2013-03-04

Online Resource Aiding Students to Practice and Perfect Manufacturing Based Skills

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Recommended Citation

Morris, R., Dunne, F., Collins, M., Online Resourse Aiding Students to Practice and Perfect Manufacturing Based Skills. *7th International Technology, Education and Development Conference* Valencia, Spain. 4-5 March, 2013.

Funder: NDLR National Digital Media Resources

TITLE

ONLINE RESOURSE AIDING STUDENTS TO PRACTICE AND PERFECT MANUFACTURING BASED SKILLS

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Abstract

As part of our teaching in the Departments of Fabrication and Transport Engineering in the Dublin Institute of Technology we use industrial metal folding machines to help students to learn the sequencing of folds on manufactured sheet metal components. Many students have difficulty visualising the folding sequences required to complete practical manufacturing assignments. This paper details the digital media resource which was developed to provide students with the opportunity to offer a proposed solution to questions which relate to the folding sequence required for these components. Feedback is provided through the medium of pre recorded videos which show the component being folded using the folding sequence the student has suggested. If the folding sequence the student has suggested is correct they are guided to a video which shows the successful folding of the component. If the folding sequence the student has suggested is incorrect they are guided to video which highlights the errors and provides guidance of on the criteria for the selection of the correct bend sequence. The students can access this resource at any time to practice and perfect their ability to sequence folds correctly. A student survey was carried out and the data was analyzed. Detailed in the Paper are the findings and recommendations which arose from the student Survey.

Keywords: Online Resource, Manufacturing based Skills, Practical Manufacturing Assignments.

1 INTRODUCTION AND RESEARCH METHODOLOGY

This paper outlines a small scale case study research project for which an action research approach was adopted. Funding for this project was provided By the Irish National Digital Learning Resources (NDLR) [8].The research was conducted in the Departments of Fabrication and Transport Engineering In the Dublin Institute of Technology Ireland. The case in relating to this project is addressing the learning needs of a group on students who have limited access to specialist manufacturing equipment which is essential to their learning. Henn et al, (2010) [1]. Suggest that cases are units of investigation, individuals, communities, groups. Stake, (1995) [2] does not see the case study as a method, but suggests that some research methods inform the case, he offers that, Case is not the method, it is the object of study. Yin, (2009) [3] holds the view that, a case study is an empirical study that investigates a contemporary phenomenon in depth and with its real life context. This project originated out of an informal discussion between the three authors, we were exploring the possibility of increasing the access for our engineering students to industrial folding machines. We are all involved in the delivery of practical metal fabrication modules on engineering degrees programs. It was our considered opinion that increased access to the folding machine would improve the students' performance in solving a specific set of written assessment questions. Unfortunately, it was not possible to arrange the additional access to the machines, so a decision was made to explore an alternative additional resource to aid the students who struggled with these questions. These questions relate to the sequencing of the folding of sheet metal manufactured components.

While considering our task we identified that it is strongly recognised in higher education research that students in higher education must develop the practice of engaging in independent self directed learning in order to succeed in their studies and later in their working lives. Tinto, (1993); Upcraft et al (1989) [4]. It was decided that we would develop a web based aid to supplement the students learning. The online digital resource developed as part of this project provides the students with the opportunity to engage in self directed learning. The students can access this resource at their convenience, as there a time limit is not set they are facilitated to learn at their own pace.
The resource provides the students with clear constructive feedback. Repeated use of the resource has resulted in a measurable increase in the students understanding of the folding process and an improvement in their ability to sequence folds correctly. The process of sequencing the folds on manufactured sheet-metal components and how the students' knowledge of this process is assessed is explained in Section 2.

2 THE LEARNING OUTCOME.

In order to understand the importance for the students of the learning outcome measured during this project, some explanation is necessary. The teaching of the skill of correctly sequencing folds on manufactured sheet metal components is delivered to students as part of fabrication modules. The teaching methodology currently used for this task is demonstration and supervised hands-on practical workshop/laboratory sessions. During these sessions the students learn to produce sheet metal components to detailed specifications provided on technical drawings. The final stage of the production of the components requires the component to be folded on an industrial folding machine. Failure to order the folds on the component correctly renders it unusable for its intended task. Economical use of materials and machine production time is of crucial importance in modern manufacturing industries. An example of a manufactured sheet metal component would be the front panel on a filing cabinet drawer. Prior to being folded the component is flat and has notches in the four corners. Due to the limitations of the folding machines design, if the edges are not folded in the correct order it will not be possible to position the part so as to perform the subsequent fold.

The process of folding sheet metal using industrial folding machines commonly known as "Press Breaks", involves the work-piece being pressed between a top punch tool and bottom "V" die tool. The three stages of a single fold and a before and after image are detailed in Figure 1.

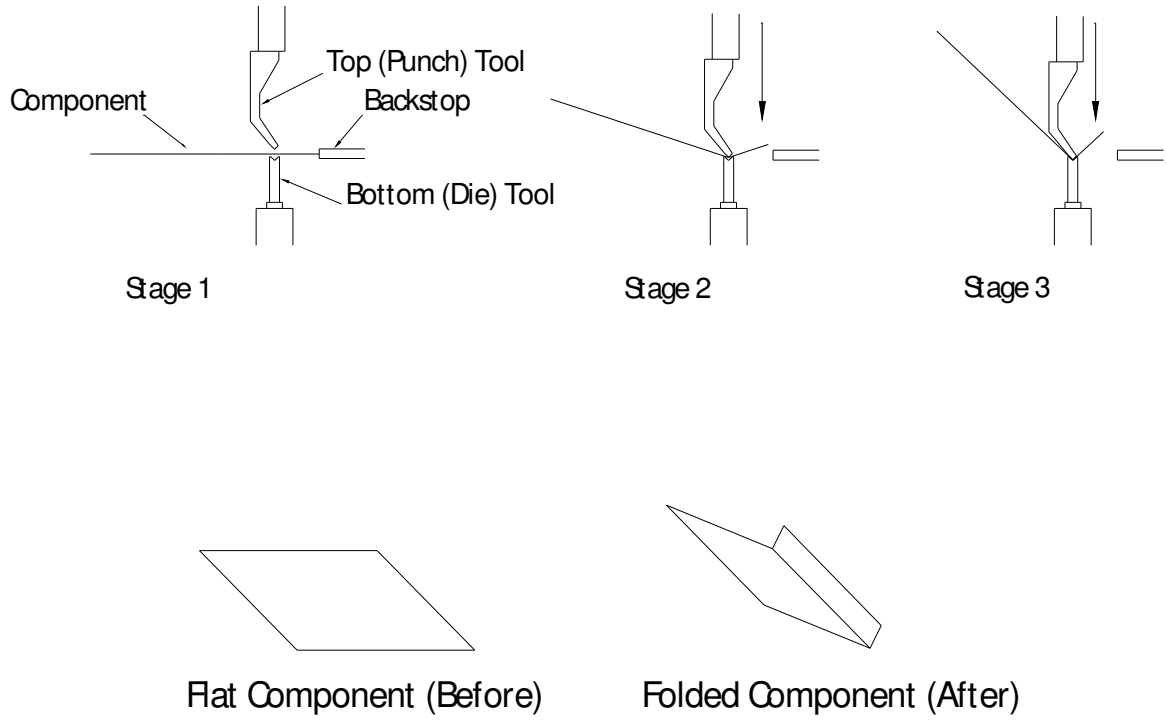
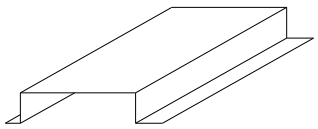


Figure 1.

The component on which the student is assessed is detailed in Figure 2 below. There are a total of four folds required on the part, as mentioned earlier these folds must be conducted in the correct sequence for the successful completion of the task.



Component with four folds complete.

Figure 2.

There are software packages such as LVD Cadman B3D [5] which allow the sequencing of the folds to be proofed using virtual modelling. These have been developed due to difficulties experienced by manufactures in the sequencing of folds correctly and the wasteful and time consuming consequences of incorrect fold sequencing. These packages are a very useful tool, however they can be expensive and not all manufacturers or engineering educators can afford them, hence the need for the student to learn this important skill. The task requires the student to conceptualise each fold in sequence and to identify and list fold sequences which can be completed successfully. For example the correct fold sequence for the component in Figure 2 is illustrated in Figure 3.

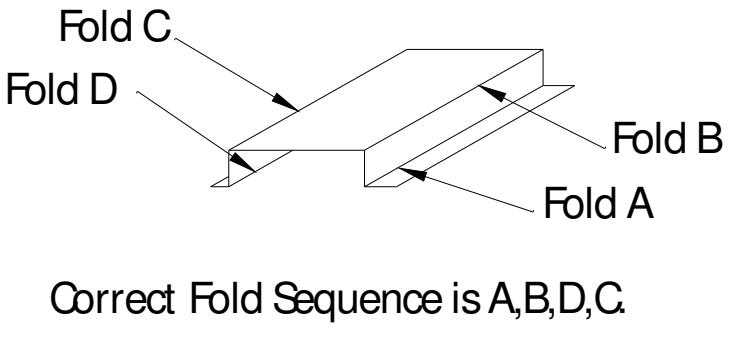


Figure 3.

If the student attempted to use the fold sequence A, B, C, D. Fold D could not be achieved since the part could not be positioned correctly as illustrated in Figure 4 below.

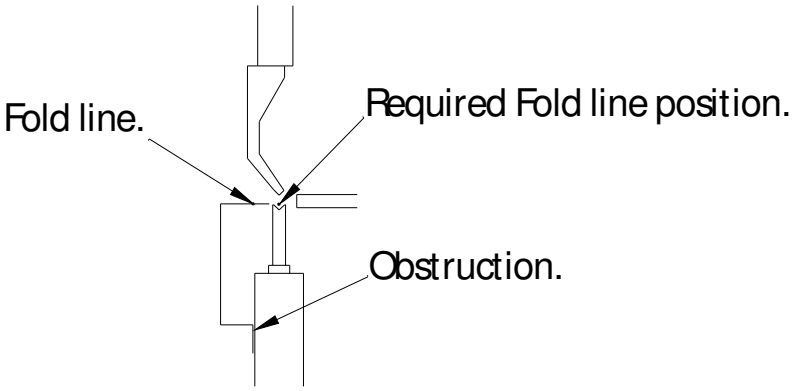


Figure 4.

As access to the industrial folding machine used for this task is limited to a single user for a short period of time it was decided that online resource which gave the students an opportunity to verify their fold sequence selections would be of considerable benefit. Through this resource the students are provided with feedback in the form of a video of the part being folded using the fold sequence they have selected. A Facebook account named Folding Tutorial [7] was set up for this purpose, a variety of problems were made available to those wishing to engage. The students made a selection from the multiple choice fold sequences solutions. Each solution directed them to start of a pre recorded video showing the part being folded using the fold sequence solution they have selected. Regardless of whether they have selected the correct sequence or not they were provided with instant feedback. If they selected an incorrect folding sequence they were advised in the video, of the reason why their selection did not work.

3 THE STUDENT SURVEY

To assess the effectiveness of this resource as an aid to the students learning, twenty engineering students who took the fabrication module in question were surveyed. All ethical issues were addressed in line with Dublin Institute of Technology guidelines [6]. The participants partook of their own free will and were afforded total anonymity. A quantitative approach was adopted for the collection of the data for his project. A survey was generated with questions set out under a variety of headings relating to the students learning, ease of use, clarity of information and the variety depth of coverage of the questions posed. Students were requested to give ratings out five for their satisfaction relating to elements under each heading. Data was gathered under these headings and was subjected to quantitative analysis as detailed in Figure 9.

4 FINDINGS AND RECOMMENDATIONS

4.1 Findings

A high percentage (90%) of the participants found the resource to be very beneficial to their learning of the topic. Many had accessed it regularly and often from home. The effectiveness of the resource as a learning aid was reflected in the assessment results after a 15% improvement in overall scores was recorded. Many participants expressed the view that it would be helpful if the there were a greater variety of questions available to select from. Some participants indicated that they would benefit from the availability of a similar resource which dealt with the setting of the backstop on the folding machine which another subject in the fabrication module.

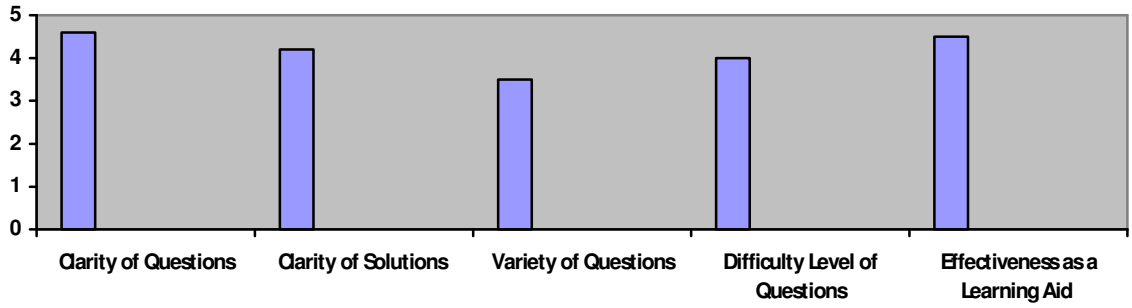


Figure 9.

4.2 Recommendations

Taking onboard the findings it is planned to increase the volume and variety of questions available on the resource. As the recording of large quantities of short videos is very time consuming it would be necessary to secure the assistance of professional video recording service providers. Consideration is also being given to the request for a similar resource which deals with the setting of the backstop on the folding machine which another subject in the fabrication module.

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