

## Some solutions to improve technical skill for students of Machine Manufacturing Technology at Thainguyen University of Technology, Vietnam

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**ABSTRACT:** Machine Manufacturing Technology is an important discipline in training the high-quality technical staff to serve the industrialization and modernization of the country. In terms of technical skills of graduated learners, besides some skills in manufacturing process such as casting, rolling, drawing, forging, stamping, turning, milling, grinding, etc., the welding skill is also one of the important career skills to perfect the capabilities of a technologist. However, the training process of Machine Manufacturing Technology at the Thainguyen University of Technology (TNUT) is currently facing difficulties in investing in equipment and organizing of training to practise the welding skill for learners. The article will refer to the improvement of professional capacity for students of Machine Manufacturing Technology at TNUT through the exploitation and using of the semi-automatic welding equipment designed and manufactured.

**Keywords** - Professional competence, Machine Manufacturing Technology, pipe welding, semi-automatic welding equipment.

### I. INTRODUCTION

Machine Manufacturing Technology is the industry that creates machines and equipment for production, for human needs such as cars, airplanes, motorbikes, bridges, roads, construction works, houseware, weapons, etc. Therefore, it plays an important role in determining the technological level of a country. The engineer of Machine Manufacturing Technology needs to have enough competence to be able to participate in the design, manufacturing, technology transfer, organization and management of the production, maintenance, repair, sales and service process in the field of mechanics. Therefore, in the training process, the learners must have relatively complete knowledge and technical capacity in the field of mechanics in general and specialize in the field of Machine Manufacturing Technology in particular.

To meet that requirement, besides the knowledge and skills of manufacturing processes such as casting, rolling, drawing, forging, stamping, turning, milling, grinding, etc., the knowledge and skills of welding must be considered a blocks of important knowledge and skills to improve the professional capacity of learners and to ensure the balance of the training program.

However, in the reality of the training of Machine Manufacturing Technology major at TNUT, the welding training still faces many difficulties due to the lack of conditions of equipment, human resources, and practical organization techniques. Therefore, the welding skill do not meet the professional needs well.

Therefore, improving the professional capacity for students of Machine Manufacturing Technology at TNUT through the exploitation and using of semi-automatic welding equipment designed and manufactured is really necessary and meaningful.

### II. CONTENTS

#### 2.1 Concept a. Skill

A skill is the learned ability to perform an action with determined results with good execution often within a given amount of time, energy, or both [6]. Skills can often be divided into domain-general and domain-

specific skills. Skills help people adapt to all situations, apply them to handle situations in work or life in the most reasonable and effective way.

### **b. Technical skills**

When we apply the concept of skill to the field of engineering, technical skill can be understood as the ability to perform professional and technical activities with high efficiency, little consumption of mental and muscular energy in changing conditions [4]. Therefore, to do their job well, the engineer needs to have technical skills.

#### **2.2 Requirements for technical skills of Machine Manufacturing Technology students**

The training program in Machine Manufacturing Technology trains engineers of Machine Manufacturing Technology with basic knowledge of science, industry and core knowledge of majors in Machine Manufacturing Technology. At the end of the course, the students must meet the basic requirements for technical skills, including:

- Set up technological process and manufacturing plan to create mechanical products.
- Manufacture, measure, test, evaluate and assemble mechanical products.
- Operate and maintain the mechanical production equipment.
- Direct, manage and operate the mechanical production process.

Therefore, in order to fulfill the above requirements, the students not only need to be trained about skills of manufacturing on cutting machines such as turning, milling, grinding, etc., but also need to be trained enough welding skill to perfect technical skills in the field of Machine Manufacturing Technology.

#### **2.3 The reality of welding skills training for students of Machine Manufacturing Technology at TNUT**

##### **2.3.1 About the structure and content of the curriculum**

- The structure of the training program: In fact, in the training of Machine Manufacturing Technology at TNUT, the knowledge block on welding has been included in 05 credits/ 150 credits of the training program (3%), in which the theory of welding is three credits and the welding practice is two credits.

- The training content: The current welding training content includes: The theoretical content is done in 4 hours, including the following contents: Occupational safety in mechanical processing; Concept of technology, tools, jigs in metal welding process; Equipment for manual arc welding, the MIG-MAG, TIG welding machines; basic welds and welding methods.

The practical content is done in 116 hours includes:

+ The general instructions (46 hours): Identify the structure of equipment, tools and jigs of metal welding; Manipulating, operating, processing on electric arc welding machine, MIG-MAG, TIG welding machines; Practice in butt welding, corner welding, fill welding; Organize the workplace.

+ The content of the welding skill training exercise includes: (1) Causing and maintaining the arc (2 hours); (2) T-angle welding by manual arc welding (8 hours); (3) Butt welding by semi-automatic MIG-MAG machine (4 hours); (4) Angle welding for stainless steel by TIG welding machine (8 hours); (5) Flat welding for steel plate S=10 by manual arc welding machine (24h); and (6) Shaft welding by manual arc welding machine (24h). The practical exercises are deployed according to the structure of the content: Analysis of drawings, processing sequence; Select welding machine, welding mode; the way to cause arc and maintain arc; The movement of the welding rod; Processing welds, welding posture; and machining detail inspection.

In fact, the basic welds that students have to practice include fillet welds, groove welds, and pipe welds in different positions in space (proximity, horizontal, vertical, ceiling) [1,2,3,5], shown in Figure 1.

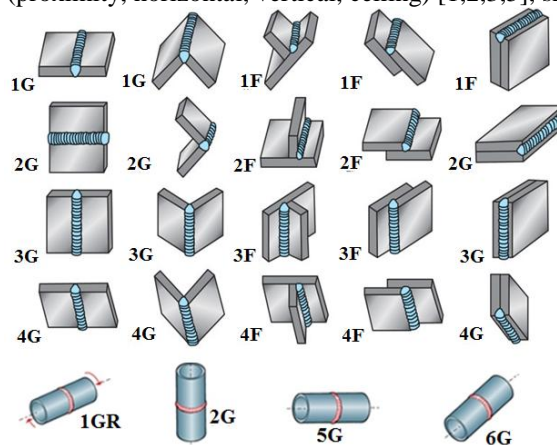


Figure 1. Basic weld types

In fact, the practical content of trained welding is mainly recognizing the structure of equipment, tools, and jigs of welding and manipulating, operating and processing on electric welding machines, MIG-MAG, TIG welding machines to perform butt welds, fillet welds and organize the welding workplace. In particular, the

content of pipe welding has not been put into practice. As we know, the pipe welding is an important and difficult welding technique in the field of welding [5]. This technique is widely applied in industries and construction such as welding oil pipelines, gas pipelines, welding rollers for conveyor belts, etc., with required weld quality. Therefore, the pipe welding skills should be considered as one of the necessary skills for a Machine Manufacturing Technology engineer and should be included in the vocational skills training program.

### 2.3.2 About training equipment

Currently, the welding equipment that is equipped for training for Machine Manufacturing Technology is still very limited. At the Experimental Center, there are currently 06 machines, including 05 manual arc welding machines and 01 MIG welding machine.

With the number of machines, the time that each learner can practice to practice skills is very limited (about 10 hours / 1 skill). However, to form a skill, the learners usually need to go through 4 basic stages including: (1) Learn - access to knowledge and skills such as theory, tools, ...; (2) Apply - apply learned knowledge to specific jobs (practice, receive suggestions, edit to perfect skills to a mature level); (3) Master (continue to sharpen skills); (4) Share (share, guide others to do the same). As we know, the welding skill is a complex skill. It is very difficult for student to form these skills with average of 10 hours to practice for a welding skill.

It can be seen that, with current equipment conditions, it is difficult to practice welding skills in general and the pipe welding skills in particular. Therefore, in addition to equipping machine tools, equipping welding equipment to serve the process of vocational skills training for the Machine Manufacturing Technology is really necessary and meaningful.

### 2.3.3 About training organization

Currently, the teachers often organize welding practice teaching process according to the following process: The teachers provides information, the students acquire knowledge and after that the students practice under the support of the teachers. This teaching model is shown in Figure 2.

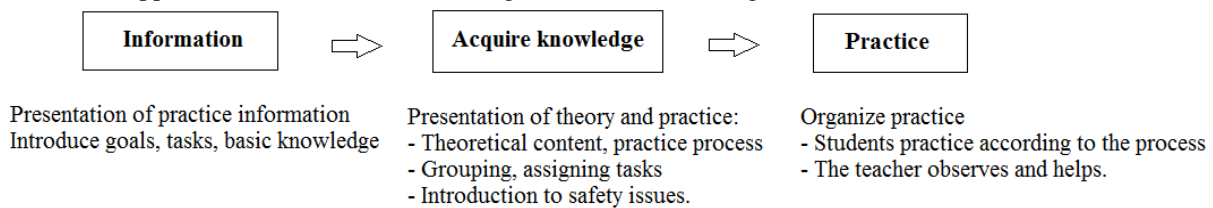


Figure 2. Practical teaching model

For example, when teaching the practice of T-angle welding by hand arc welding, the teacher organizes it with 3 stages:

+ Stage 1 provides instructions on drawing analysis, machining sequence, selection of welding machine, welding mode, creating the arc, maintaining the arc, creating the movement of the rod, welding wire, welding posture and measuring, checking the workpiece.

+ Stage 2: The teachers do modeling; the students observe, imitate; teachers check. In the third stage, the students practice under the supervision and guidance of teachers.

This teaching method helps students acquire practical manipulation procedures to form symbols and new skills. Therefore, it is not suitable for all welding practices very much. It can be considered appropriate at the stage of basic skill formation. On the other hand, the method easily makes students passive according to the of the teachers' knowledge and experience.

## 2.4 Solutions to improve welding skills and pipe welding skills for Machine Manufacturing Technology students at TNUT

### 2.4.1 About the structure and content of the training program

To enhance welding skills, besides practical contents such as creating and maintaining arcs, T-angle welding; butt welding; Angle welding of stainless steel by TIG welding machine, welding of sheet steel by hand arc welding machine and shaft welding by manual arc welding machine, the training program should add the practice content of pipe welding 1G, 1GR, 2G, 5G and 6G by manual arc welding machines, MIG, MAG, TIG welding machines. Moreover, the students also need to be trained in welding with many types of welding machines at many positions. It makes the students completely confident to adapt to the actual working environment when they graduate.

### 2.4.2 About training equipment

Besides the arc welding machine, it is necessary to equip more automatic and semi-automatic welding equipment so that students can practice skills in using a variety of welding equipment to process many types of parts. This will contribute to improving their vocational skills for students. One of the welding equipment that has been researched and created is a semi-automatic pipe welding machine (Figure 3).



Figure 3. The designed and manufactured welding equipment

When using this welding machine, the students can weld pipes manually or semi-automatically for many different pipe products, such as welding conveyor rollers for processing lines of wood, tea, etc. Figure 4 illustrates a conveyor tube welding product of a woodworking line. It is machined by the above designed and fabricated welding machine.

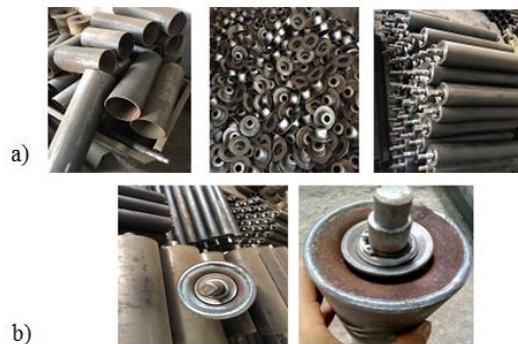


Figure 4. Workpieces and products to be welded with the manufactured welding machine

It can be seen that the students are practiced and participated in the production process, they will be reinforced in theory, form skills in a favorable and sustainable way. Therefore, they will be more mature and confident to develop their careers in the future.

#### 2.4.3 About welding training organization

In order to develop welding skills and further develop in learners cooperation ability, information acquisition ability, labor planning capacity, etc., we can use the following practical teaching model in the training process to form the pipe welding skill.

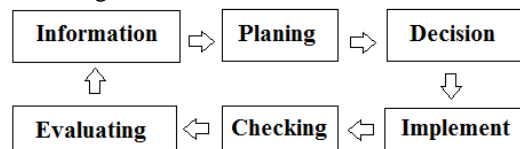


Figure 5. Model of teaching and practicing pipe welding

When applying this teaching model for practice content of the conveyor roller welding, we can do the following:

Step 1: Collect information. The students acquire independently information to know the content of pipe welding work (analysis of structure, function, working conditions of details and requirements of pipe welding).

Step 2: Make a working program. The students learn independently or collaborate in groups to make working plans for individual or working group.

Step 3: Exchange expertise with the teachers. The students exchange practical content (materials, welding modes, operations, techniques, types of defects, ...) with teachers to determine the way to complete the task, and prepare the means, equipment, condition for pipe welding.

Step 4: Perform the task. In this step, the students organize labor activities to perform individual or group tasks.

Step 5: Test and evaluate. Based on the requirements for pipe details, the students check and evaluate the level of task completion compared to the original requirements.

Step 6: Summarize the experience. The students discuss with teachers about the results achieved when welding pipes, identify strengths, weaknesses and the way to improve performance for the next process times.

It can be seen that this teaching model is suitable for pipe welding training because the students now have basic welding skills. On the other hand, when applying this model, the students have the opportunity to be independently and cooperatively solve learning tasks, thereby promoting the activeness and initiative of the students in the training process and perfecting basic skills for the engineers of Machine Manufacturing Technology.

### III. CONCLUSION

Welding and pipe welding is one of the important skills of a engineer of Machine Manufacturing Technology. To perfect these skills, we need to have synchronous solutions on the structure and content of the training program; equipping welding equipment, especially semi-automatic pipe welding equipment, and organizing the training according to the 6-step model to improve the students' thinking, creativity and adaptability.

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