

Skill Learning in Lathe Operations: Strategies for Selecting and Training National Skill Competition Participants

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Abstract

The teaching and learning of skills are more complicated, dynamic and diverse than those for general disciplines. For this reason, it is important to understand the personality type most suited to being a skill-oriented student in industrial vocational high schools. This study aims to explore the skill learning process of skills competition prize-winners and their personality traits in the context of the lathe operation category of Taiwan's national vocational high school students' skills competitions. The study adopts a qualitative approach using interviews as the data-collection method. Four prize-winning students in the lathe operation category of Taiwan's National Skills Competition are selected as the cases. Those interviewed are the four participants and their instructors. As well as indicating 6 personality traits among study participants, the study results reveal 8 skill learning points of commonality among them. Finally, the study proposes 7 instructional strategies for selecting and training lathe operation students for the industrial vocational high school skills competitions.

Keywords: *Skill Learning, National Skills Competitions, Personality Traits*

1. Introduction

To encourage students to value highly their skills and practical training, and to improve their technical level through peer discussion, vocational schools hold a variety of annual student workmanship contests. In addition to motivating students in their studies, the competitions are designed to promote inter-school observation and to develop the schools' capacity to respond to the needs of national economic construction and development. This is vital to ensure that senior industrial vocational school education meets current national needs. In the contests, industry-related disciplines are highlighted more than others. With annual increases in the number of students signing up for lathe operations training in industry-related disciplines, competitiveness in this subject is particularly strong. In terms of lecture strategy, only limited research into the effect of instructors' teaching strategies on participants' skill-learning has been undertaken.

Skills competitions for students of industry-related disciplines are held to ascertain the effectiveness of technical and vocational education for students learning skills, and to enhance the various skill levels. Through commendation from the schools or government in public, the competitions not only allow participating competitors to observe, emulate and learn from one another by exchanging views, but also inspire the general public to recognize the importance of technical ability. The contestants are given the opportunity to learn from one another. The contests allow the effectiveness of technical professional education to be examined, and enable teaching quality to be upgraded. One of the chief purposes of senior vocational education is to cultivate professional skills. Through the establishing of the correct professional attitude, senior vocational school students learn vocational skills that prepare them for their future careers and to work at a technical level consistent with current national needs.

Equal emphasis on "Theory and Practice" is considered the aim of technical and vocational education. This balance is achieved by training students to be engaged in learning by doing. Hence in the senior vocational education stage, special attention is paid to operating skills which enable students to master various skill levels. Accordingly, various workmanship contests have been held which are highly valued and broadly acclaimed.

Broadening the scope from industry disciplines to commercial and maritime disciplines, skills competitions have demonstrated the remarkable skills of senior vocational school students, reflected in their outstanding competition performance. They have also won the approval of instructors and students, business circles as well as the general public. Through skills competitions, participants receive clear indication of their technical and academic performance and are able to discuss techniques with each other. This, in turn, motivates students to improve their skills both for themselves and for their schools. In addition, supervising instructors are able to share training methods with one another during the contest, which helps students to be better prepared for the next contest. This study sheds light on early stages of the process in which instructors prepare students for competition and highlights the factors that lead to adequate training and competition success. In so doing, the study serves as a reference for instructors intending to train students for future competitions.

In light of the discussion above, we define the participants' learning process as the research area. Furthermore, we investigate the differences in participants' backgrounds and personality traits to assess the impact of instructors' current lathe operation skills teaching strategies. The objective of so doing is to provide to the mechanical division of senior vocational high schools the information necessary for planning appropriate strategies to increase the effectiveness of instructors' training courses and students' skill learning process.

Background

Skill to act is an ability procurable by learning, which governs human bodies' motion as regards to speed, accuracy, perfect dynamics, balance and other aspects of performance (Gagne, 1985). Four ideas dominate the definition of skill-learning: 1. Skill-learning is the process of action to obtain technical ability. 2 Skill-learning is the result of practice and experience. 3 Skills are procurable through internal behavioral changes, not by observation. 4. Valid technical actions and skill-learning are related. Technical learning involves utilizing a range of sense-making capacities and assumes physical action, as well as knowledge acquisition, as essential components for understanding (Hansen, 2008). Since skill teaching involves the use of many mechanical equipment or tools, its learning environment is more complicated, dynamic and diverse than general disciplines (Tsai, 1995). Simpson (1966) proposed another model of mental motion area of behaviors, which include seven hierarchical levels of the classification: 1) the perception, tackling sensory stimulation, the choice of clues, and conversion; 2) preparation, including psychological, physical and emotional preparation; 3) guided response, dealing with imitation and learning through trial and error; 4) mechanism, dealing with the skills and habits of action; and 5) – 7) complex explicit responses, adaptation and creation.

Skill learning is also a process that combines the individual's intelligence and actions, which is also a chain of multiple reactions and multiple actions (Peng, 1991), and therefore is more complicated than learning an action. It is mainly the learning of new reactions or actions which requires effort and time to complete. The skill learning procedure and action development depend on physical development and training (Li, 1994). Phenomena that influence learning activities are called influential factors, and are found at the physical, psychological and social levels. Skill-learning is subject to such influence. Maslow (1968) highlighted two types of learning potential: aggressiveness & hard-work, or escapism & ignorance, from among which students choose. However, environmental factors, including instructors and counselors, may have effects on the students' selection; that is to say, these factors affect the effectiveness of students' learning. Gagne (1985) pointed out that learning is a multi-faceted phenomenon, often involving strengthening, repetition, time and behavior orientation. Psychologists named learners' own "conditions at the bottom of their heart" as the underlying conditions "which include the learner's aptitude, motivation and past learning experiences". Reynolds & Walberg (1991, 1992), pinpointing relevant factors affecting science learning effectiveness, highlighted the impact on learning of motivation, teaching time, family background, earlier disciplinary groundwork, quality of instruction and other factors.

2. Methodology

This study adopts a qualitative approach and interview method. Representative cases are selected from the list of award-winning students in the lathe operations category of industry-related disciplines for 2005 – 2007 in the Taiwan national vocational high school skills competition. Specifically, the subjects of the study are four

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instructors and four winners of the competition's Golden-hands Awards in the lathe operations category. The schools represented by the study participants are Hsinchu, Dajia, Sanchung & Shioushuei, four senior industrial vocational high schools with extraordinary performance records in this national skills competition (table 1).

Table 1: Prize-winning statistics in the 2005-2007 skills competition, lathe operations category

Schools	Golden-Hands Awards	Total awards
National Hsinchu Senior Industrial Vocational School	6	6
National Dajia Industrial Senior High School	3	4
Natl. Sanchung Commercial & Industrial Vocational High School	1	4
National Shioushuei Senior Industrial Vocational High School	1	4

3. Results

Using the prize-winning students' learning processes and their supervising instructors' teaching strategies as indicators, the interview data are sorted into the following two categories: 1) participants' personality traits; 2) participants' learning process.

Participants' personality traits

In terms of opinions about the personal qualities essential for competition participants, we found each participant has his own perspective. However, all ranked personal moral conduct as the most important quality, with other qualities following from this. Similarly, all participants agreed on the value of having considerable enterprise accompanied by interest and motivation to learn. Participants viewed character as capable of being transformed step-by-step through the long process of training. Qualities such as industriousness, stamina and perseverance could all be cultivated. In addition, the study participants highlighted the value of having more opportunities and time to confront problems. Also emphasized were learning how to trouble-shoot and developing students' capacity to respond to specific problems as they arise. Furthermore, emphasis was placed on the importance of harmony between students and supervising instructors throughout the entire process, with mutual communication also being important. These factors should be taken into consideration by instructors when selecting future participants. The essential personal qualities for successful competitors according to the participants in this study are depicted in Tables 2 and 3 below.

Table 2: Personality traits and instructor interview summaries

Personality traits	Brief description of interviews
A1-1 Interested in learning and self-motivated	Instructor Liao Chang-xiang: <i>...In terms of the way we select contestants, the primary concern is that the competitor himself has to have interest... I feel that it is of the utmost importance for the students to have interest in view of the fact that it takes a lot of time to practice. The key to learning a skill is to practice incessantly. So long as the student has interest and has sufficient time, they stand a good chance of winning a prize when participating in the intra-school contest ...Some students might be weeded out during the process of training. They will probably have lacked interest, or been unable to harmonize well, and will have failed to do things as well as others. All those factors influence my contestant choice.</i>
A1-2 Highly cooperative attitude with respect to learning	<i>...I think Hong-jie is well-behaved and very obedient. Now that he is obedient and fits in well, we can teach him everything we know. Some students do not adapt well, for example, being absent when the instructor arrives. We have to look for them elsewhere. With students with such a low level of organization skill, how can we teach them? No matter how good they are, there is no way that we can teach them properly.</i>
A1-3 Good moral character and integrity	Instructor Wang Jin-zhu:
A1-4 Good response	

capability	<i>...Generally speaking, I take the contestant's enterprising spirit into account, then his moral conduct, and finally his involvement. Providing that he possesses all three attributes, I would consider him to be a suitable candidate for training to become a contestant. In fact, it's quite simple. As long as students are aware of this kind of message, and also know that they must go out to practice, they will have better chances.</i>
A1-5 Highly enterprising	
A1-6 Hard-working and capable of endurance	<i>...Jiong-yu is not very smart, but he takes things seriously and is willing to make an effort to practice. Although the questions in the lathe operations category were announced beforehand, actually they were simply testing the contestants' degree of familiarity... In the end he didn't get good grades in his academic subjects and the contestant ranked third caught up with him. So academic ability is rather important.</i>

Instructor Hong Zhao-liang:

...In fact, nowadays the top consideration when selecting contestants is the extent to which they can cooperate with instructors, i.e. their moral conduct and integrity. Sometimes one is too egoistic, and not receptive to the instructors' ideas. Naturally, that type of contestant is no good. Secondly, he has to communicate with his family in advance so that his family can support him. Thirdly, he must be prepared to work hard. All those attributes are rather important, too.

...Sheng-ru is always ready to cooperate. He accepts whatever the instructor tells him. In the process of practice, listening to the instructor's advice as much as he can will make it easier for him to adjust his movement. Moreover, his moral conduct and integrity are unquestionable. Although the training process is strenuous, he will not be affected by external factors. In long-term practice, one must be capable of overcoming difficulties and working tirelessly.

Instructor Zhou Wen-ching:

...In fact, the contestants should be very sensitive to issues relating to our profession. If he has this sort of feeling at the outset, then he can be trained. In addition, he has to be bright enough to be flexible when confronting problems. At the same time, we also pay attention to moral conduct ... so to be a contestant, one must possess these attributes. I believe that many of the aforementioned ideas are similar on the whole. It's impossible to train a contestant if he is not smart.

...Jun-ting has always had high scores and has been good at academic subjects. In addition, he is highly receptive and understanding, able to do things in accordance with our methods and procedures. A good contestant ought to have good all-round ability and easily understand what their supervising instructors mean. Since he is able to devote himself to the job, and to put in the necessary effort, he is on the way to success.

Table 3: Personality traits and summary of interviews with participants

Personality traits	Brief description of interviews
A1-1 Interested in learning and self-motivated	Participant Chen Hong-jie: <i>...It takes considerable time to participate in a skills contest. A good contestant must make the effort to practice and practice repeatedly. He must be tough enough in character. Encountering something he doesn't know, he will seek the advice of his seniors and instructors. When facing problems, he should first think for a while on his own. If that doesn't work, he should then consult his instructor. So it is necessary to have an appetite for knowledge. In no way can the emerging problem be ignored.</i>
A1-2 Highly cooperative attitude with respect to learning	Participant Lin Jiong-yu: <i>...A contestant must be diligent. To win prizes, diligence is essential. The second most important thing is to exert oneself. If you are not enterprising and allow the task</i>

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A1-3 Good moral character and integrity	<p><i>to be finished less than perfectly, telling yourself that you will do better next time, this means that you failed to exert yourself. I have made this point clear to highlight areas for improvement. If you ponder on them, this problem is likely to be resolved. Then the next point is to have patience. In general, students with no patience do not last long...</i></p> <hr/> <p>Participant Li Sheng-ru:</p> <p><i>... Because training is time-consuming, I am of the opinion that a good contestant must be willing to spend lots of time to the discipline. Furthermore, he has to put in more effort than others. In the process of practice, instructors gave me a lot of guidance, so that I am now in a position to gradually improve my skills in various respects. So for anyone who is willing to learn, I believe no matter what he does, he will make progress.</i></p> <hr/> <p>Participant Chen Jun-ting:</p> <p><i>...I really spent a tremendous amount of time practicing, and contestants must be stimulated by their instructors. We'll accomplish whatever our instructors ask us to do. Basic skills in academic subjects are also desirable, since academic abilities play a considerable part in it. Then the next thing is to have interest and considerable enterprise. In this way one will have the opportunity to learn as much as possible about technical work.</i></p>
A1-4 Good response capability	
1-5 Highly enterprising	
A1-6 hard-working and capable of endurance	

Participants' learning process

The participants going through training have access to up-to-date technology. Above all, their final goals should be to win awards at the annual skills competition. During the contest, students demonstrate that their skills meet the contest requirements as the result of daily training, bring their talents into full play, and exhibit themselves to the best of their ability. In the interview process the researcher found similarities between each participating student in terms of the learning process. Tables 4 and 5 display the points of commonality in the participants' skill learning process.

Table 4: Learning process points of commonality and instructor interview summaries

Learning process items	Brief description of interviews
B1-1 Training in school prior to skills contest	<p>Instructor Liao Chang-xiang:</p> <p><i>...a specialization training course was held in the first year, I asked those interested students to attend...and they could take part in subsequent group training. Our participating students must come through the school artisanship competition and must be willing to listen to the instructor's advice. They must be sure to attend the school skills competition, and get the proper rankings. Artisanship competitions in school are held for the first, second and third year of high school. In the second year, students are chosen to represent their schools.</i></p> <hr/> <p>Instructor Wang Jin-zhu:</p> <p><i>...If students have an interest, they can use the evenings to go and watch their seniors practice. If possible, they may make use of evenings to practice beforehand. Since it is required by the school to pass through a selection procedure which demands students to do extensive practice, contestants will be selected in the second year and develop slowly. As a rule, those students going out to practice in advance will be more outstanding in due course, and will rightly be selected. It is vital that students are aware of this message, namely that to get more opportunities, it's essential to go out to practice in the evenings.</i></p> <hr/> <p>Instructor Hong Zhao-liang:</p> <p><i>...Our school holds annual intra-school artisanship competitions, which are conducted separately for the first and second grades. The majority of the</i></p>
B1-2 Family background as an influential factor	
B1-3 Aptitude test guidance prior to school education	
B1-4 Further education as goal	
B1-5 Making good use of time	

B1-6 Gradual learning method	<i>participating students are from the second grade. If the first prize winner shows no interest, we will ask the second prize winner. For instance, Lee Sung-ru was the champion of the workmanship contest of the second year group in our school.</i>
B1-7 Training on-site response capability on one's own	<i>Because he wants to compete, we have nurtured him.</i>
B1-8 Upgrading self-learning ability	Instructor Zhou Wen-ching: <i>...First of all, we will observe whether the students are interested, and then they attend the group training program, where we judge whether they are suitable for the job. Finally, a workmanship contest within the section is held in the school, in which the top few winners will be selected. Our school has an internal mechanism, where we carry out training first. Then the school skills competition winners are identified before finally becoming actual contestants. The best of these students qualify for group training before the next and final selection is made.</i>

Table 5: Learning process points of commonality and participant interview summaries

Learning process items	Brief description of interviews
B1-1 Training in school prior to skills contest	Participant Chen Hon-jie: <i>...In junior high school I had the opportunity to participate in the school's artisanship program, being introduced to machinery-related professional courses, which led me to become highly interested in the machines. My father is also engaged in mechanics-related work.</i>
B1-2 Family background as an influential factor	<i>...At first I became aware that the instructors were training contestants, and that those prize-winning contestants have the opportunity to further their education, which was why I wanted to participate. Now I have entered Taipei University of Technology, thanks to the instructors' guidance. They gave me this opportunity to exhibit my skills.</i>
B1-3 Aptitude test guidance prior to school education	<i>...Having been selected, the instructor's training model is to start from simple tasks. We have been practicing for a long time. During practice, we began with a single item, a relatively unskilled task, and practiced repeatedly. In the beginning, the instructor would not ask us to work on difficult tasks. As the questions were given out, the instructor would calculate how much time it would take us to finish them and would then reduce the time limit. He set the rule that every time we work on a task, we should be sure to remember how long it takes.</i>
B1-4 Further education as goal	Participant Lin Jiong-yu: <i>...My father was also engaged in work related to mechanical processing, so I have also been affected by him. Gradually I fell in love with machinery, so after my graduation from junior high school, I chose to enroll in the mechanical section. Since then I have always maintained a positive learning attitude and had the opportunity to participate in the training for contestants.</i>
B1-5 Making good use of time	<i>...My instructor's training style was to give you a diagram that you had to change the size of by yourself. That was how you would get your to practice. To begin with you would think how to exercise your own processing methods. Sometimes he glanced at your work as he walked past, and mentioned if there was any better structure you could use. He would also give you some general ideas about problems with your structure. He would ask if there was any other way to replace it or how to deal with it, or after certain changes, if it was still possible to complete it with the method you were using. He would tell you what might be wrong with your method. He expected you to think about how to change it. He would not want you to reach an impasse in your work in terms of how to do it. He would give you a free hand to learn on your own.</i>
B1-6 Gradual learning method	Participant Li Sheng-ru: <i>...My learning situation is very much influenced by my parents. Because both of</i>
B1-7 Training on-site response capability on one's own	

them were engaged in machinery-related work, I frequently encountered different mechanical problems, such as dismantling and installing apparatus at home or understanding the operational mechanism of various machines.

...Accordingly I developed a passion for machines and motivation for research. In my junior high school days I took the aptitude test for this discipline, and the results indicated that my personality was also suited for this area of work. I said that if it was possible, I would commit myself to this line of work. Of course I chose to study in those schools with mechanical sections. I have learned a lot here, thanks to the teaching of my instructors in Mechanical Science. I hope I can put my knowledge to practical use.

...In the training process, if I failed to do it in the right way, instructors would talk to me, so that I could learn how to be more creative. We worked this way quite often and eventually it became clear to me how to process the finished product faster, and how the seniors ahead of me did their processing work. I spent a lot of time going over lessons from the instructor, to see if there was any mistake. I also tried out a variety of processing methods in order to find out the best approach, to which I think I have devoted considerable time.

Participant Chen Jun-ting:

...In my junior high school days it gradually became clear to me that I was suitable for vocational school. So when filling in the forms of "choice of school subjects", I chose those schools with machinery sections as my first choice.

...I am fairly interested in this area while currently my main objective is still focused on study in the hope of having the opportunity in the future to use these techniques learned in the vocational school. Actually, I took up training not for the purpose of entering a college. For most of us, perhaps getting the first or second prize in the golden hands award will be more important. Otherwise obtaining lower rankings won't make much difference.

...To begin with, our school had two contestants in the same professional category practicing together. Thus there was competition as well as group study. Initially, we had to start with single items while practicing. The instructor would reduce our production time as it had to be within reasonable limits. Afterwards we were able to slowly develop our accuracy.

4. Conclusions

With respect to factors affecting effectiveness in skill-learning, students who learn skills should undergo a series of educational and training activities in a programmed environment, which will allow them to demonstrate a high degree of skillfulness, accuracy, sophistication, variability, and other qualities. Skill-learning, in addition to action skills, includes cognitive and affective dimensions; that is, the desire to receive positively the teaching in the early stages that is essential for a broad and firm foundation to learning. In addition to personal factors, other factors affect learning skills such as intelligence, memory, physical fitness, motivation. Also of importance is the ability to interact socially. Individuals that are able to interact in groups are able to increase their knowledge and perfect their technique through observation of others' demonstrations. Also of key importance are environmental factors, in which instructors' instructional strategies, practice time, practice style, practice environment and feedback have considerable effects on skill-learning.

On the basis of respondents' experiences and suggestions, this study highlights the following teaching strategies for training students who are preparing to participate in the skills competitions. These strategies will also serve as useful references for instructors selecting participants for these competitions.

1. Hold internal school skills competitions for students to generate a sense of honor

In general, schools should nurture participants for skills competitions by selecting them through in-house school skills contests. In these competitions, students' sense of honor is generated through a fair yet

competitive environment.

2. Practice prior to the school skills competition has a positive impact on learning outcomes

If students can be instilled with the importance of hours of practice in schools prior to in-house school skills competitions, this will be more effective than learning this lesson after selection, which is a time of considerable competition pressure both from peers and from previous competitors who provide guidance.

3 Multi-staged skills competitions can enhance students' sense of presence

If school skills competitions are arranged in multiple-stages and select participants through filtering, students are better able to face challenges and withstand pressure. Supervising instructors are also able to identify and monitor suitable candidates over a longer time period.

4. Instructors' recommendations can provide a useful reference

Participants are often not those taught by the instructors themselves in the classroom. In the process of selecting participants for skills contests, asking the students' original instructors for recommendations will enhance the supervising instructors' understanding of the students.

5. Grasp the personalities of participants

Each participating student has a different personality. If instructors are able to grasp the personality of individual students and use that understanding to strengthen the participants' weaknesses, develop their confidence, and enhance on-site response capacity, it will be easier for the students to demonstrate their real capability in the contest hall.

6. Limit the students' practice time

As contest questions are given prior to the competition, the length of training directly affects the students' skill-learning proficiency. If instructors can fully utilize participants' practice time, it will increase participants' chances of winning.

7. Systematic and periodic training style

Supervising instructors should establish a complete training program, help participants to improve their learning performance stage-by-stage, and understand students' learning situation. The participants are advised to take the initiative to learn and discuss the techniques for targeting problems arising in the training period, finding ways to solve these problems, and strengthening their ability to handle contingency.