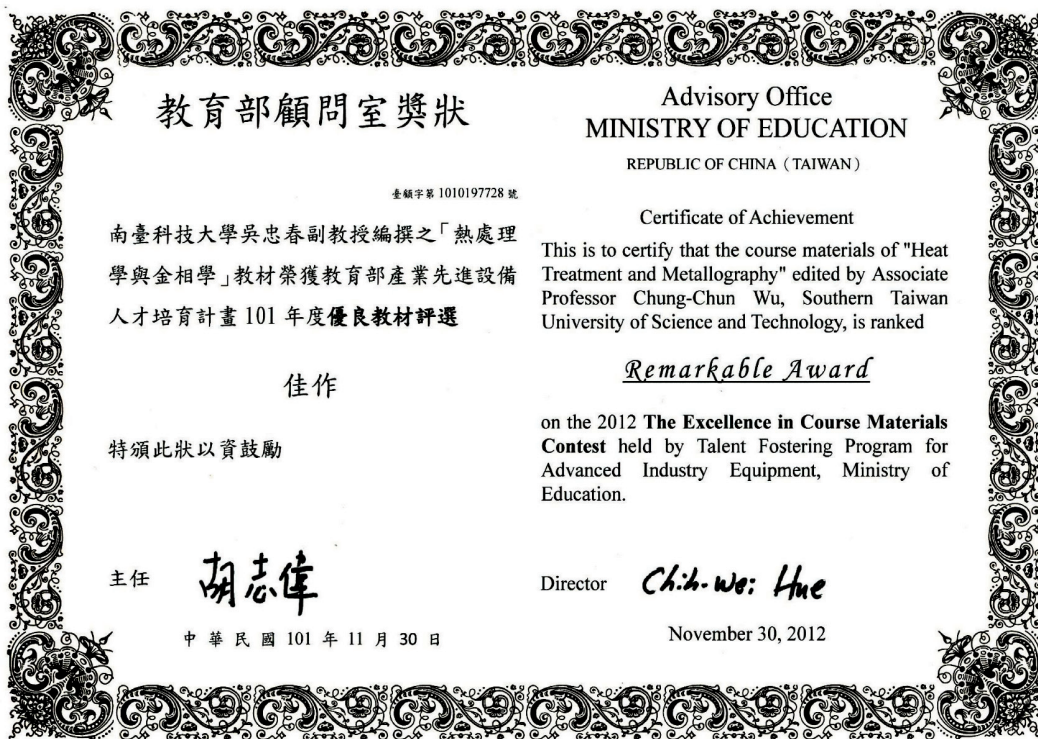
II. Design example of a part teaching content planning of "heat treatment of metallography"

- (i) In response to our school having the advantage of qualification examination place of class B and C skill category of heat treatment technician certificates, this course not only instill heat treatment technology and industrial applications to students, but also set the goal of students obtaining technician certificates of heat treatment in class B and C skill category. Due

to there is no relevant teaching materials in the current market, therefore, textbook was written by the author, and the related teaching VCR video was filmed to assist in the teaching of implement training. The textbook about qualification examination of technician certificate for heat treatment in class C skill category has been published on May, 2015.

- (ii) The written of the textbook of "heat treatment of metallography", was recommended by National Kaohsiung First University of Science and Technology education resource center to join the competition of 2012 The Excellence in Course Materials Contest held by The Ministry of Education. This excellent textbook was funded by the Talent Fostering Program for Advanced Industry Equipment and won the Remarkable Award, as shown in Figure 3.

Figure 3: Remarkable Award on the 2012 The Excellence in Course Materials Contest of the Ministry of Education



4. TEACHING METHODS AND TECHNIQUES

Using Multiple Teaching Methods to Enhance the Students' Interest in Learning:

Currently, many vocational university acquired subsidy of Teaching Excellence Project from the Department of the Technical and Vocational Education of the Ministry of Education. With the promotion of the Teaching Excellence Project, "teachers' professional development community", "miniature teaching", "TA teaching assistant system" and "e-learning platform and digital textbooks" are provided to assist the teaching works. Teachers can observe great teaching skills from others, strive for human resources of teaching assistants(TA), and think about the appropriate teaching methods and teaching skills. And it is believed to enhance the effects of teaching works. In recent years, the author tried to use different teaching methods and skills in different courses, it is worthwhile to propose and share with all education colleagues, that including:

- (i) Make teaching aids and atomic model used in teaching, and showing the real object of abstract packing to students, so as to enhance the effects of teaching.
- (ii) Join the course with the operation of laboratory equipment, strive for human resources of teaching assistants(TA), and arrange demonstration and Implementing unit within the content of the course.
- (iii) As for internship or implement training courses, in addition to writing "operating steps and schedule plans" supplementary teaching materials for students to learn, the author also plan to film teaching VCR video for students to observe and practice in advance, which is very helpful for implement training.
- (iv) Collect relevant instructional videos or computer animation to help teaching activities. This lively and interesting teaching method is not only easy to understand, but also attracts students' learning interest.
- (v) Apply "e-learning platform" to enhance teaching skills and teaching results, including materials uploaded, the use of online quizzes and online discussion, and so on.
- (vi) The design and application of classroom learning examination papers can improve students' focus both in class and study.
- (vii) Apply teaching materials, video or retrieved database platform published on the web, and teach the skill practice and implementing teaching on the web.

Sharing of teaching methods and skills of curriculum for “heat treatment and metallography”:

This course link “heat treatment” with skills certification programs together. In addition to teaching students about the heat treatment knowledge and implementation technology of heat treatment of metal materials (including steel, aluminum, etc.), we also encourage students to pass qualification examination of heat treatment to achieve the technician certificates in Class C and B skill category, respectively. In addition to teaching basic of heat treatment, the course also provides implementation training, including the spark test, high frequency surface hardening heat treatment practice, temperature measurement, changing furnace dew point implementations, metallography practice and microstructural observations, and surface hardness test, etc. The implementation training of this course also joins with W. C. Su, C. F. Yang and S. C. Wang, who are teachers at the same department and conduct counseling of the qualification examination of heat treatment technician certificates together. It is really tired for teacher to teach and train our students because that we always tutor students to practice skills and implement at night time. However everyone feels glad and satisfy when our students enjoy the happiness and self-affirmation after they pass the qualification examination and get their technician certificates.

It is worth mentioning that while attending implementations tutoring program of heat treatment, we asked students to attend the class at night time, and almost everyone showed up on time. The lecture hall which can accommodate about 140 students was packed fully. The spirit and attitude of hard-working of our students let the author and all students on the spot deeply touched. Many students claimed that this was the first time they sit on the floor listening the teaching class for three hours, and feel great sense of achievement. In recent five years, the author totally tutored more than 2600 students to achieved technician certificates of heat treatment in class B and C skill category. This great and successful teaching result helped the author to be ranked First Place Award on the 2014 The Excellence in Project Execution Contest held by Talent Fostering Program for advanced equipment industry supported by the Ministry of Education, as shown in Figure 4-1.

In addition to focusing on filming the video of implementation training VCR teaching materials, writing supplementary handouts and teaching materials in response to the focus skills and practice training also significantly help our student to study well in this course. To make students more familiar with operating procedure during implementation training, we took pictures and decomposed action flow-chart to accomplish the writing of supplementary handouts by use of real equipments in the Labs. Moreover, by using the building functions of our

school's digital learning platform, we made "online simulation test system" for our student to prepare the qualification examination of technician certification. The test system was helpful that our student were more familiar with the content and type of the qualification examination, obviously enhancing our students' confidence to participate the examination. Based on the teaching effects, I think the above teaching method and skills are worth to consider and use in implementation training course.

Figure 4: The first place award on the 2014 the excellence in Project Execution Contest



5. QUESTIONNAIRE, REFLECTION AND TEACHING ACTIVITIES

Questionnaire Design and Implementation

The author participated the program to cultivate talents in the field about advanced industrial equipments from 2011 to 2014 under the Ministry of Education. One of the biggest gains for author was to know teaching achievements by the implementation of questionnaire. Each taught courses are subjected to the implementation of

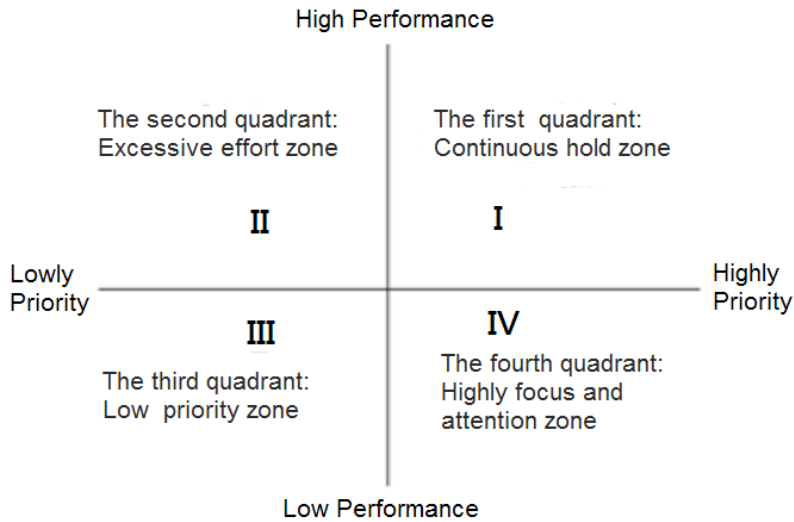
10.	Instructor teaches the course in accordance with curriculum schedule plan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11.	Course content can be coupled with professional equipment to assist teaching works	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12.	Courses can provide opportunities for company internships or factory visiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13.	Courses designed to provide appropriate training opportunities (for example: practice, hands-on)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14.	Instructors encourage students to think, ask questions and express their views	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15.	Instructors can seriously correct homework, reports and papers, and the results back to the students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16.	Instructor timely process students' question and related issues	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17.	Instructors will not catch the lesson and ignores student learning situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18.	Instructors teach classes with enthusiasm	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19.	Instructors teach classes well- prepared	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20.	Instructor's expression clearly structured	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21.	Instructors teaching methods can promote students' interests in learning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22.	Instructor's expertise can answer student questions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23.	Instructors are willing proactively to help students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24.	Instructors always concerned about learning situation and needs of students	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25.	Perfect after-school tutoring system (for example: assistant teaching system, Office hour)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
26.	Class time can fit the time schedule of the participants	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Presentations and Reflections of Course questionnaire Information

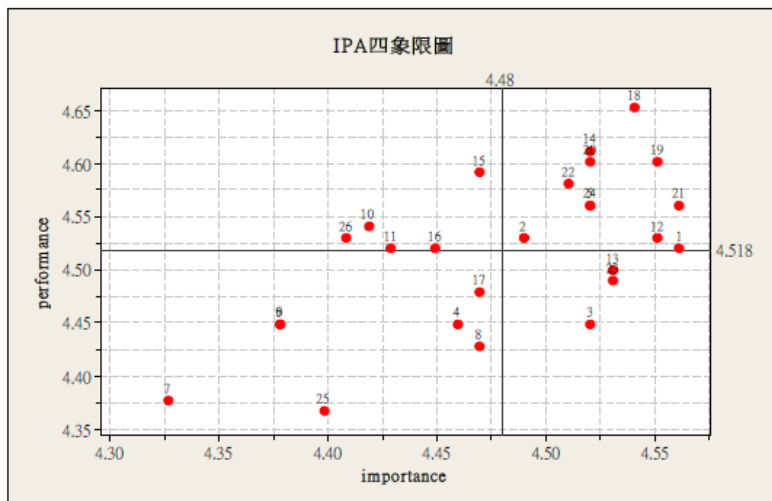
Course questionnaire Perceived Importance-Performance Analysis, P- IPA[®] as shown in Fig. 1. The items located in the first quadrant means the response from questionnaire are excellent and suggest instructors to hold continuously. The items located in the second quadrant means the response from questionnaire are also excellent, however students don't focus the importance and effort of these items. The items located in the third quadrant means the response from questionnaire indicated these items seem to be lower priority items for students. The items located in the fourth quadrant means the response from questionnaire indicated these

items seem to be highly focused and paid more attention to promote the learning efforts for students. The analyses and meanings of the course questionnaire in the present study are shown in Table 2.

Figure 1: Perceived Importance-Performance Analysis, P- IPA



(a)



(b)

Table 2:
The analysis and meanings of the presented questionnaire

	<i>Subject</i>	<i>meanings</i>
The first quadrant: excellent and continuously hold zone	1. Teaching materials and curriculum planning are consistent with teaching objectives 2. Rich and multiple teaching materials (both theory and practice) 5. Curriculum integrated with industry Experts to teach Collaboratively 12. Courses can provide opportunities for company internships or factory visiting 14. Instructors encourage students to think, ask questions and express their views 18. Instructors teach classes with enthusiasm 19. Instructors teach classes well-prepared 20. Instructor's expression clearly structured 21. Instructors teaching methods can promote students' interests in learning 22. Instructor's expertise can answer student questions 24. Instructors always concerned about learning situation and needs of students	Among 26 items of teaching quality, a total of 11 items fall in the first quadrant. showing the high degree of both importance and satisfaction of these items. This result indicates that the course possess good quality performance and meet the expectation of students. These items in the future can continue to remain in this part, in order to provide students with perfect course of study.
The second II quadrant: Excessive effort zone	10. Instructor teaches the course in accordance with curriculum schedule plan 11. Course content can be coupled with professional equipment to assist teaching works 15. Instructors can seriously correct homework, reports and papers, and the results back to the students 16. Instructor timely process students' question and related issues 26. Class time can fit the time schedule of the participants	Among 26 items of teaching quality in 26 items, a total of 5 items fell in the second quadrant. This result indicates these items were less important with teaching quality for students, however the overall performance is quite good. on behalf of the students already feel good for these teaching quality and the importance of the quality of these items were not concerned by the students, the teaching quality of these items in the future can remain continuously but also can consider to minimize resource inputs in this regard.

The third III quadrant: Low priority zone	4. Teaching materials to provide information related to the course learning resources 6. Course homepages can provide sufficient information 7. Good classroom multimedia equipments 8. Teaching equipment or experimental equipment complete 9. Classroom space arrangement can meet the needs of the class 17. Instructors will not catch the lesson and ignores student learning situation 25. Perfect after-school tutoring system (for example: assistant teaching system, Office hour)	Among 26 items of teaching quality, a total of 7 items fell in the third quadrant, showing both the importance and satisfaction of teaching evaluation are low. It means we can ignore these items under limited resources. However, if the university has extra resources or efforts on improving teaching quality of these items, it will enable the more perfect quality of teaching provided and raise the overall satisfaction significantly.
The fourth IV quadrant: Highly focus and attention zone	3. Teaching Materials Clear and understandable 13. Courses designed to provide appropriate training opportunities (for example: practice, hands-on) 23. Instructors are willing proactively to help students	Among 26 items of teaching quality, a total of 3 items fell in the fourth quadrant, showing the main priority improvement items. For students, these items of the teaching quality items have been expected to high degree of importance, however, the level of actual satisfaction was low. Therefore, it need immediately promote and provide better teaching quality, to make students more easy to learn and improve overall satisfaction.

Teaching Promotion and Reflection:

Teaching questionnaire data were presented above. most effectiveness of teaching got certainly good responses from students, encouraging the instructors continuously maintain their efforts. However, three items should need more review and reflection, including (1) Teaching Materials Clear and understandable, (2) Courses designed to provide appropriate training opportunities, (3) the instructors is willing proactively to help students. It will be helpful to remind the instructor can strive harder and finally enhance the effectiveness of teaching significantly.

For “Teaching Materials Clear and understandable” comment, we are going to publish two textbooks successively, including “Technician Certification and Licensing for heat treatment Grade C” and “Technician Certification and Licensing for heat treatment Grade B”. It will be helpful to investigate the reviewed examination contents and implement technical skills. Coupled with the previously used textbooks, we believe that the supplied teaching materials will become more clear and more understandable.

For “Courses designed to provide appropriate training opportunities” comment, This opinion shows that the arrangement training period for students to practice heat treatment techniques was not meet the needs of students. The time period will be ranked about 30 hours and 42 hours for Technician Certification grade C and grade B, respectively. Recently, the number of students participated the heat treatment Technician Certification significantly increasing to 250 in our university, resulting that some students feel not enough time to practice the heat treatment techniques. This information from the teaching questionnaire is quite important, as long as students are willing to practice in techniques and skills, the instructor of course fully cooperate with a further increase the practice hours for students in the future. I believe the Technician Certification of heat treatment should provide enough practice hours and appropriate training opportunities.

Finally, for “the instructor proactively and willing to help students” comment, it revealed that some students require the guidance from the instructor and teaching assistant in the learning process (including discipline teaching and technical subjects implementations) but they didn’t achieved and satisfied. Since the number of students participating in Technician Certification of heat treatment increased in the number to 250 or more, the heavy load may cause the instructor and TA felt tired and exhausted, therefore the students can not feel the passion from instructor and TA. This comment reminds and encourages us to work harder together with the teaching assistants to promote the teaching quality significantly.

6. TEACHING ACHIEVEMENTS AND CONTRIBUTIONS

In recent years, the author planned the teaching programs and activities according to industrial development and personnel training as the direction of curriculum planning. This method not only can improve teaching quality but also interact the industry-university cooperation program successfully, resulting in a number of awards, as shown in Table 3. These awards are related with curriculum planning and educational goals closely. The above achievements indicated that instructors of technical colleges can also grow up and achieve plentiful contributions by properly establishing curriculum goals and teaching materials planning, participating personnel training works in the industry, shortening the drop between the academic learning and industrial techniques, etc.

Table 3:
Teaching Achievements and Contributions

<i>No.</i>	<i>Specific Achievements and Contributions</i>
1.	Enthusiastic assistance of IEET certification of the university in the serious and responsible manners. At the same time, I learned a lot of teaching activity and method to improve the teaching assessment and teaching skills.
2.	Enthusiastic investment in the industrial personnel training and Technician Certification programs. This result was ranked as the first place award on the 2014 the excellence in Project Execution Contest held by Talent Fostering Program for Advanced Industry Equipment, Ministry of Education.
3.	Dr. Wu has been honored with the excellent teaching award of Southern Taiwan University of Science and Technology for five consecutive years. The special feature was the individualized teaching and careful diligence.
4.	The number of students admitted the Technician Certification licenses of Ministry of Labor exceed 1080 within five years.
5.	Dr. Wu provided kindly services and enthusiastic dedication for the relevant teaching learning and activity, who was honored with the excellent service teacher of Southern Taiwan University of Science and Technology for seven consecutive years.
6.	Dr. Wu interacted well with students and manage the class carefully. He has the honor with the excellent tutor of Southern Taiwan University of Science and Technology up to 25 times.
7.	Dr. Wu guide the practice project of undergraduate students, who participated in a national feature production contest. It is lucky to say that we win the contest more than 40 times. It is worthwhile to note that a total of 6 awards issued from the Minister of Education.
8.	Dr. Wu enhance graduate thesis level and guide graduate students to participate in a national essay contest. Six papers have the honor with the excellent paper award.
9.	Actively involved in the preparation of school textbooks, Dr. Wu was ranked Remarkable Award on the 2012 The Excellence in Course Materials Contest of the Ministry of Education.
10.	Actively involved in the implementation of general research and industry-university cooperation program, Dr. Wu has executed over 30 fruitful projects and was ranked as 2011 annual outstanding research achievement award from National Science Council.

11. Workforce Development Agency to assist the Ministry of Labor Skills Certification Center to promote the technical testing of Technician Certification for heat treatment subject. A total of 2,868 person-service candidates were tested at Southern Taiwan University of Science and Technology within five years.
 12. To implement the spirit of lifelong learning, active learning education, a total of six domestic and two international certificates were licensed within two years. We have found significant effect to enhance our teaching skills.
 13. To perform the project about Talent Fostering of Digitized Mold and Die of Research Center for Advanced Industry Equipment of the Ministry of Education for three years, we foster industry talent and try to shorten the learning gap with goals.
 14. Dr. Wu was ranked with 2014 Tainan SUPER Teacher Award, showing enthusiastic about education and professional about techniques.
 15. To preside MOST science activities program for “Heat Treatment Camp” and “Metallography Implementations contest”, It was successful to attract students to understand the “metal heat treatment” technology and possess an enthusiastic response.
 16. The textbook titled as heat treatment Technician Certification for grade C was completed in May 2015. We actively involved in heat treatment certificates of industrial personnel training.
 17. Dr. Wu was ranked as the 2015 country’s college group SUPER Teacher First Place Award, the teaching effects and class management were excellent.
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In recent years, the author invested in teaching and personnel training of “heat treatment of metal materials” field. It is found that for the teachers in vocational colleges, teaching efforts and achievements can be extended to the aspect of “service”, “industry-university cooperation” and “academic research”, and then joined together to bring greater performance. Start from the promotion of teaching works, academic research by postgraduate frequently achieved Seminar Paper Award^[5-9]. Furthermore, the author has executed many personnel training programs and industry-university cooperation projects, achieving “industry-university outstanding achievements award” provided by the National Science Council. Guiding students to win the project contest and good interaction with students, the author was always awarded by Southern Taiwan University of Science and Technology, including “the excellent teaching award”, “the excellent service award”, “the excellent tutor award”, and so on. These achievements above are closely related to the investment and promotion of “teaching” works.

For last four years, cooperating with execution of the personnel training of the Ministry of Education, I started to invest in teaching the tutoring of technician

certificates of “heat treatment” skill category. The author used his spare time to assist students in applying technician certificates, and found that many students are willing to take subjects tutoring course and technical implementation practice at night time. Their hard-working attitude makes me feel much admired. Obtaining technician certificates not only allows students to understand the importance of industrial implementations, but also lets students develop positive attitude of studying hard. As a result, I personally strongly encourage students to apply more technician certificates before graduating from Southern Taiwan University of Science and Technology, which symbolize our students possess positive attitude for learning. Finally, I am glad to invest in teaching technician certificates tutoring program in the future continuously.

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