

DESIGN AND IMPLEMENTATION OF SCORING RUBRICS FOR THE INDUSTRIAL TECHNOLOGY PROGRAMS

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Abstract

The process of assessment is to measure student performance. Industrial technology professors need to make sure that the assignments are scored as objectively as possible when evaluating a project. A rubric helps to set clear expectations and defines the quality of work for a given project. Descriptive scoring schemes have become a common method for evaluating course content [1,2]. The descriptive scale supports the evaluation of the criteria set for each project. The focus of this paper is the design and implementation of scoring rubric models for industrial technology programs. The major points of this paper include identifying common definitions of assessment, identifying specific observable attributes in evaluating student performance, defining and brainstorming characteristics that describe each attribute, and the designing and implementation of scoring rubrics for industrial technology courses. The following steps are involved in developing scoring rubrics: defining and listing learning objectives for industrial technology courses, identifying the specific attributes that students should demonstrate in their performance, identifying each attribute and its characteristics, and identifying the excellent and poor quality work using narrative descriptive criteria. Holistic rubrics and analytical rubrics are the most common types of rubrics used to measure students' understanding of course content. Holistic rubrics provide a choice to state the highest and lowest levels of performance combining the descriptors for all attributes and analytical rubrics state the highest and lowest levels of performance using the descriptions for each attribute separately [3,4]. The use of rubrics allows the instructor to provide quality feed back to the student along with providing evaluation and reflection opportunities for an instructor as well. The use of rubrics in industrial technology program will provide accountability and evaluation that is beneficial to both students and the department.

1. Introduction

Designing a valuable assessment to measure students' understanding of course content is both challenging and complicated, especially if designed prior to establishing clear course objectives, goals, and expectations. The purpose of assessments is to reinforce the accountability of both the student and instructor. This gives the student an opportunity to demonstrate their full potential, capacity, and ability to internalize, process, and apply the presented course content. Furthermore, the instructor has provided an opportunity to process results and determine student strengths and weaknesses within the course. This is a beneficial instrument to generate purposeful feedback for students to recognize their misconceptions and reconceptualize these deficiencies within the course content. At the same time, instructors reevaluate their educational

techniques and improve their effectiveness, to better steer students away from common misconceptions. The industrial technology professors can take this evaluation piece a step further by incorporating the rubric.

The purpose of the rubric is to outline the assessment's expectations with required course related details. Typically, a rubric assigns a score range based on student performance of outlined expectations. Curriculum experts believe that educators who design rubrics will be more effective educators [4]. Professors will be compelled during the evaluation process to think meticulously about generating successful student outcomes. The industrial technology professors know what they are going to teach, facilitate, and evaluate to ensure students benefit from their courses. Incorporating scoring rubrics to industrial technology course assessments are one way to evaluate student's responses to performance assessments. Both analytical and holistic scoring rubrics can be used to evaluate industrial technology courses. Once the performance assessments, with accompanying scoring rubrics are designed, the coursework objectives are facilitated, to prepare students for the upcoming assessment administered. Utilizing rubrics increases both instructors' and students' accountability for student learning with the accountability of the program. The industrial technology program is required by the professional accrediting agencies to prepare students for the professional careers. Designing and implementing a systematic industrial technology course evaluation is beneficial to students and industrial technology departments.

2. Scoring Rubrics

Educators design the scoring rubric with a descriptive format that evaluates and determines the students' performance based on required criteria to meet course content goals. Scoring rubrics will define the required effort, quality, and judgment necessary to master course objectives. Foundational skills and content knowledge are required to create a toolpath for the CAD/CAM process [5]. This performance objective can be evaluated using scoring rubrics. The score ranges are based on descriptive scales that reflect the students' mastery level of the set criteria. Rubrics provide two benefits in the evaluation process of a course. First, they support the degree of accomplishments and the extent to which specific criteria has been mastered. Second, they provide feedback to students with suggestions to improve on their performance.

2.1 Different Types of Scoring Rubrics

Several different types of scoring rubrics are available. Two widely used types of rubrics are analytical and holistic. Holistic rubrics are appropriate when there is no one specific answer for the project. Holistic scoring rubrics support broader judgments concerning the quality of the process or product. The ability to use layers to create geometry for each available toolpath is an example of a holistic scoring rubric. Analytical rubrics provide more information than holistic rubrics. Analytical rubrics can be used by industrial technology departments in assessing a student's skill in completing a project. For example, the students are required to understand and achieve mastery to create and edit geometry for the purpose of toolpath creation. Then apply different toolpaths to create a part and correctly use tool parameters. An analytical rubric defines the skill needed for each part of CAD/CAM process. The holistic rubric does not list separate levels of performance for each criterion. Instead it provides a level of mastery across multiple criteria as whole [1,3]

2.2 Developing Scoring Rubrics

The first step in developing a scoring rubric is to identify the technical skills and content knowledge necessary to assess student proficiency on course objectives. Next we evaluate the desired outcome from the assessment and determine to use analytical or holistic scoring rubrics. Both the top level performance and lowest level of performance criteria should be defined by the evaluator. The contrast between the top level performance criterion and bottom level performance criterion will help to write the criterion for middle level performance. The following steps involved to develop scoring rubrics:

1. Define and list learning objectives for a technical course.
2. Identify the specific attributes that students should demonstrate in their performance.
3. Identify each attribute and its characteristics.
4. Identify excellent versus poor work using narrative descriptive criteria.
5. For holistic rubrics, state the highest and lowest levels of performance combining the descriptors for all attributes.
6. For analytical rubrics, state the highest and lowest levels of performance using the descriptions for each attribute separately.
7. Collect student work and record the results.
8. Update and revise the rubric as necessary.

Holistic Scoring Rubric

Generating Toolpath Using CAD/CAM System

4 Points

Toolpath is correct and functional contains a drawing with different layers and needed parameters and verifies perfectly. Consistently does all of the following:

- All available toolpaths including contour, face, pocket, drill and island is used in the geometry.
- Layers are used for each individual toolpath at a time.
- All sections of the geometry are enclosed and if lines are intersecting they have been placed on different layers.
- Tool parameters and toolpath parameters are set correctly.
- Tool used in generating the toolpath model is selected correctly and it results in generating the toolpath model without any overcuts caused by selecting the wrong size cutter.

3 Points

Toolpath is correct and functional contains a drawing with different layers and needed parameters and verifies perfectly. Consistently does all of the following:

- Only contour, face, pocket and drill are used in the geometry. Island function is not used in the toolpath.
- Layers are used for each individual toolpath at a time.
- All sections of the geometry are enclosed and if lines are intersecting they have

<p>been placed on different layers.</p> <ul style="list-style-type: none"> • Tool parameters and toolpath parameters are set correctly. • Tool used in generating the toolpath model is selected correctly and it results in generating the toolpath model without any overcuts caused by selecting the wrong size cutter.
<p>2 Points</p> <p>Toolpath is correct and functional but geometry does not contain different layers. Does most or many of the following:</p> <ul style="list-style-type: none"> • Layers are not used for each individual toolpath at a time. • All sections of the geometry are enclosed and are drawn on the same layer. • Geometry is simple and one or two available toolpath is used. • Selected tool size from the library is incorrect and produces a toolpath model which has overcuts.
<p>1 Point</p> <p>The toolpath is simple and functional. Consistently does all of the following.</p> <ul style="list-style-type: none"> • Geometry is simple and some lines overlap other lines, so toolpath cannot be created for section of the geometry. • Tool parameters and toolpath parameters are not set correctly. • Toolpath generates an error message when it is verified. • The geometry and the toolpath parameter need to be edited before it can be verified.

Figure 1: Holistic Scoring Rubric for CAD/CAM Process

Analytical Scoring Rubric					
Generating Toolpath on a CAD/CAM System					
Criteria	Beginning 1	Developing 2	Accomplished 3	Exemplary 4	Score
Understanding how to create geometry, editing geometry and be able to use layers in the geometry.	Only simple geometry is used. Geometry contains lines, arcs and fillet geometry is drawn on a single layer.	Simple geometry with different sections is drawn on the same layer the geometry is correct and functional.	Geometry is complex the layer function is used to avoid overlap between different parts of drawing geometry is correct and functional.	Geometry is complex and multi level, different layers are used for each toolpath function toolpath verify correctly and generates a complex part.	
Understanding of all possible toolpaths including contour,	The finished part is simple tool retraction is not used. One or two of	The part is simple all toolpaths have the same	The part is complex all toolpaths are created at the same level not	The part is a complex shape all available toolpaths are combined to	

pocket, island, drill and face assigned to each layer.	available toolpaths are used.	elevations; all toolpaths are used but not the island.	all available toolpaths are used.	create a 3D multi level part.	
Correct use of tools, tool parameters, toolpath parameters are used, which together are applied to generate a toolpath model when program is verified.	Only toolpath parameter including feed rate, spindle speed, plunge rate and depth of cut is set by the operator the rest of the parameters are at default value.	Parameters including feed rate, spindle speed, plunge rate and depth of cut is set by the operator; machine direction cutting method and step over distance are not set correctly.	Parameters including feed rate, spindle speed, plunge rate and depth of cut is set by the operator, machine direction cutting method is set correctly, and only rough machining parameter is used.	Parameters including feed rate, spindle speed, plunge rate, retract rate and depth of cut is set correctly. Machine direction, cutting methods and step over distance are also set correctly.	
Toolpath generation skills and part generation complexity is evident.	Only contour or drill toolpath is used. One single cutter is used for the whole operation to create a simple part.	More than one available toolpath is used, a drill and an end mill is used to generate a part.	Toolpath is generated using different toolpath options using different cutters at different elevation to generate a functional part.	All available toolpath options including the island are used to create a complex part using multi cutters with different depth of cut.	

Figure 2: Analytical Scoring Rubric for CAD/CAM Process

3. Conclusion

An informative assessment is the process of measuring educational effectiveness with comparisons to a set of standards, goals and objectives. Scoring rubrics use a descriptive scoring format that develops a common thread for evaluation process of industrial technology courses. Rubrics are a motivating tool for students, feeding them the necessary confidence to meet required expectations outlined within the mastery levels. The feedback encourages students to inquire why they received the score they earned and improve their overall performance.

References

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