

## Building and Using Rubric in Assessing the Skills of Teachers with Experiments for Students of Physics Pedagogy

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**SUMMARY:-** Physics is one of the basic sciences, widely applied in engineering and life. There are two ways of studying physical phenomena: theory and experiment. In the first case (theoretical physics), based on known laws of physics and using mathematical tools, draw new relationships. In the second case (experimental physics), new relationships between phenomena are obtained by physical measurements. Here, the tool used is much more diverse, a lot of equipment, experiment equipment... Therefore, teaching skills with experiments is an important element that plays an important role in the teaching process. Especially in schools, while teaching physics, lecturers often study phenomena, laws of physics in reality, ask questions and seek answers, explain phenomena and physical law to innovate teaching methods that help learners discover problems and solve problems. Experimental physics has become one of the most effective solutions to improve the quality of teaching.

**Key words:** Physics, physics pedagogy, theoretical physics, experimental physics, rubric, skills.

### I. INTRODUCTION

The fourth industrial revolution took place from the beginning of the 21st century. The characteristic of this industrial revolution is the increasing popularity of artificial intelligence and automation machines, bringing a combination of virtual and realistic systems. In the digital age, higher education will change from the educational environment, the role of teachers and learners to teaching methods. Therefore, in the current school, teaching is not only about teaching something but also how to teach it. Innovating teaching methods is an urgent and breakthrough requirement to improve teaching quality. The high school physics laboratory subject, part of the credit-based training program of physics pedagogical students at Saigon University, is a very important part of practical practice in teacher training. high school. Therefore, the well-organized teaching activities of this module will be an important basis to supplement, consolidate, deepen and expand the professional knowledge and pedagogy that students have learned. Besides, the inspection - evaluation plays a huge role in improving the quality of training. The results of the test - assessment are the basis for adjusting teaching, learning activities and educational management. This article presents the development and use of rubric in assessing teaching skills with experiments.

### II. CONTENTS OF THE RESEARCH

#### 2.1. Concept of rubric

Since being introduced and widely used in the 1970s, many studies around the world and Vietnam have given the definition of rubric. Although these are expressed in different ways, these definitions are consistent in the rubric view that a tool for evaluating performance based on predetermined criteria and classifying them into rankings for each criteria.

Rubric is a evaluation tool used relatively widely in education in general and higher education in particular. Rubric is derived from the word "ruber" Latin meaning red which is the title of the paragraphs in ancient books and printed in red.

Carnegie Mellon University defines Rubric as a scoring tool that clearly expresses the expected results achieved for a job or a task. A Rubric will divide the work into several component parts and provide clear descriptions of the characteristics of the work related to each component, at each level of proficiency. Rubric

can be used as a score board, assessment or to provide feedback to support student's current academic progress. [3]

Beverly Busching (1998) defines Rubric as a guide to assessing the quality of student work. It provides assessment criteria and corresponding knowledge standards for these criteria. Using Rubric as a scoring framework helps teachers determine what to look for, which results represent different levels of knowledge gained, thereby increasing the consistency of the assessment and clarity of standards. [4]

Smith and partner (2010) suggested that Rubric is a two-dimensional matrix or table used to make systematic and transparent judgments about the performance of students. Rubric presents a summary of the facilities used to make the assessment. The lines in the Rubric table show the dimensions of the selected work as the focus areas for evaluation. Each line corresponding to an aspect (an aspect, a characteristic) is called a criterion. The columns in the matrix are the standard grades of the job - usually consisting of 4 or 5 levels (excellent, good, average, poor). Similarly, a rubric can list column evaluation criteria with standard row hierarchies. The evaluation criteria are determined from the analysis of student performance assessments to identify aspects that can explain the quality of the student's work and the grades shown completion levels for these criteria. The information on the whole matrix is combined to give general conclusions about the quality of student work. [5]

According to Ton Quang Cuong: Rubric is a systematic detailed description (standard, criteria and level) of the results (knowledge, skills, attitudes) that learners should do and need to do to achieve final goal when performing a specific task. Rubric used in teaching is designed for different evaluation purposes, but it is based on the same general principle: comparing, comparing and verifying the achieved results with agreed standards and criteria built before performing the operation. [1]

In this research, we think that rubric is a system of assessment/scoring tools (including specific criteria and scales) developed by lecturers to support the detailed evaluation of student's learning activities.

## 2.2. Classification rubric

Based on the function and purpose of evaluation, rubric can be divided into the following two types:

- Qualitative/ Holistic
- Quantitative/ Analytical

Qualitative (Holistic) rubric is often used to overall assess the overall process of performing a specific task or product. Qualitative rubric does not require a detailed description of the performance criteria (indicators) of each stage or intermediate outcome. Qualitative rubric helps teachers to mark quickly, consistent with the final assessment. However, this type of assessment does not provide much feedback for teachers and students [2]. The disadvantage of qualitative rubric is that it does not indicate the level of achievement for each function in the aggregate feedback, so it is less useful for students.

Quantitative rubric (analytical) is used to evaluate each stage or intermediate results during the learners' performance of tasks. Component evaluation points will be added to the final score. The disadvantage of quantitative rubric is that it takes a long time to build the criteria system and when evaluating. [6]

Rubric analysis requires a detailed description (specification) of indicators corresponding to the criteria, level/ level and score.

## 2.3. Rubric construction principle

A rubric is structured with 3 basic parts: job task description (student's assigned work), criteria for evaluating results (listing the skills or knowledge required for the job). assignments) and descriptions for each quality level of results achieved for each of the evaluation criteria.

According to Ton Quang Cuong, to design rubric needs to meet the following 4 principles:

- a) "Idealization": criterion descriptions need to be expressed in a spectrum (range) going from the highest to the lowest (or vice versa).
- b) Differentiation: criteria descriptions need to show the boundaries (differences) between the levels / levels of completion for each learner and among learners.
- c) Objectiveization: the criteria description needs to fully show the characteristics and aspects of the activity or product performance (according to the goal), because the evaluation criteria is the "re-express the goal" in detail!
- d) Stimulating and creating development motivation: descriptive criteria need to indicate the orientation that learners/ instructors need to work towards to achieve goals, helping learners/ teachers to self-assess and assess price and same review.

Thus, based on the Rubric construction principles mentioned above, we propose the principle of rubric construction in the process of experimental teaching as follows:

- a) Criteria descriptions need to be expressed from lowest to highest

- b) The criteria description should state the difference between the quality of the job.  
 c) The description of the criteria should fully reflect the aspect characteristics of the skills content to be assessed.  
 d) Criteria descriptions need to indicate the orientation students or faculty need to work towards to achieve the goals, help them assess themselves, and evaluate them together.

### 1. Rubric teaches experiments with Physics pedagogical students

Based on the above principles, the content of the proposed rubric paper is to evaluate teaching skills with experiments for students of physics pedagogy.

**Table 1. Rubric measures experimental skills by the degree of criteria**

No	Skill	Criteria	Level 1	Level 2	Level 3	Level 4
1	Use safety experimets	1. Understand and strictly follow laboratory safety rules and regulations	Incompletely understand; Not yet complied with laboratory regulations and rules	Understand and strictly follow some laboratory rules and regulations	Understand and implement laboratory rules and regulations	Understand and implement the laboratory rules and regulations very well
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		2. Know how to use and store tools	Know how to use the tool but still have errors and preservation is not according to the regulations	Know how to use and store a number of simple laboratory equipment	Understand the rules of use and care for some equipment	Proficient use and understand the method of storage of tools
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
2	Conducting experiments	3. Identify and select the equipment needed for the experiment	Can not select the tools	Wrong number of tools selected	Select the right tools	Creativity in choosing tools
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		4. Assemble the necessary kits for each test, understand the effects of each part, know the analysis of right and wrong in how to install the test equipment	Cannot be installed or installed incorrectly.	Correctly install the necessary kits for each test, do not understand the effect of some parts in the installation of test instruments	Correctly install the necessary kits for each experiment, understand the effects of some parts, and analyze the right and wrong methods of installation	Correctly install the necessary kits for each test, understand the effects of each part, know the analysis of right and wrong in mounting
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		5. Proficient use of laboratory equipment	Inability to use tools	Usual laboratory equipment but still small errors	Use of laboratory equipment without errors	Proficient in using laboratory tools
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		6. Doing a safe, right, and successful experiment	Experimental conducted, but still process errors	Conducted a safe, wrong experimental procedure, but succeeded	Doing safety experiments according to procedures, success.	Doing safe experiments, clear and successful procedures and easy-to-observe

		Point	0,25 points	0,5 points	0,75 points	results
3	Observe, describe the phenomenon and conclude	7. Know how to observe and identify experimental phenomena	No experimental phenomenon detected	Know the method of observation, receive unknown experiments	Identify the experimental phenomena but not complete	There are methods of observation, clearly identify the experimental phenomena
		Point	0,25 points	0,5 points	0,75 points	1,0 point
		8. Exactly describe the experimental phenomena, conclude on the experimental phenomena and draw conclusions	No description of experimental phenomena, no conclusions drawn	Full description of experimental phenomena, not yet drawn conclusions from the experiment, but incomplete	Fully describe experimental phenomena, draw conclusions	Accurately describe the experimental phenomena, fully draw conclusions
4	Processing experimental information	9. Know how to apply theoretical content to explain experimental phenomena in a scientific way.	Do not know how to apply the content of knowledge to explain the experimental phenomena.	Applying theoretical content explaining incomplete phenomena.	Applying theoretical content to explain the phenomena, but not fluently expressed.	Applying theoretical content explaining experimental phenomena scientifically and accurately.
		Point	0,25 points	0,5 points	0,75 points	1,0 point
		10. Analysis and processing of experimental results	Inability to analyze and process empirical results of some quantitative experiments	Students can analyze and handle experimental results of some quantitative experiments with the help	Know how to analyze and handle empirical results of a number of quantitative experiments	Proficient handling of experimental results of some quantitative experiments
		Point	0,25 points	0,5 points	0,75 points	1,0 point
<i>Description of quality level</i> <b>Excellence: 9 - 10 points</b> <b>Good: 7 - 8 points</b> <b>Satisfactory: 5 - 6 points</b> <b>Not achieved: 0 - 4 points</b>						

Table 2. Rubric measures teaching skills with experiments according to the degree of criteria

No	Skill	Criteria	Level 1	Level 2	Level 3	Level 4
1	Preparing and experimenting equipment for teaching	1. Choose the right tool, enough and suitable for the experiment	Choose equipment that is not suitable for the experiment or do not know how to choose an experiment tool	Select the wrong equipment but can be used to conduct the experiment	Choose the right tools and suitable for the experiment, but there are some unnecessary tools	Choose the right tool, enough and suitable for experiment with creativity
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
2	Perform experiments in teaching	2. Proficient in using tools	No skills to use the tools	Not proficient use of tools	Proficient use of tools but errors	Proficient in using tools
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		3. Conducting a safe experiment, following the procedure, the results are successful and easy to observe	Conducting experiments improperly, unsafe experiments, unsuccessful experiment results, difficult to observe phenomenon	Conducting safe experiments, not in accordance with the procedures, successful results, difficult to observe phenomenon.	Conducting experiments are safe, in accordance with the procedure, the results are successful, and the phenomenon is difficult to observe	Conducting a safe experiment, in accordance with the process, the results are successful, and the phenomenon is easy to observe
Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>		
3	Teaching experiments	4. Select experiments that are appropriate to the teaching objectives and students' subjects	Don't know what testing option to use for the lesson	Know how to choose experiments that meet teaching goals, but not yet suitable for students	Knowing how to choose experiments that are suitable for teaching goals and students, but many experiments	Know how to choose experiments that are appropriate for the teaching objectives and students' subjects
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
		5. Use experiments in accordance with teaching method	Using experiments not suitable for teaching method	Use experiments consistent with teaching method, but not clear.	Use experiments consistent with teaching method (Method of raising and solving problems, research methods, methods check evidence, ...) but not yet to help students	Use experiments consistent with teaching method (Method of raising and solving problems, research methods assist, verification methods, ...) help

			think positively	students think positively
	Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>
	6. Knowing the problem so that students understand the purpose of the experiment	Had intended to question students understand the purpose of the experiment but have not expressed it	Ask students to understand the purpose of the experiment, which has not attracted students to explore.	Set the problem for students to understand the purpose of scientific experiments, lengthy, to attract students to learn
	Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>
	7. Have skills performing experiments combined with words	Unknown methods of performing experiments with words of teachers	Have skills to perform experiments with teachers' words but not yet effective	Skills of performing experiments combined with words of proficient teachers
	Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>
	8. Ability to describe the experimental phenomenon accurately, scientifically, briefly, using the right physical language	Describe the phenomenon of experiments in a preliminary, unclear, and incomplete physical language	Skill to describe experimental phenomena correctly, but not yet clearly	Skills to describe empirical phenomena accurately, scientifically, using the right physical language
	Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>
	9. Know how to ask questions to guide students to observe the phenomenon to draw conclusions.	How to ask questions to guide students to observe the phenomenon to draw unclear conclusions, difficult to understand students	How to ask questions to guide students to observe the phenomenon to draw incomplete conclusions, unclear expressions	How to ask questions to guide students to observe the phenomenon to draw complete and scientific conclusions
	Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>
	10. Know how to test and evaluate practical laboratory skills	Did not know how to build exercises forging laboratory practice skills	Develop exercises forging a number of experimental	Building exercises forging experiments, not
				đánh giá Building exercises forging laboratory

				practice skills, using only one type of assessment test	combining well the types of assessment and evaluation	practice skills, combining the types of testing and evaluation
		Point	<b>0,25 points</b>	<b>0,5 points</b>	<b>0,75 points</b>	<b>1,0 point</b>
<i>Description of quality level</i> <b>Excellence: 9 - 10 points</b> <b>Good: 7 - 8 points</b> <b>Satisfactory: 5 - 6 points</b> <b>Not achieved: 0 - 4 points</b>						

### III. CONCLUSION

Rubric is a result evaluation tool that benefits both teachers and learners and has been applied effectively in the process of university teaching in many countries with developed education. This is a tool that is considered to be very appropriate in evaluating scoring in the process of teaching with experiments, increasing the objectivity and transparency for conclusions and results in the process of testing reports. This article has proposed the concept of rubric, building rubric to evaluate experimental skills and experimental teaching skills.

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