MAXIMIZING EDUCATIONAL QUALITY FOR INDUSTRY APPLICATIONS: HARNESSING RUBRICS FOR PROGRAM OUTCOME ACHIEVEMENT

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Abstract:
This study explores the effectiveness of rubrics as a valuable assessment tool in fostering quality education for industry applications within higher education institutions. Rubrics, comprising four fundamental steps, serve as structured frameworks for evaluating student performance and promoting self-assessment to achieve high academic standards. The implementation of rubrics provides ample opportunities for low-performing students to enhance their performance by adhering to the rubric's indicators. The case study mentioned in this paper, which applies rubrics to a major project, states that the performance of the group familiar with rubrics has obtained 70% to 90% marks, which means 30% to 50% higher marks than the group unfamiliar with the rubrics. Rubrics extend beyond project assessment to encompass lab assignments, presentations, oral exams, and co-curricular activities, fostering peer learning through collaborative assessment processes. While rubrics contribute to maintaining academic excellence, ensuring evaluation consistency, and identifying areas for improvement, challenges such as time intensiveness and subjectivity require careful consideration. Overall, the strategic adoption of rubrics enhances educational quality for industry applications within higher education, empowering institutions to excel in achieving program outcomes.
Key words: Rubrics, Higher Education, Program outcome, Peer Group learning, industry-relevant skills

I.Introduction

A rubric serves as both a learning and assessment instrument, outlining the expected criteria and levels of achievement for a particular performance, comprehension, or conduct. It is a valuable tool for grading students' assignments, enabling faster and more consistent evaluation while reducing potential bias. By sharing the rubric with students beforehand, it ensures that they understand what is required of them for the assignment. Furthermore, it provides an opportunity to check that the assignment aligns with the intended learning outcomes and allows for adjustments to the assignment prompt, as necessary (Suskie L 2009).

Rubrics contain four essential features which includes (Mitchell 2006):

• A task description or a title that accurately describes the activity or assignment students is required to produce or perform.

• A rating scale with corresponding scores that indicate the level of proficiency necessary for each component of the task, such as exceeding expectations, meeting expectations, or failing to meet expectations.

• Components or dimensions that specify the skills, knowledge, or other aspects that student must consider when completing the task.

• Performance descriptors that describe the quality of performance for each component or dimension at each level of mastery (Andrade 2000).

A rubric is a tool used to assess students' learning progress and measure their achievement of predetermined criteria or learning standards. Rubrics are designed to establish clear academic expectations or objectives for students, ensuring consistency in evaluation from student to student, assignment to assignment, or course to course. Rubrics typically include the educational purpose of

an assignment, specific criteria or learning objectives that students must meet, and the quality standards used to evaluate student work.

Rubrics may be explained to students at the beginning of an assignment to ensure that learning standards are understood. They may be designed in various forms, including numerical scoring or descriptive language to establish the standards students need to meet. Rubrics can help students see connections between learning and assessment, as feedback becomes clearer, more detailed, and more useful. Rubrics may also encourage students to reflect on their own learning progress and help teachers tailor instruction, academic support, or future assignments to address distinct learning needs or gaps.

Rubrics may be locally designed by a district or school or provided by outside organizations as part of a specific program or improvement model. In some cases, common rubrics or assessments may be collaboratively developed by a school faculty, academic department, or team to promote greater consistency in teaching or assessing learning throughout a school. Common rubrics can also help schools refine their lessons and instructional practices to target specific learning areas in which their students tend to struggle.

Rubrics are designed to be straightforward, clear, and easily understandable by students. They can be used to help students see the connections between what they are learning and how their work will be evaluated. By providing detailed and specific feedback, rubrics can help students identify what they have learned and what they still need to work on. Teachers can use rubrics during the course of an assignment to help students assess their progress and identify areas where they need to improve before submitting their final work. Rubrics can also encourage students to reflect on their own learning and help teachers to adapt their instruction and support to meet individual learning needs.

In some cases, students are involved in co-creating rubrics for class projects or for evaluating their own or their peers' work. Rubrics are also used by school leaders and teachers to maintain consistency and objectivity in teaching and assessing learning across grade levels, courses, or assignments. Schools may use common rubrics or assessments to promote consistency and help teachers to refine their lessons and instructional practices. Common rubrics are often collaboratively developed by a school faculty, academic department, or team, and can be used across academic subjects or disciplines. Rubrics can be locally designed by a district or school, or may be provided by external organizations as part of a specific program or improvement model (The Glossary of Education Reforms- Rubric 2013).

Recent developments in the use of rubrics for industry-aligned learning have emphasized several key themes. Bjorklund (Bjorklund 2020) explores the application of rubrics in project-based engineering education, highlighting their role in promoting student agency by granting learners greater autonomy and control over their educational journey. Dolen and Sun et. al (Dolen and Sun 2019) focus on the development of industry-driven rubrics tailored to assess engineering students' problem-solving skills, ensuring alignment with real-world expectations and demands. Hodges et al. (Hodges 2021) discuss the importance of aligning student learning outcomes with assessment practices targeting industry-relevant skills in technology education, with rubrics serving as essential tools in achieving this alignment. Additionally, Knight and Yorke (Knight 2017) emphasize the significance of assessment practices that enhance student employability, underscoring the role rubrics can play in facilitating this preparation for the workplace. Finally, O'Neill and McCormick (O'Neill 2020) advocate for the design of authentic assessment tasks reflecting actual workplace scenarios, with rubrics serving as effective evaluation tools to gauge student achievement of industry-relevant competencies. Together, these recent developments underscore the critical role of rubrics in fostering industry-aligned learning and preparing students for success in the professional sphere.

II.Rubrics aligning rubrics with industry-relevant skills

Rubrics serve as multidimensional assessment tools that provide specific guidelines for scoring, ensuring consistency in evaluating student work across various disciplines. Particularly in higher

education, such as engineering colleges, pharmacy colleges, and management studies, rubrics play a pivotal role in assessing assignments, internships, projects, lab assignments, oral exams, and presentations on multiple dimensions. They create a transparent environment where students can assess their own performance and provide instructors with a structured support system to elevate students' work to the desired standard.

By clearly delineating expectations, rubrics offer informative feedback to students, aiding their understanding of performance criteria and grading. Moreover, rubrics facilitate standardization of grading, contributing to fair and equitable assessment practices. Furthermore, rubrics encourage instructors to reflect on standards and outcomes for students, promoting self-directed learning and fostering peer learning mechanisms. This aligns with the findings of Hodges, Lange, and Hodges (Hodges 2021), who discuss the importance of aligning rubrics with industry-relevant skills in technology education. Their work underscores the significance of incorporating rubrics that reflect real-world expectations, enhancing students' readiness for the demands of the industry. Overall, rubrics serve as invaluable tools in higher education, promoting transparency, consistency, and the development of industry-relevant skills among students (Lucas, 2008).

III.Design procedure of Rubrics

Rubrics can generally be divided into four basic components. The first step is to clearly identify and describe the task that is being evaluated. Then, the task should be categorized and divided into four basic rubric components, as illustrated in Figure 1.

3.1 Simply the rubric includes

1. Design the learning outcomes

In order to design a rubric, it is important to frame the learning outcomes based on the actual expectations from students. These learning outcomes should be designed to support both students and teachers in measuring and assessing student performance.

2. Define required criteria

The objective of designing criteria for a rubric should be to support students in demonstrating proficiency in completing assignments (Allen Deborah and Kimberly 2006).

The desired learning outcomes should be aligned with the categories included in the rubric. For instance, if the objective is to assess the ability of engineering students to solve problems, the rubric should include categories such as understanding the problem, formulating the correct approach, steps of the problem-solving process, written communication skills, accurate calculations, and correct answers up to two decimal places.
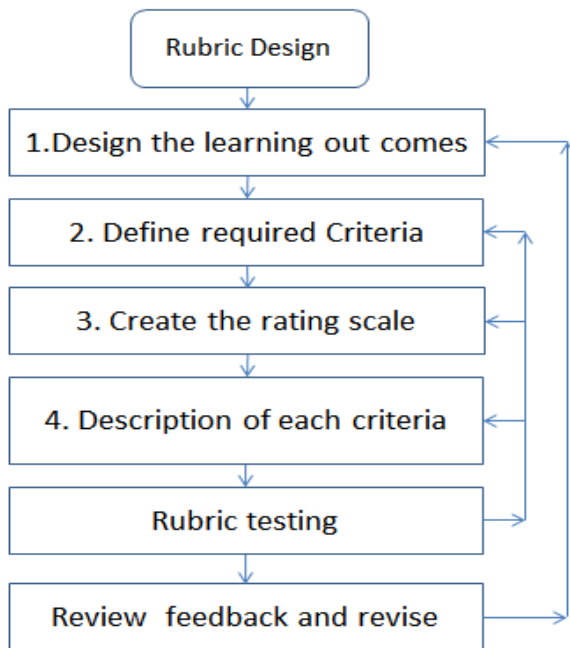
Figure 1 Flow chart to design a rubric

To design the rubric, the teacher can assign the task to multiple students (e.g., A, B, and C), assess their performance, and establish the criteria necessary to achieve the learning goals and expectations. To define the criteria for the rubric, the teacher should consider the following questions (O'Reilly L. 2006).

- What do you want students to learn from the task?
- How will students demonstrate that they have learned?
- What knowledge, skills, and behaviors are required for the task?
- What steps are required for the task?
- What are the characteristics of the final product?

Once the list of criteria has been developed, the next step is to arrange them based on their importance or priority. Typically, rubrics consist of 3 to 8 criteria.

IV. Create the rating scale

The rating scale used in rubrics can vary depending on the type of rubric being used. Analytic rubrics, for example, often use 3 to 5 levels of rating. For instance, the levels can be: Inadequate (0 to 19%), Needs Improvement (20-39%), Adequate (40-59%), Good (60-79%) and Excellent (80-100%). To avoid increasing complexity, it's advisable not to use more than 5 levels. Alternatively, a different rating scale can be used such as:

The rating may also be taken as:

- **Excellent** (5): Accurate information and conveyance of the main idea
- **Good** (3-4): Includes persuasive information.
- **Needs Improvement** (1-2): Include persuasive information with few facts.
- **Incomplete** (0): Information is incomplete, out of date, or incorrect.

It's important to use consistent language across all performance levels in order to provide clear and consistent feedback to students.

V. Description of each criteria

The description of each criterion for every performance level is essential. The description of outcome or performance expected from students, which was studied by teachers while finalizing the criteria.

Before writing the description, it is necessary to keep in mind the course outcomes and program objectives usually framed in higher education like engineering, pharmacy, management etc. Use concrete words in description, which may describe criterion properly and demonstrate to attempt it. Describe measurable behavior and use parallel language for clarity; the wording for each criterion should be very similar, except for the degree to which standards are met.

VI. Rubric testing

Rubric testing may be carried out using a various student assignments or student's work to get the realistic rubric. After getting the realistic rubric further if required change the criteria, rating and criteria descriptions. Rubric in realistic to encourage the students to assess themselves and improve their efforts and creativity, also motivate them to progress beyond the rubric. Sometime it is difficult to bring all the scoring or grades of all the instructors at common level. So it is necessary to decrease the difference in the scores with meeting and discussions. This process helps to develop consistency in scoring /grading and make the grades more valid reliable.

VII. Review feedback and revise

To review about the rubrics applied to any assignment or project, it is suggested to take feedback from your colleagues and discuss about the essential changes observed. This step will definitely help full make your assessment tool more efficient.
- Accurate information and convey of main Idea.
- Includes persuasive information.
- Include persuasive information with few facts.
- Information is incomplete, out of date, or incorrect.

VIII. Rubrics for Lab Assignment

Criteria for Rubrics for Lab Assignments may vary depending on the specific goals and objectives of the lab assignment. However, some common criteria that may be included in the rubric are:

Procedure:
This criterion evaluates the student's ability to follow the experimental procedure correctly, including preparing materials, conducting experiments, and collecting data.

Data Analysis:
This criterion assesses the student's ability to analyze the data collected during the experiment, including using appropriate statistical tools, drawing conclusions from the data, and making recommendations for future experiments.

Communication:
This criterion evaluates the student's ability to effectively communicate the results of the lab assignment, including writing clear and concise lab reports, creating graphs and tables to present data, and making oral presentations.

Safety:
This criterion assesses the student's ability to follow safety guidelines, including wearing appropriate protective equipment, handling hazardous materials safely, and correctly disposing of waste materials.

Creativity:
This criterion evaluates the student's ability to approach the lab assignment in a creative and innovative way, including designing their own experiments, developing new methods, or adapting existing methods to suit their needs.

Teamwork:
This criterion assesses the student's ability to work effectively in a team, including collaborating with others, sharing ideas and resources, and contributing to the success of the group. The details rubric for lab assignment is illustrated in Table 1.

Table 1 Rubrics for Lab assignment

Criteria	Levels			
	Excellent (5)	Good (3-4)	Needs Improvement (1-2)	Incomplete (0)
Procedure				
Data Analysis				
Communication				
Safety				
Creativity				
Teamwork				

IX.Types of Rubrics

There are two main types of rubrics,

Analytic Rubric: An analytic rubric specifies at least two characteristics to be assessed at each performance level and provides a separate score for each characteristic. Types of Holistic Rubrics is illustrated in Table 2.

Holistic Rubric: A holistic rubrics provide a single score based on an overall impression of a student's performance on a task (University Utah Valley 2017) .Types of Analytic Rubrics is illustrated in Table 3.

Table 2 Types of Holistic Rubrics

Holistic Rubrics			
Type of Rubrics and definition	**Components**	**When to use**	**Pros and Cons**
Checklists: Lists of criteria that are checked off as completed	• Questions that are yes/no in nature	Specific directions that lists everything within the assignment or project.	• Simple Straight forward • Gives student an outline • Good for measuring specific skills or beginners. • But Teachers cannot identify different levels of quality
☐ **Simple Rating Scale**: ☐ Records the level of student work Indicates whether student work is a certain quality of student work	• List of the dimensions or expectations • Weight (points) that are involved	• Designed to provide general guidance as to expectations • Grading of written assignments.	• Versatile in Feedback conduct but may not be specific enough
Holistic Rating Scale: Scores the overall process without judging the component parts separately	• Assesses student work as a whole. • Description of overall grade. • when a single score based on an impression of a student's performance is to asses	It is used with writing, oral presentations,etc.	• Quick scoring about student achievement. It focuses on or the product process as a Whole. • But does not provide detailed information and also difficult to provide an overall score.
Task Specific: Unique to a specific task.	• Lists a number of task which equal a certain grade level	Designed to provide detailed guidance regarding a specific assignment or task.	• It more reliable assessment for performance of any task. • But It is found difficult to construct rubrics for specific tasks.

Table 3 Types of Analytic Rubrics

Analytic Rubrics			
Type of Rubrics and definition	**Components**	**When to use**	**Pros and Cons**
▪ **Detailed Rating Scale**: Describes explicitly what constitutes performance on each criterion Communicates common performance standards	• Descriptive sentences of what is expected for each of the ratings. • No formal numbering	Evaluating performances	• Make the scores more consistent • Scoring based on the reviewers opinion • Time consuming
Combination rubrics: Combination rubrics include methods for • both detailed feedback ▪ bigger-picture evaluation	• The details beneath each are marked with comments to show areas of strength and weakness. • Use a range to rate performance • Write specific descriptions student performance	Focus on measuring a stated objective	• Instructive type of rubric. • Gives detailed feedback for students • Gives the bigger-picture view progress. • Organize grading criteria into major and Sub-criteria. • The rating scales may be somewhat subjective.
Total points/ Analytic rubrics: Specific details underneath that are marked to indicate strengths and weaknesses	• Each category of a total point's rubric is assigned a certain number of points which then produce a total score • Multiple descriptors for each criterion evaluated • Describes domains of product/ performance separately	To break assignments or scores down into separate components for grading	• Easy to communicate the weighs of certain parts of an assignment to students that are important. • It allow for specific feedback, which may lose focus. • Students tend to do the work and make efforts to maximize point values. • But students may be less likely to try new strategies or experiment with ideas. • It also has limited descriptors

X. Rubrics for Undergraduate-Level Project Assessments

In the Undergraduate Professional colleges let engineering college, the curriculum includes a project that requires continuous weekly assessment. To ensure that the project meets the expected standards, students are required to make two presentations to demonstrate their project in detail. Teachers / Instructors can use rubrics to assess the project report, presentations and maintain high standards for the project (Kenneth Wolf and Stevens 2007) (Hacker D. J. 2000). The design of Rubrics in details for Major project assessment is illustrated in Table 4.

Table 4 Design of Rubrics for Major project assessment

Criteria	Levels		
	Excellent (80 -100%) 5 points	Good (79-50%) 3-4 points	Need Improvement (20-49%) 1-2 points
Abstract	The abstract should succinctly summarize all the key points addressed in the main body of the report, including a summary of the results, within a limit of 150 words.	The abstract summarizes some of the main points discussed in the report and presents the results in a concise manner within 150 words.	The abstract is not written or missing, incomplete, or inaccurate.
Introduction, Literature Review	The report's introduction is comprehensive and outlines the project's objectives. The literature review section clearly addresses the project's topic and aligns with the project's outline. Moreover, the problem statement is analyzed with a conceptual framework and research questions insightful.	The report's introduction clearly outlines the objectives and problem statement, while the literature review section provides a conceptual framework and empirical evidence to address the research question.	The introduction section may lack clarity and completeness, with a vague problem statement. The research questions may not be clearly defined or measurable.
Materials and Methodology	The methodology section should contain crucial information about the materials, methods, procedures, instruments, and their specifications. It should also describe the data handling methodology and treatment. Moreover, the methodology may include a novel approach to the project. The conceptualization and protocols for data collection, such as questionnaires, interview questions, observations, experimental observations, etc., should be mentioned in the appendix.	The methodology section includes essential information regarding materials, methods, procedure, instruments and their specification, data handling methodology and treatment.	The methodology section has lack of essential information regarding materials, methods, procedure, instruments and their specification, data handling methodology and treatment.
Results and Discussion	Results are properly explained and presented	Results are discussed with certain data table	Results are inaccurate or

Criteria	Levels		
	using appropriate graphs, flow charts tables etc.. The analysis focused the objective and outline of the project. The findings are clearly discussed.	appropriate graphs, flow charts etc. But the analysis in not clearly focusing objective and outline of the project.	incompletely presented.
Conclusion	The conclusion should connect all the main points of each section of the reports as per the objectives and research approach. All the findings are clearly interprets all sections of the report.	The conclusion should connect all the main points of each section of the reports but not as per the objectives and research approach. All the findings are clear and easy to understand.	The conclusion is not connecting all the main points of each section of
Limitation	Limitations are extensively described.	Limitations of the study are discussed.	Limitations of the study are not discussed.
Bibliography	Bibliography are correctly cited in the main body of the report and presented on a separate page as bibliography page in APA/MLA format	Bibliography are not correctly cited in the main body of the report, but presented on a separate page as bibliography page.	Bibliography is missing, incomplete, or incorrectly cited.
Appendix	The observations, data, questionnaires, photographs etc. are presented in appendix.	-	Not mentioned

XI.Peer Group Learning

Peer group learning refers to a learning approach that involves a group of people who are at a similar level of knowledge and experience working together to learn and develop their skills. In peer group learning, members of the group share their knowledge and experience with one another, and work together to solve problems, complete tasks, and achieve shared learning goals.

Peer group learning can be achieved through various methods, such as group discussions, peer tutoring, group projects, and peer review. Although commonly practiced in educational settings, it can also be utilized in community and workplace environments. A key advantage of peer group learning is that it enables learners to obtain feedback and assistance from their peers, leading to a more comprehensive understanding of the subject matter and improved self-assurance.

The utilization of both peer assessment and rubrics has experienced an upsurge in popularity in recent years. This trend can be attributed to the increasing prevalence of web-based peer assessment tools and the widespread recognition of the benefits facilitated by rubrics. The outcomes and applications of peer assessment tools and rubrics have been investigated, with research conducted to evaluate the validity of their purported advantages (Kavanagh Sam 2016) .

XII. Assessment of Major Projects Using Rubrics: A Case Study

Students are often tasked with major projects as part of their academic curriculum, and their guides provide them with a fundamental outline to follow. However, in order to improve the students' performance, a sample study was conducted at engineering college to launch Rubric for the first time to analyze major projects extensively. Rubrics were tested and applied to improve the attainment of Course Outcomes (CO) and Program Outcomes (PO).

The attainment levels of PO5 and PO12 were found to improve significantly, leading to an improvement in the overall quality of major projects. This improvement in quality also contributed to the research index of the college, as students were able to publish and present their research

Rubrics are an essential tool that can provide a clear evaluation framework for students, making it easier for them to understand what is expected of them in their projects. They help students to organize their ideas, set clear goals, and assess their own progress. Rubrics also help guides to evaluate the students' work in a more objective and consistent manner, and provide feedback that is clear, specific, and constructive.

By using rubrics to evaluate major projects, students are encouraged to take ownership of their work and develop the skills needed to succeed in their chosen fields. They are able to see the connections between their coursework and their professional goals, and develop a deeper understanding of the importance of research and critical thinking. Ultimately, rubrics help to improve the overall quality of education, and prepare students for success in their future careers.

The case study was performed among two different groups of students to analyze the effectiveness of rubrics in evaluating major projects. The case study was performed among two groups of 10 students as mentioned below.

Group 1: The detail about the rubrics was not communicated to Group 1.

Group 2: The above rubrics designed to analyze the major project and the grade to marks conversion an essential components of the rubric evaluation process. The students Group 2 fully taught the criteria for evaluation and how their grades would be determined. The detail about the rubrics was communicated to Group 2.

12.1   Findings of the Case Study

Group 1: The average marks obtained by students in Group 1 were 21 out of 50, indicating a poor performance in their major projects. Almost all of the students in Group 1 had an average performance of up to 40%, which was a shocking result and presented a significant challenge to improve.

The poor performance of Group 1 students highlighted the need for an effective evaluation system to assess their major projects. The use of rubrics in evaluating students' work provided a clear framework for evaluation, enabling more objective and consistent assessment by both teachers and students.

Group 2:

The students in Group 2 achieved an impressive average score of 44.5 out of 50 in their major projects, with almost all students demonstrating excellent performance up to 90%. This significant improvement in performance can be attributed to the effective use of rubrics to evaluate the students' work.

The rubrics provided clear guidelines and expectations for the major projects, ensuring that students were aware of the criteria they would be evaluated against. The rubrics also allowed for a more objective and consistent evaluation of the students' work, leading to a more accurate assessment of their performance.

Overall, the excellent performance of Group 2 students was a testament to the effectiveness of the rubrics in evaluating major projects. By providing clear guidelines for evaluation and helping students to understand the criteria they would be evaluated against, the rubrics helped to improve the quality of the students' work and encourage them to perform to the best of their abilities.

XIII. SCOPE OF RUBRICS

Rubrics can serve as a valuable tool for professional colleges, such as engineering colleges, aiming to enhance their performance and educational quality. Here are some potential scopes of rubrics for such institutions (Hacker D. J. 2000):

1. **Objective evaluation**: Rubrics provide a clear and objective framework for evaluating student performance, which can help engineering colleges to demonstrate that they are maintaining high standards of academic excellence.

2. **Consistency in evaluation**: Rubrics allow for consistent evaluation of student work, regardless of who is doing the evaluating. This helps to ensure that all students are being evaluated fairly and equitably.

3. **Continuous improvement**: Rubrics can help engineering colleges to identify areas for improvement and create action plans to address those areas. By continually evaluating student work and refining the rubrics, colleges can ensure that they are always striving to maintain high standards of academic excellence.

4. **Data-driven decision-making**: By analyzing the data collected through rubric evaluations, engineering colleges can make data-driven decisions about program improvements, curriculum changes, and other strategic decisions.

5. **Alignment with Professional standards**: Rubrics can be designed to align with the professional standards, which can help colleges providing higher education to demonstrate that they are meeting the requirements for higher standards.

6. **Industry-Relevant Skills Assessment:** Rubrics can be tailored to assess student mastery of industry-relevant skills, ensuring that graduates are adequately prepared for the demands of the industrial sector. This scope enables engineering colleges to demonstrate their commitment to producing graduates who possess the necessary competencies to excel in industrial applications.

XIV. LIMITATIONS

The rubrics can be a valuable tool for engineering colleges, but also have some limitations. Here are some limitations of rubrics in engineering colleges:

1. Efforts and Time-consuming
2. Subject to some degree of subjectivity during evaluating qualitative aspects of student work.
3. Rubrics inflexible as it has fixed set of criteria for evaluation.
4. Over-emphasis on grading, may not necessarily promote deep learning or critical thinking.
5. Difficulty in measuring soft skills.
6. Difficulty Assessing Industry-Specific Competencies: Rubrics may struggle to capture nuanced skills required in industrial settings, limiting their ability to fully evaluate graduates' readiness for real-world applications.

XV. CONCLUSION

The strategic integration of rubrics within higher education institutions fosters educational quality tailored for industry applications. The case study highlighted in this paper, where rubrics were applied to a significant project, illustrates a noteworthy disparity in performance between groups familiar and unfamiliar with rubrics, with the former achieving 70% to 90% marks, indicating a 30% to 50% improvement. Rubrics extend beyond project assessments to various academic activities, promoting peer learning and collaborative assessment processes. While rubrics contribute to maintaining academic excellence, ensuring evaluation consistency, and identifying areas for improvement, challenges such as time intensiveness and subjectivity warrant careful consideration. Nevertheless, the benefits of rubrics significantly outweigh these limitations, empowering institutions to excel in achieving program outcomes and preparing graduates for success in industry applications. Therefore, by continually evaluating and refining rubrics, higher education institutions

can effectively demonstrate their commitment to academic excellence and produce graduates equipped to meet the demands of the industry.

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