
Traits Analysis and Influences on High Performing Students in Mechanical Education

Chih-Yang Chao
Chen-Sheng Huang

National Changhua University of Education, 1 Jin De Road, Paisha Village, Changhua 500, Taiwan

The learning of mechanical techniques is an essential element of industrial vocational education. For this reason, two Taiwanese students who had won the gold medal in the International Youth Skill Olympics were selected in order to explore their personality traits and the environmental factors affecting their skill development. It was hoped that this could enhance skill learning knowledge for future technical education. Based on a literature review, the data was collected from documents, interviews, direct observation, visiting their family, teacher and trainer, etc. It was found that students who displayed excellent performance during the learning process had an aggressive mind with specific goals and exhibited excellent mechanical drawing skills. Reasons for higher performance achievement include that the teachers/trainers taught them seriously, students were encouraged during the training courses and a competitive environment and complete facilities were offered. The frequency and duration of practice were the most significant variable related to their performance. During the learning process, the feedback function needs to be emphasised.

INTRODUCTION

The main function of technical and vocational education is to cultivate a technical labour force across all levels. The goal is to give students a standard of occupational capacity in order to meet the demands of the employment market. Therefore, the practical learning of skills is the main feature of technical and vocational education [1]. The emphasis of vocational education development has been stressed with regard to the industrial aspects of Taiwan. Coordinated with the economic and industry development for over forty years, the policy of the industrial and vocational education has been renewed continuously [2].

No matter how science evolves and industries progress, the mechanical industry is always the foundation of industrial development. For example, students learn the mechanism, the principles and the use of methods of various forms of machinery, as well as skills involved in the manufacture, assembly and testing of parts from the process of mechanical skill learning. This will allow them to combine the theory and the reality, and thereby obtain solid skills in profession. Thus, the effect of skill learning is the main hinge of success or failure in industrial vocational educa-

tion. As such, it is obviously a meaningful task to discuss the skill learning traits of excellent students to provide a reference for educators and learners.

Skill learning refers to the process that people without skill capacity, or people whose skill capacity has not reached a certain degree, accept a series of educational and training activities in a planned environment and acquire or increase their manipulative abilities [3].

Skill learning and motor development is dependent on physiological growth and postnatal training, while the performance of skills belongs to the capacity of learning. This kind of capacity is based on physiology but surpasses the physiological limit, and expresses various features of high proficiency, accuracy, precision and changeability [4]. Weiner stated that inducible elements in the educational environment are: ability, diligence, degree of difficulty of homework, mood or health, luck, other people, etc [5][6].

Y.N. Lin has described contestants who took part in the International Youth Skill Olympics as follows:

The national representative shall be provided with efforts of being quiet as in meditation; that is, to think thoroughly, to be prudent and cautious, with both good order and good

reasoning, healthy, capable of enduring hardship, the more frustration the braver, and to have the spirit of persistent fighting [7].

This statement shows the complex phenomenon of human behaviour and attitudes, and it cannot be covered only by quantified information that has been divided into several independent aspects [8]. Consequently, the researchers sought to discuss the outstanding skill learners' mental characteristics and environmental influential factors by using the case study method. Face-to-face contact preceded analyses of quality to observe and realise the subject's thoughts, concepts and emotions in a natural environment.

PURPOSE

Schulman thought that the case study of *Expert Teachers* could be the material for teacher education [9]. Students with excellent marks in skills provide successful models of skill learning. It is envisaged that the investigation of these features will supply valuable information that can showcase examples for students in the technical and vocational education system, and also can be a reference point for teachers.

By means of the exploring of skill learning, this study hoped to achieve following purposes:

- To understand the traits of outstanding skill learners in mechanical techniques.
- To understand the factors that affect the students' achievements in mechanical skill learning.
- To discuss and investigate effective stratagems for mechanical skill learning.

METHODOLOGY

The case study method was adopted to establish systematic steps as shown in Figure 1. Additionally, several qualitative methods were used in this study, including document collection, interviews, direct observation, visit to the subject's family, teacher and trainer. These qualitative methods were executed by the follow procedures.

Research Design

This research adopted *criterion-based selection* method, which sets up selecting the standard first and then finding proper cases. According to the research targets, the criteria of this would be those who had won the gold or silver medal in mechanical aspects at the International Youth Skill Olympics.

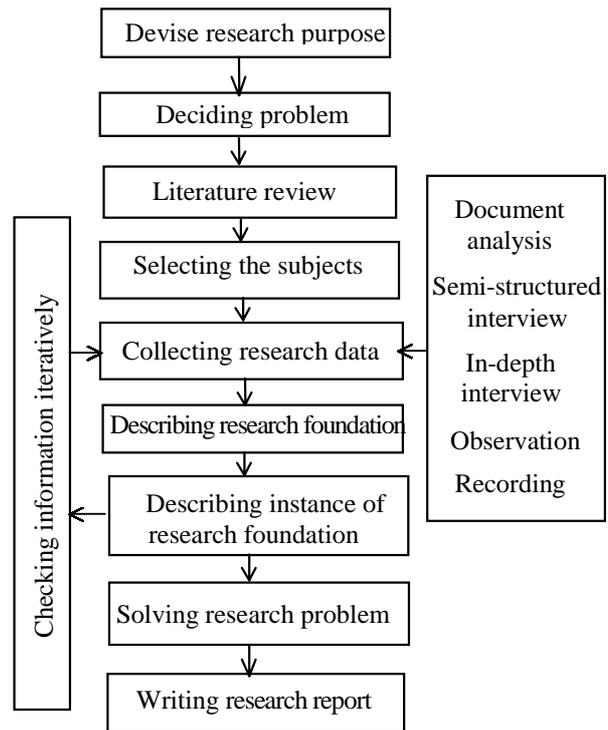


Figure 1: Systematic steps of the case study.

Agreement with the Subject

When seeking agreement, the case in this research must comply with the following conditions:

- The subject was willing to provide the report about skill learning and the long-term interview in the research period.
- The subject must have fluent oral capacity with good order and good reasoning and be able to supply the researcher with substantial, complete and meaningful information.
- The subject had a strong interest in analysing skill learning.

Data Collection

The subject's mental data was collected, which was written out targeting the triumph of the International Youth Skill Olympics. A semi-structured interview was undertaken, listing the relative theme of skill learning and getting the answer of the subject to understand the personal viewpoint of the winner.

An in-depth interview was undertaken with the subject. Before this, the researcher blended into the natural circumstances of the subject to comprehend the thoughts, concepts and emotions of the subject from direct observation.

The interview with the subject's instructor or trainer was also embarked upon, wherein they were asked to

describe the learning course of the subjects from the viewpoint of a trainer, quoting experiences, opinions, feelings and knowledge.

The subject's family environment was visited, to understand the subject's course of growth from the family's statement and identified inherent characteristics. The subject's grades were collected or the training certificate in the phase of the professional high school in order to gather more evidence regarding the subject's background. The researchers also took advantage of the time during the project work for direct observation and to be conscious of the features showing in the practical field.

There was regular reviewing of collected materials in all directions with analyses. Heightened credibility was evidenced using the triangulation method, with discoveries listed in the conclusion.

Subjects

In adopting the criterion-based selection method, samples were chosen from the recommended students who studied at the Department of Industry Education at the National Changhua University of Education (NCUE) in Changhua, Taiwan. Originally, there were five samples selected. However, difficulties in cooperation arose at the time, resulting in two cases selected for profound discussion instead.

The first case was Mr Jin-Jwh Wang, who studied mechanical technique in the vocational high school phase and won the Gold Medal of International Youth Skill Olympics in Instrument Making in 1993. The second was Mr Long-Bin Lay who won the Gold Medal for Pattern Making in the same phase.

Instruments

The semi-structured in-depth interview was ordered into an outline tackling the thinking direction of personal motives, background, and environment. The outline of the questions was as follows:

- Why was this category of competition chosen?
- Who affected you the most in the whole course?
- What are the skill capacities required for the category chosen?
- What should one possess to learn these skill capacities?
- What unique characteristics do you have from the average classmates?
- List your parents' occupations, your siblings' rankings and how the parents discipline children.

Except for this, the researcher used records and notes as the instruments for data collection, learned

relative skills, discussed the learning theory in order to enter the individual subject's world and understand his beliefs, values, viewpoints and motives.

Research Implementation

The study plan and study questions were defined in August 1997, but were analysed later. The initial five recommended NCUE students with strong skills were contacted in mid-October 1997. The researcher found that all five candidates were confident of becoming world-famous, willing to share their valuable experiences and hoped to be of help with their participation.

The study proceeded by schedule, beginning with an analysis of the report of participation in the International Youth Skill Olympics in sophomore. The researcher held several in-depth interviews, semi-structured and non-structured, in late November 1997. Due to time constraints and difficulties in finalising meetings, it was decided to proceed with an in-depth interview with only two cases.

Interviews with the subject's instructor or trainer proceeded between February and March 1998. Contact with the case's family was in April 1998, with grade data collection at the same time. The study entered the last phase in May 1998 with direct observations for two weeks by means of the *project work* programme.

All people involved in the interviews were willing to go on record, although some constraint was noticed of the parents. The qualitative data included the notes and the recording.

Research Reliability

A tape recorder was used to mitigate questions concerning reliability. The initial analytical result or report outline would be used to make primary communication with the subject for correction. By way of participant correction, the interviewee was asked his viewpoint again for relative questions so as to represent the content practically.

Research Ethics

In the beginning of this study, the subject had been told the goal and methods of the research and the role of the researcher. Anonymity was offered to the subjects. The people involved were confident and happy to share the successful experiences. After prudent consideration, the result was that as the content did not demand major privacy, real names were used.

Data Analysis

Data analysis covered several elements, namely categorisation to understand influential factors and features and putting the notes and recorded data in order. The case's traits and the influential factors on skill learning were induced using various methods.

RESULTS

The Comprehension of Skill Learning

By the collection and discussion of the document, the synthetic results of induction are as follows:

- Skill learning included mental speculation and good hand-eye coordination.
- Skill development must be through learning and training of plans.
- Skill learning included cognitive, affective and technologic domains.
- The learning of skills has its phase in development.
- The skill learning content of students in the department of machine categories must take society's demands into consideration.
- Skill learning is influenced by personal factors.
- Skill learning is influenced by environmental factors.

THE SKILL DEVELOPMENTAL TRAITS OF CASE NO. 1

The first case was that of Mr Jin-Jwh Wang, who thought that the factors affecting skill learning were *having the mind to throw oneself in the matter with patience and perseverance, the instruction of a good teacher and abundant machine equipment*. Also, the researcher found that Jin-Jwh had at least four features, namely:

- The ability of inducement: the report's paragraphs were properly divided and in good order.
- Sensible understanding of parents' hardship: considerate of the family's load and chose the class of public expenses to study.
- Modest and grateful: *The honour to win the gold medal derived from the teacher's cultivation.*
- Characteristics of mutual cooperation with people: practicing with the freshmen together in the training centre and not caring about competition with each other.

In the process of the interview, the researcher listened to the detailed description of Jin-Jwh about

the contest and felt his happiness. For him it was a good memory regardless of all the difficulties. Calmness was also detected in his speech. In the interview, the details Jin-Jwh described roughly matched the paper report in sophomore and were more complete. Indeed, it was not easy to compete with other people in the Joint Entrance Exam by grades on a normal subject in a class without a good study custom.

Jin-Jwh grasped his personal advantages on the skill subject, developed towards the direction of skill learning with fortitude, and finally had his own piece of the sky. Indeed, he stated: *When I am not studying, I can sit longer to do matters such as fixing articles or making handicrafts.*

Jin-Jwh thought that the following terms issues were important to learn mechanic skills well:

- Being decisive.
- Being more careful than the average student
- Have the ability to measure and control the tolerance of a work piece up to μ while producing a mechanical part.
- Being able to endure hardships.
- To have goals and ambition.
- Having a good teacher to instruct you and aid in solving problems.
- A good training environment; having the *opponent* in training will gain more opportunity for comparison.

Furthermore, other traits observed included: placidity, confidence and friendliness.

Interview Analysis

The in-depth interview was undertaken on 22 December. The data collected indicates that Jin-Jwh's experience of skill learning before winning the gold medal in the International Youth Skill Olympics was a long course.

The total time he studied was six years; he studied in the vocational high school from August 1987 to June 1990. During this period, he won the fourth prize in the provincial and also the national contests in 1989, the first prize in the provincial contest and the third prize in the national contest in 1990. He was recommended to Chyn-Yih Technical Junior College in 1991 but suspended the schooling only after a semester because his good friend and partner was badly injured in a car accident and he wanted to leave the sad place. Later, they returned to the Central Vocational Training Center to undertake vocational training together.

He was chosen as the national representative in November 1992 and won the gold medal in the International Youth Skill Olympics in 1993 after eight

months' training. One year later, he was recommended to the Department of Industrial Education at the NCUE. Although the process was difficult, he has no regrets.

Being able to bear hardship can best represent Jin-Jwh. He hoped his achievements would contribute to society as thanks for the nation's cultivation.

Jin-Jwh remarked that one must have the ability of knowing drawing and concepts of the trigonometric functions on mathematics in learning instrument making. The others were proficiency of operating machines and the grasp of size and accurate degrees.

Trainer Interview

Jin-Jwh's trainer, Mr Chang Wang, was interviewed on 17 March, and was Jin-Jwh's teacher of enlightenment. He had since left the Central Vocational Training Center and had started a personal business.

The trainer reflected that it took approximately seven years to train Jin-Jwh, which should be enough to train a world gold-medal level player. The competition was held domestically, which offered convenience in time, location and human elements. Generally speaking, the trainer thought Jin-Jwh was a very good player, who worked very hard and never got carried away with victories. He commented *That was exactly what I wanted to see from a player. It is very important for a player not to be arrogant when successful, not to think that he is second to none.*

During the interview, Chang not only mentioned the requirements for a player but also thoroughly referred to the excellent performances of Jin-Jwh in his training. Chang thought that both the quick response and talent of the trainee are important. Players must be quick in reaction and must be intelligent to a certain extent. They should be neither smart nor stupid. Furthermore, they must have the intention and be highly interested in learning. If they did not want to learn, they would get nowhere.

With these supplements, trainers only had to focus on the training itself. Furthermore, trainees must learn skills well and should not be lazy. Schools taught them the most basic mechanism, which required theoretical support. Without theory, how could they challenge their abilities? Besides, not every competition was the same. For instrument making, it was equally important to possess the capability of project management and analysis. Trainees must do many assignments because this would enhance their judgement. A player did not only require hard work but must also know how to think during the training process as quick responses would help in undertakings.

In summary, Chang thought that Jin-Jwh was very mature and diligent. He was not arrogant with his

victories. His poor background did not impede him from working hard and he was serious throughout the whole process.

Family Interview

The family was interviewed on 18 April. Jin-Jwh lives on Ting San Chuang Road of Ching-Shoei Township and is currently a senior at the NCUE. He usually lives in the dormitories and does not go home until Saturdays or Sundays. The unfamiliarity with his parents drew the researcher back from a visit without the presence of Jin-Jwh. The house was difficult to find, although there was a warm sense of community in the small agricultural village.

Jin-Jwh's mother was very happy with all her children and grandchildren. She was proud of her sons and daughters being very obedient and filial. She was especially proud of the youngest child, who was well known to the international community.

Jin-Jwh has three brothers and two sisters and the family's economic condition is not very good. Since childhood, every child, regardless of sex, had to help on the farm and became strong and mature under the parents' care. Children learned frugality from the parents. *Every child was very understanding of the poor family condition and tried all out to help on the farm, which gave them no time to go out and play like other children.*

This family background developed Jin-Jwh into hard working person. Being understanding and helping with house chores prevented him from exposure to bad behaviours. No wonder neighbours always praise Wang's children for being the nicest. During the interview, Ms Wang also mentioned that Jin-Jwh sometimes had to get up very early in the morning and work on the farm before he went to school. At noon, when he returned from school, he also had to help cutting pastures for cows. Everything was in such a hurry so that he almost always ran to school.

As a child, Jin-Jwh could work as much as an adult. This showed the traits of diligence, activity and health. Moreover, children were encouraged to work hard for pocket money.

Analysis of Academic Grades

Jin-Jwh's training certificate recorded the training and learning hours of diverse subjects in detail. The training and learning hours in three academic years were up to 6,113.5 hrs (NB: The Senior Mechanic Class does not have winter or summer vacations, therefore the learning hours are much more than the average mechanical department in the vocational high school.).

In the document, the practical training of the mechanical engineering was 2,821.5 hrs, or 46.15% of total learning hours, while the practical training of factory production was 2,200 hrs.

His best grade was for Good Conduct (A+), which showed law-abiding traits, while the second best was for Practical Training (A). While the normal subjects in learning hours were lower in proportion, most grades were still over B.

Direct Observations

When the *project work* programme was in the state of intense preparation, the researcher accessed the site to make observations over two weeks in order to inspect Jin-Jwh’s traits on practice and identify his distinguished features, such as being sociable, cooperative, not impetuous, working initiatively with an earnest attitude, responsible, and having a preference for skill practicing.

The researcher also consulted with the student’s professor, Prof. Ching-Jang Luo to seek his long-term impression of Jin-Jwh. The descriptions were: *Not over-excited in speech, the mood is not changeable, very calm, reasonable, not rash in doing the job, and having his plan.* This matches with the observation and interview analyses.

Summary

Table 1 lists out influential factors and the traits of skill learning for Jin-Jwh.

Jin-Jwh grew up in a industrious and thrifty environment. Helping on the farm in childhood let him have rapid reaction and fostered the hardship-enduring spirit. He was an ambitious, healthy, distinguished young man. The researcher felt his virtues of sincerity and cooperation through the direct observation. The spontaneity, hardworking attitude and persistence in the skills that interested him were the key points that allowed him to surpass the peak of his life. Taking over two projects also showed that he had won the teacher’s trust and his emphasised his traits of being unafraid of difficulties, without complaint despite the hardships and criticisms.

THE SKILL DEVELOPMENTAL TRAITS OF CASE NO. 2

The second subject of this study was Mr Long-Bin Lai and the contest he participated in was Pattern Making. Long-Bin was a boy who knew what he wanted. Intently striving upward, he was not only earnest in learning, but also took every chance he had to learn other people’s experience during his days of

Table 1: Influential factors and characteristics of skill learning of Case No. 1.

	Document analysis	Semi-structured interview	In-depth interview	Trainer s interview
Factors affecting JinJwh's skill learning	Total commitment. Goal-oriented. Patience and perseverance. The instruction of a good teacher. Abundant machine equipment. Substantial experience and practical training hours on mechanical techniques in vocational high school.	Being decisive. Being more careful than normal. Being able to endure hardships. Have goals and ambition. Have a good teacher. Good training environment; learn from each other.	Know drawing techniques. Know concepts of the trigonometric function. Proficiency in operating machines. Being able to grasp the size and accurate degree.	Be highly interested in learning. Quick reactions. Cultivate the basic capacity of subjects. Quick responses Be neat and efficient. Be intelligent to a certain extent. Be able to learn by analogy; to think. The teacher's match. Capabilities in project management and analysis. Do many assignments to improve judgement.
Jin-Jwh' s skill barning traits.	Inducement. Sensible Understanding of parents' hardship. Modest and grateful. Guiding freshmen and cooperating with each other. Law-abiding.	Calmness, placidity. Confidence. Considering friendship as an important matter.	Being able to bear hardship. Fortitude. Gratitude.	Mature. Diligent. Not arrogant with successes. Poor background is no barrier to working hard. Be serious throughout the whole process.

being a contestant. Directed guidance from the teachers, in particular, accelerated his advance and progress in techniques.

Due to his experience of *carefully learning and seriously doing*, which had been accumulated over a long time, he was awarded with the gold medal in the item of Pattern Making in the international contest of skills and techniques and was recommended for admission to college. His personality of knowing what he wanted not only brought honour to him, but also helped him to realise his ideals.

Long-Bin persisted in his personal choice and had great interest in mechanical pattern making. Interest is an important factor for a person to keep on working, and he worked hard continually, making the most of summer and winter vacations. He practiced his skills in factories, regardless of his wages, and kept on emulating and learning by observing people at all times. He was full of ambitions and planned for future prospects, which all played a critical part in the continuous improvements of his technical capabilities.

He was so absorbed in the pursuit of his goal as to neglect sleep and meals, which was a substantial expression of conscientiousness and bearing hardships and hard work. Furthermore, he would motivate himself and learn patience from stringent requirements he established and he also had strength of appreciation and emulation when he saw another do better. These elements were critical to his success in the learning of technical skills.

Interview Analysis

The semi-structured interview with Mr Lai Long-Bin took place on 20 November. The researcher carefully listened to Long-Bin talk about the progress of skill learning. Long-Bin displayed confidence in talking about his successful experiences and stated that his ... *3-year life at the vocational school should become a crunch during the process of my life*. He became the top expert of Pattern Making from knowing nothing.

Long-Bin showed devotion to his family through his hard work, steadfast perseverance and filial devotion towards his mother. Long-Bin's father died when he was 11 and his elder sister was handicapped and could not speak. Long-Bin's mother had to take care of four children independently. Being the first boy in the family, Long-Bin decided to quit studying after graduating from the vocational high school. Therefore, he made up his mind *to master a technique* so as to find a job quickly and help his family.

The details described in this interview matched the written report of Long-Bin when he was a sophomore. The requirements of learning pattern making mentioned

by Long-Bin during the interview included: skilful craftsmanship and sophisticated techniques, drawing knowledge and capability, common sense and skills of *casting*, mechanical processing, knowing metal materials and woods, woodwork skills, flexible mind as well as the spirit of industriousness. Long-Bin was mature, sensible, perseverant and had practical experience, which were prime factors of his success in learning the skills of pattern making.

An in-depth interview with Long-Bin was held on 24 December. The researcher kept close communications with Long-Bin during the research period. Sometimes, certain missing information was discovered during talks with Long-Bin concerning his past and the future. Information was supplemented quickly upon discovery.

Long-Bin was admitted to the Department of Mechanical Pattern Making, Senior Industrial Vocational School, NCUE, in September 1989. Long-Bin became interested in pattern making gradually under the instructions of his teachers. He did not care about low wages; instead, all he wanted was to learn a little more about the technique, which was really a prospective approach. When he finished his part-time job, he would stay to watch others do their work. This not only revealed his strong ambition to excavate treasures from others, but also showed that learning intention is an important factor of mastering a skill.

Long-Bin participated in the regional skill contest in his second year of senior high school and was honoured to be in the third place; however, he was only ranked sixth in the national contest. After graduation in June 1992, he found a job in a factory and took part in the contest once again. He was at the top, both in the qualifying round and semi-finals, and was selected as a national representative for the 32nd international contest. Finally, he came to the fore and was awarded with the global gold medal in Pattern Making after eight months of intensive training.

Based on a comprehensive survey of Long-Bin's success, he is determined to *master a technique*. He set up goals and works hard to achieve them after being illuminated by his teachers and choosing the subject of Pattern Making. He has a strong and sturdy will to bear hardships and hard work by practicing incessantly. These were all important elements of his superior skills.

Trainer Interview

Long-Bin's training teacher, Mr Huang, was interviewed on 5 February. Mr Huang spoke with fervour and assurance as he was excellent at pattern making and had his peculiar opinions for the technique of pattern

making. Mr Huang provided his sophisticated experiences without reservation. During the interview, Mr Huang listed the requirements necessary for selected contestants and made an in-depth description of Long-Bin. It was evident that the teacher's attentive and diligent direction, as well as opportune encouragement, was important to help students in learning.

Mr Huang indicated that in addition to interest, a learner had to be dedicated totally and active in learning. Moral conduct is also important. If a learner was careless and opportunistic, it would be impossible to master a skill. Any careless negligence was disallowed in the contest. Therefore, carefulness, clear and quick mind, flexibility and proper planning for the flow of a task are required. Learning by watching others as much as possible helped improvement, added with practical practice on one's own. Major points of evaluating Pattern Making included the dimension/size, function of the model, slope, work drawing and precision, etc. As a result, the capability of making drawings should be developed.

According to Mr Huang, Long-Bin is characterised with devotion, conscientiousness, active, quick and with a flexible mind in learning. However, Long-Bin did not get along with his classmates in the beginning, which lasted until he was selected contestant for the country. If Long-Bin could pay more attention to his interpersonal relationships, he would do well in an interactive society for the future.

Family Interview

Mr Lay Long-Bin's Family was interviewed on 21 April. Long-Bin's hometown is in Chair Keng Tzy, Changhua, which is a primitive village and is somewhat remote. His family made a living on farming. It was apparent that Long-Bin's mother was tremendously proud and pleased with her son's filial devotion and accomplishments in skills.

There were two boards hung on the walls of the living room, inscribed with *Skilled & Exquisite Craftsmanship* and *Superb & Outstanding Techniques*. All the people in the village and Long-Bin's boss were so happy about his achievements.

Suffering hardship and perseverance in toil is a portrayal of farmers and Long-Bin was imperceptibly influenced under this kind of environment. As his father passed away when he was 11, he had to help with everything in his family. Therefore, a personality of sensibility, filial dedication and enduring hardships was developed slowly. Even now, Long-Bin still helps with *spraying chemicals, applying fertilisers and irrigating* diligently. Long-Bin's mother indicated that he told her not to work any more because he had made

some money from a part-time job and was concerned about her health; this revealed that Long-Bin was truly a caring young man who took care of his family.

Analysis of Academic Grades

Long-Bin did not do well in the first semester of his first year. It was later realised that the reason was because Long-Bin did not seek further study at that time; instead, he wanted to get prepared for learning skills and finding a job. However, he gradually did better in his second year because the school also had certain requirements for the selected contestants since good technical and academic performance was crucial for recommended admission to college. To be selected as a contestant, Long-Bin had to force himself to do well on all subjects, which resulted in his better academic records later.

Long-Bin's academic records show his average score on moral education is 92 because he scored 99 on the first semester in his third year due to the prize won. Scores of other semesters ranged from 89 to 93, revealing Long-Bin to be a well-behaved, law-abiding good student with a sense of honour.

Direct Observations

During the period of direct observations of two weeks, Long-Bin did a pattern making of a milling machine with another partner on the assembly stage. Long-Bin had skilful techniques, concentration on the task and a composed and confident attitude. This paralleled Prof. Luo's descriptions that Long-Bin had steady emotions, did not become angry easily, was calm and rational, did not speak in an excited way and managed things in an orderly manner. This also matched the observations and analyses of the interviews.

Summary

Long-Bin grew up in a farming family and needed to help with farming when he was little. He developed a character of diligence, suffering hardships and persevering in toil. All he expected was proficiency in a speciality so as to help with the family livelihood, which showed him to be an excellent youth with filial devotion.

Long-Bin's dedication to his work is as apparent as his pleasant relationship and consideration for his partner from direct observations. Table 2 shows influential factors and features of skill learning for him.

CONCLUSIONS

This study aimed at an exploration of the skill developmental traits of two Taiwanese students by means

Table 2: Influential factors and features of skill learning of Case No. 2.

	Document Analysis	Semi-structured interview	In-depth interview	Trainer interview
Influential factors of skill learning for Long-Bin	Teachers' encouragement and instructions. Making use of summer and winter vacations to learn skills at pattern making factories. Doing one's best. High self-motivation. Have patience. Can appreciate other people's merit. Learning by observing. Work hard and earnestly. Can endure hardships and persevere.	Practical experience in factory. Superior's careful instructions. Skilful artisanship and sophisticated techniques. Drawing knowledge and capability. Common sense and skills of <i>casting</i> . Mechanical processing. Know metal materials and types of wood. Woodworking skills.	Teacher's instructions. Interest in Pattern Making. Have goals. Be willing to work hard.	Teacher's instructions. Teacher's opportune encouragement. Be interested and active in learning. Good morality, neither careless nor opportunistic. Be careful. Flexible mind. Arrange time. Observe other's merit. Capabilities in making and knowing drawings.
Features of skill learning for Long-Bin	Specific goals. Strong ambitions. Planning for prospective future. Intense interest. Follow rules.	Flexible mind. Mature and sensible. Enduring hardships and perseverance. Get to points. Work hard and persevere. Responsibility.	Prospective. Ambitious. Endure hardships. Careful and attentive.	Dedication. Serious. Active in learning. Flexible mind.

of qualitative case study. The following conclusions can be drawn from this study.

Traits of Outstanding Students

The two outstanding students in this study possessed such personality traits as being ambitious, having fixed goals, etc. They were also active and prospective in learning.

Analysis of in-depth interviews and observations showed that the outstanding students had aggressive minds and specific goals. They were also devoted to their academic courses, studied automatically, had the vision to organise their future career, were patient when suffering from learning were strongly motivated in their schoolwork. These made their aims more achievable.

Influences on Improved Performance

The main reasons why students in these cases could achieve a better performance were: trainers' or teachers' attitudes, the peers' cross influential settings and sufficient equipment.

The teachers or the trainers taught them seriously, students were encouraged during the training courses and a competitive environment and complete facilities were offered. These helped in establishing definite goals for students where their skill development would obtain significant improvement.

Impact of Drawing Skills

The ability of mechanical drawing may affect the development of professional skills. The two subjects of this study had very good skills in mechanical drawing. They also thought that the mechanical drawing was important in their growth process. It might be that spatial concepts and attentive awareness about mechanical drawing were important in the achievement of professional skill practice. This demonstrated that mechanical drawing was an important course in fostering the mechanical skill development.

Impact of Social Abilities

The social ability may affect the development of professional skills. According to the data analysis, the two subjects were gregarious with peers in the whole training process. Mutual assistance and cooperation may be important to the acquisition of professional skills.

The students with better social abilities had a more opportunities to exchange views with their classmates to facilitate feedback to improve skill learning. Although motor learning demanded self-expression, group activity was still very necessary. Individuals could emulate others' performance or behaviour to increase their experiences and then improve their operational skills. Besides, the learners obtained positive encouragement in the group through feedback and they became more diligent in improving their performance.

Behaviour and Skill Development

Behaviour may affect the development of professional skills. According to the document analysis, two subjects' grades of behaviour evaluation were very positive in this study. It demonstrated that professional skill practice might be connected with individual characters. The students whose behaviours were good had more disciplined living habits so they could learn with all their devotion step by step. No wonder they could reach a better condition of mechanical skills development.

SUGGESTIONS

Based on the above conclusions, the following suggestions can be proposed.

Guidance in Establishing Targets

The instructors should give strong guidance in helping students to establish their targets. In this research, both cases benefited from the proper guidance of instructors and were thankful for it. Students usually felt strange in a new setting. As such, the instructor's assistance was valuable for them to establish definite goals. Above all, instructors should help individuals to behave and to develop educational objectives.

Arouse Student Interest

The instructors should arouse the interest of students to give them positive motivation for learning. Both students possessed strong motivation in skill learning. The first subject's learning motivations were to think entering a higher school and striving for vindication. The other was only to learn a practised skill in order to enter the working market for his family's financial benefit. However, general students usually felt that the learning period was boring, even painful. As such, instructors could give students some learning opportunities including selection of the skill project, making plans by oneself, designing core-curriculum, etc. This would be sure to promote motivation quickly.

Improve Students' Drawing Abilities

The instructors should enhance the drawing ability of mechanical engineering students and combine it with practical technology. The learning of mechanical drawing could cultivate spatial ability and careful consciousness. Therefore, curriculum designers should think highly of improving students' drawing ability and ensure that the drawing content matches with students'

technological instruction comprehension. Then, the instructional activity would be more practical in promoting technical skills.

Allow Time for Self-questioning

The instructors should give students sufficient time for self-questioning in the learning process. The learning of skills has its phase in development. Plenary practice and seasonable feedback are especially important in the self-governed phase. For this reason, mechanical technique upbringing should take notice of offering adequate practice times, even offering the chance for over-learning, providing seasonable feedback and correction in order to smoothly reach the self-governed phase.

Teach Students the Working Norm and Merit

The instructors should teach students the working norm and merit via hidden curriculum design. The mutual aid and cooperation of peers could give students opportunities for exchanging views with one another. It might be the important formula of skill development. Thus, teachers ought to emphasise the arrangement of the instructional setting and atmosphere in order to assist students to understand the rules and construct their techniques.

Enhance Routine Education

The instructors should enhance the execution of routine to educate well-behaved students. Working security and occupational morality are essential items of mechanical skill learning. So, the instructors have to plan a systematic strategy to carry out the rules of the school and class in the process of mechanical skill instruction. This should facilitate establishing a stable foundation for skill learning.

ACKNOWLEDGEMENTS

The researchers would like to thank the people who gave their time for the interviews conducted for this study, including the instructors and families.

REFERENCES

1. Lii, R.Y., Contemporary educational problems and stratagem. *Technology and Vocational Education*. (1995).
2. Yang, C.T., Vocational training vs. industrial vocational education. *Educational Information Periodical*, 19 (1994).

3. Chao, C.Y., Jong, R.G., Chang, J.L. and Chang, J.W., The students' fitting ability research of the industrial vocational high school in Taiwan area. *11th National Technology & Vocational Educ. Conf.*, Taipei, Taiwan (1996).
4. Chang, C.H. and Lin, C.S., *Educational Psychology*. Taipei: Dong-Hwa Press (1983).
5. Weiner, B., *Theories of Motivation: from Mechanism to Cognition*. Chicago: Markham (1972).
6. Weiner, B.A., Theory of motivation for some classroom experiences. *J. of Educational Psychology*, 71, 3-25 (1979).
7. Lin, Y.N., *The Retrospect and Impression of Judge Holding in the International Youth Skill Olympics*. Taichung: Central Vocational Training Center (1996).
8. Liu, C.J., Another idea of combining qualitative and quantitative study: the study interest of Pyngh-Shy-Ren. National Pyngh-Dong Normal College, Taiwan, 103-112 (1996).
9. Shulman, L., Those who understand: knowledge growth in teaching. *Educational Researcher*, 15, 2, 4-14 (1986).

BIOGRAPHIES

Dr Chih-Yang (Frank) Chao is a Professor in the Department of Industrial Education at the National Changhua University of Education (NCUE) in Changhua, Taiwan. He completed his MA degree from National Taiwan Normal University in Taipei, Taiwan, and his PhD from Iowa State University in



the USA. He has served as Dean of General Affairs at the NCUE since 1999.

Dr Chao's research interests have been focused on total quality management (TQM), curriculum development, creative instruction in technology education and topics of mechanical teachers' education at vocational high school. His latest research interests include instructional supervision in engineering and technology education and the exploring of qualitative research.



Mr Chen-Sheng Huang is a teacher at the Dong-Shyh Industrial Vocational High School in Taichung County, Taiwan. He has served as a Director of the Electronic Department since 1998. He completed his MA degree from the National Changhua University of Education in Changhua, Taiwan. He is

in the process of studying his doctoral degree in industrial education at the same school on a part-time basis.

Mr Huang's research interests have been focused on skill learning, creative instruction in technology education and topics of industrial vocational education.



WORLD TRANSACTIONS ON ENGINEERING AND TECHNOLOGY EDUCATION

The UNESCO International Centre for Engineering Education (UICEE), based at Monash University in Melbourne, Australia, has established a new publication series called the *World Transactions on Engineering and Technology Education*. This will publish high quality international, fully refereed papers on engineering and technology education and cover a wide and diverse range of issues including case studies, regional and country issues, pedagogical issues, etc, thereby facilitating the transfer of information, expertise and research and development on engineering education and thus realising the UICEE's mission. The *World Transactions* will contribute to the publication of engineering education papers globally, essential for academic life and the continued growth and evolution in knowledge and understanding.

A definite need has been identified for the publication of refereed papers by engineering and technology educators who are unable to attend conferences due to cost restrictions that inhibit international travel. Such cost factors can unfortunately lead to excellent papers being neglected and may result in grossly reduced involvement from less privileged nations. However, the UICEE's *World Transactions* will counter this by providing a forum for engineering debate where authors will offset the production of publication costs, as with conference registrations, but without the further time and money spent on travel, accommodation and additional expenses.

High quality will be maintained through peer referee evaluations by distinguished academics, language correction, editing, as well as standard formatting, as with all UICEE publications. Furthermore, it is envisaged that the authors of the best three to five papers in each issue, based upon the referees' reports, may be invited to revise and expand their papers for inclusion in the UICEE's *Global Journal of Engineering Education* (GJEE).

It should be noted that the GJEE's objective is mostly to publish expanded award papers and selected keynote addresses presented at conferences and there is little room spare for other papers to be published in the Journal. The *World Transactions* is a new publication, the objective of which is to fill the gap between conference transactions and journal papers by gathering high quality articles, which deal with a topic in a stand-alone form, much like a book chapter. The UICEE's *World Transactions* will be published often, subject to demand, and will be made available on the Internet after some delay.

Hence, a call for papers is made for the inaugural edition of the *World Transactions*, which will be published in 2001 shortly. The absolute deadline for submission of papers is 12 October 2001. Multiple submissions of original work from authors will be accepted. Interested persons should submit their papers to the UICEE for inclusion in the *World Transactions* but must be aware of the standard formatting structure, which will essentially be the same as for UICEE conference proceedings. Papers are to be submitted in Word format in 10pt font, single-spaced, double column, and a *maximum* of 4 pages in total, including abstract and figures. Fees are based on cost recovery and every paper will cost \$450 Australian; this includes one copy of the *World Transactions* and airmail postage to anywhere in the world.

Standard formatting details and submission forms, covering copyright, will be supplied on request. Please e-mail Mr Marc Riemer on marc.riemer@eng.monash.edu.au