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Assessment of the Effectiveness of an Aid for the Development of the Kinetic Skills Required for T.I.G. Welding

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Title
"Assessment of the effectiveness of an aid for the development of the kinetic skills required for T.I.G. welding"

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Abstract

This action research project was carried out in the Dublin Institute of Technology, Ireland. The authors are both Lecturers of Engineering in this college and have a keen interest in providing the best possible aids to their students learning. Three groups of engineering apprentices and one group of part time students took part in this project. At the time these students were taking a third level Tungsten Inert Gas welding (T.I.G.) training module. Qualified T.I.G. welders are in very high demand worldwide and as such can demand a very high rate of pay for their services. The kinetic skills applicable to this discipline relate to the close control of the movement of the hands, arms, head and upper body of the student during the T.I.G. welding process. The authors were keen to provide additional help to the many students who struggled to master these skills. The students who took part in this project tested and provided feedback on a device which was developed by the authors. The purpose of this device was to aid the students to understand and appreciate the specific set of kinetic skills required for the successful completion of the T.I.G. welding module. It was anticipated that the device, in addition to helping the students to develop their kinetic awareness would reduce the cost of delivering the module by reducing the quantity of consumable resources such as electricity, and welding gas required to train the students to the required international standard. A quantitative survey was completed and the analysis of the data gathered provides an interesting insight into the impact on the learning of the participants and also the potential of the device to reduce the cost of delivering the module.

Keyword: Kinetic Skills, Welding skills, Innovative cost savings in Technical Training.

1 INTRODUCTION

At the time of writing, and for the preceding five years, Ireland has been in the grip of the worst economic recession in its recent history. It is well documented that, for many years leading up to this recession there had been an over focus on the construction industry. High rates of pay in this industry attracted many students who would have traditionally have sought education and training in manufacturing specific skills. The collapse of the construction industry in 2008 left Ireland with a considerable skills shortage in these skills which are essential for its economic recovery [1]. The skill of tungsten inert gas (TIG) welding is one of those manufacturing relayed skills and the training for it is the focus of paper. Demand for training in this field is currently at an all time high. However the funding available for the delivery of this training has been reduced considerably as a result of Ireland's financial dilemma. As indicated earlier, the authors are both Lecturers in the Dublin Institute of Technology Ireland, (DIT) and are involved in the delivery of a third level Tungsten Inert Gas welding (T.I.G.) training module to Sheet Metalwork, Metal Fabrication, and Manufacturing and Maintenance Fitter Apprentices in addition to undergraduate Engineering Students. This skill is an essential to the development of growth industries such as food processing, tool making and pharmaceutical-chemical production [1]. This scenario inspired the author to develop a task specific teaching aid with two aims in mind.

1. To speed up the time required for the development of the kinetic skills applicable to this discipline. These relate to the close control of the movement of the hands, arms, head and upper body of the student during the T.I.G. welding process.

2. To reduce the cost of the delivery of the TIG welding module.

The most significant costs associated with the delivery of this module include the purchase of electricity, metal work-pieces and of consumables such as Tungsten Electrodes and Argon Shielding Gas. It was the considered opinion of the authors that less of these would be used if the students could develop the essential kinetic skills before being permitted to attempt an actual weld.

One requirement of the TIG welding process is that the tungsten electrode, which is housed in a hand held torch, is held close to the work-piece prior to the electric arc being initiated. Once the arc has been initiated the tungsten must be moved along the joint. There is a very limited range permitted for the proximity of the tungsten to the work-piece (this distance is known as the "Arc Length") for the successful completion of a TIG weld. A weld defect occurs if the tungsten is allowed to get too close to, or come in contact with the work-piece. Should this occur the tungsten electrode must be removed, ground down to remove impurities, and then replaced. In this scenario, the contaminated work-piece would require considerable rework or possibly or may even be disposed of. In addition to being a frustrating process which takes valuable time. It wastes expensive metal, Argon Shielding Gas and as the tungsten electrode shortens each time it is ground, it eventually gets too short to be used, calling for its replacement. Similarly, if the Arc Length is allowed to get too long, a weld defect will occur.

The device developed by the authors, allows the student to practice the kinetic elements of the skill set required reducing the incidents of the errors detailed above.

2 THE SIMULATION DEVICE

The simulator devise was designed to suit the specific weld standard test piece called G6 illustrated in figure 1 below. Turning of the pipe during the TIG welding process is not permitted.

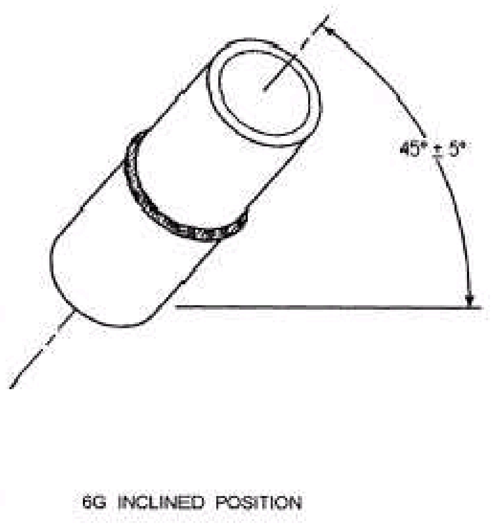

Fig1.

The fact that the pipe may not be turned means that welder must stop welding and reposition themselves four times before the weld can be completed.

This requirement was considered in the design of the unit, as was the need for a method of altering the student if the mock tungsten made

a. Made contact with the work piece.
b. Was too great a distance from the work piece, In other words, the arc length was too long.
c. Was out of alignment with the joint being welded.

The authors arrived at the design illustrated in figure 2.

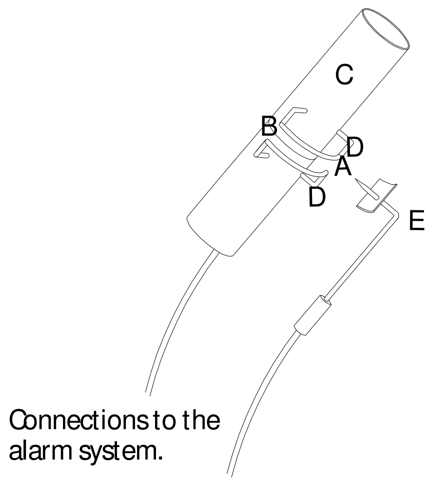

Fig2.

The operation of the simulator device requires the student to move the torch E from point A to B without touching the pipe C or the frames D. The plate on the torch must be between the frame and the pipe.

This task must be completed with the device in four different positions as illustrated in figure 3.The kinetic skills required to complete this task, match exactly those required to TIG weld in the 6G position correctly. If the torch does come in contact with the frame or the pipe, a buzzer sounds and the student must return to the start. Not until the student is capable of completing this task, are they permitted to attempt to carry out an actual TIG weld.

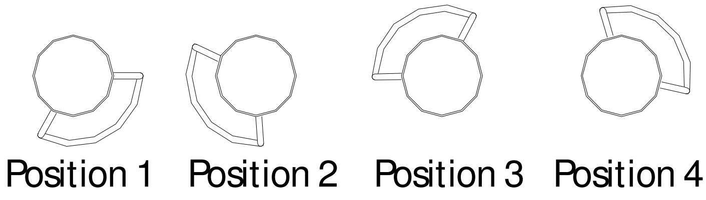

Fig3.

The device illustrated in figure 4, was manufactured by the authors using the facilities in the DIT. The components required for the manufacture of the device which were of relatively low cost and were funded by the DIT and the author.

Fig4.

3 RESEARCH METHODOLOGY

This research has been carried out from the position of one with a pragmatic world view. Pragmatists focus on the research question and allow it to inform the procedures, methods and techniques of the research that best meet their needs and purposes. Creswell, (*2009*) [2].Having reflected on the approaches we were taking to teaching the very complex kinetic skills required for TIG welding the authors who have decades of experience in teaching this skill, decided that the action research approach was best suited to the research methodology for this project. Revans, (1980) [3] argues that,

"The clever man will tell you what he knows; he may even try to explain it to you. The wise man encourages you to discover it for yourself, even though he knows it inside out."

There are many difference types of action research. Henn (2010) [5]. Generally it can be described as an approach taken by a researcher are a team of researchers, in a social setting to the collaboration in the diagnosis of a problem and in the development of a solution based on the diagnosis. Bryman (2012) [4]

3.1 The Participants and Survey

Three groups of engineering apprentices and one group of part time students working towards a specific TIG welding qualification took part in this project. An anonymous self completion questionnaire was generated and used to collect the data from the participants. The students were requested the answer the questions with a rating on a scale of one to five. The following are some of the ten questions posed in the questionnaire.

Please rate the following from 1 to 5

	1	2	3	4	5
A. Clarity of the instructions for the use of the device.	☐	☐	☐	☐	☐
B. Ease of use of the device.	☐	☐	☐	☐	☐
C. Simulation of the device to actual TIG welding.	☐	☐	☐	☐	☐
D. Effectiveness of the device as an aid to the development of the Kinetic skills required for TIG welding.	☐	☐	☐	☐	☐

The DIT ethical guidelines were strictly adhered to for the duration of this project. All participants volunteered to take part and their identities were fully protected.

The fifty participants used the device over a period of six weeks during the second semester of the 2012/13 academic year. The students completed the questionnaire on completion of the six week period after which, data was gathered and subjected to qualitative data analysis.

4 ANALYSIS AND FINDINGS OF THE DATA

The fifty participants used the device over a period of six weeks during the second semester of the 2012/13 academic year. The students completed the questionnaire on completion of the six week period after which, data was gathered and subjected to qualitative data analysis. All fifty of the questionnaires were usable which meant that the findings could be displayed a percentage. The findings provided an interesting insight into the opinions of the participants. Some of these are illustrated in figure 5.

85%	Scored the clarity of the instructions for the use of the device at 4 or Higher
87%	Scored the ease of use of the device 4 or Higher.
80%	Scored the Simulation of the device to actual TIG welding at 4 or higher.
82%	Scored the effectiveness of the device as an aid to the development of the Kinetic skills required for TIG welding at 4 or higher.

Fig5.

Cost savings

There was an estimated overall financial saving of 20% generated on the purchases of welding consumables, by having the students use the device to perfect the kinetic skills prior to allowing them to start actual TIG welds.

Conclusions.

The authors considered the project to be a considerable success, the device met its expectations by helping the students with the development of their kinetic skills, by reducing costs and by helping to reduce the amount of frustration experienced by the students when they made an error. The effectiveness of the device and the potential cost saving cost savings generated by using it are likely to result in it development as a marketable teaching aid in the future.

References.

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