

# Scientific Journal of Applied Social and Clinical Science

## DESIGN AND VALIDATION OF A RUBRIC TO EVALUATE PRACTICAL SKILLS IN CLINICAL MICROBIOLOGY LABORATORY AT HIGHER EDUCATION LEVEL

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**Abstract:** The evaluation of practical professional competence in laboratory students in health areas is increasingly complicated but necessary. To achieve this objective, the rubric is commonly used as an evaluation instrument. An efficient rubric must allow a real, robust, thorough, comprehensive, flexible/adaptable and reproducible description of the important skills of the professional task. Additionally, the rubric improves students' academic performance, saves time in assessment, and improves communication between teachers and students. In the case of the evaluation of the Clinical Microbiology Laboratory Learning Unit, the challenge of evaluating student learning based on the competencies of "knowing how to do", "knowing how to be" and the fundamental theme of the subject "knowing ". To address this challenge, an evaluation system was designed and validated using rubrics that will allow measuring the skills acquired by students in clinical practices. The study used exploratory and correlational research, in which eight professors from different public universities in the country participated. The evaluation system was designed using rubrics and its content was validated using the reliability calculation. A pilot test was carried out with 41 students and two items were identified within the rubric that reduced the internal consistency of the instrument. These items were modified and in the second round of evaluation an overall internal consistency value of 92.1% was obtained. The rubric was presented to 26 experts, who rated it as "excellent/efficient" for the most part. In conclusion, through collaborative and cooperative work of expert teachers in the development of rubrics and the professional discipline of the clinical microbiologist, an efficient competency evaluation instrument was designed and validated for the Clinical Microbiology Laboratory Learning Unit. This instrument

will allow the competencies developed and demonstrated by students in clinical practices to be evaluated in a fair and efficient manner.

## INTRODUCTION

The efficient evaluation of practical professional competence (know-how) in students of laboratory disciplines in health areas is increasingly complicated, but at the same time, more necessary (PETERSON, 2023). To achieve this objective, one or more valid instruments are required, which allow a fair evaluation of the student. The instrument most frequently used for this purpose is the rubric (GARCIA-ROS *et al.*, 2024). For the rubric to be efficient, it must allow a real, robust, thorough, comprehensive, flexible/adaptable and reproducible description of the important/critical skills of the professional task of the discipline (JACOBSON *et al.*, 2015). Table 1 describes the characteristics of an efficient rubric.

Characteristic	References
<b>Realistic/Descriptive:</b> It must be appropriate, clear and detailed in its description of the criteria and levels of performance, allowing an accurate and objective evaluation of the student.	ALONSO y ALEMAN, 2018; MORCELA, 2015
<b>Robust:</b> It must be able to cover different aspects of professional competence, such as clinical communication, clinical reasoning, Knowing how to be, Knowing how to do and professional values.	GALIANO Y DE CASTRO, 2010
<b>Careful:</b> It must be able to evaluate with precision and detail the practical skills and competencies of students.	ALONSO y ALEMAN, 2018; MORCELA, 2015
<b>Comprehensive:</b> It must evaluate the different aspects of professional competence in a global and holistic manner..	PINILLA-ROA, 2013
<b>Flexible/Adaptable:</b> It must allow its application in different contexts and disciplines, and its adjustment to the specific needs of each subject and career.	ALONSO y ALEMAN, 2018; MORCELA, 2015
<b>Reproducible:</b> It must ensure that evaluation results are consistent and comparable between different evaluators and contexts.	ALONSO y ALEMAN, 2018; MORCELA, 2015

Table 1: Characteristics of an efficient rubric

A rubric is a document made up of three elements; i) describes the criteria that will be taken into account for the evaluation of a job, task, product or activity of the people evaluated; ii) lists the quality levels for each of the criteria, providing examples of skills or characteristics that must be demonstrated to be assigned a certain quality level for a criterion; and finally, iii) in the case of being used for summative evaluation, it includes the weights of each criterion and the points assigned to each quality level (GATICA-LARA AND URIBARREN-BERRUETA, 2013; MARIN-GARCIA, 2015). The rubric improves the academic performance of students, saves time in evaluation and improves communication between teachers and students (ARRUFAT, 2014).

The evaluation of the Learning Unit (UA) of the Clinical Microbiology Laboratory (LMC), immersed in the curriculum of the Bachelor of Biological Pharmaceutical Chemist, at ``Universidad de Guadalajara``, Mexico, is complex, given that 80% of the subject is laboratory practice. In this context, evaluating student learning, based on the competencies of “*knowing how to do*,” “*knowing how to be*,” and the fundamental theme of the subject “*knowing*,” is a challenge for the teacher/instructor. It is necessary to provide students studying the UA with a detailed description of the type of desired performance, which allows feedback and self-assessment, in such a way that students are aware of what is expected of them and that allows them to increase their commitment, responsibility and performance.

**Goal:** The present study aims to demonstrate the process of homologation, design and validation of the contents of an evaluation system using rubrics to measure the skills acquired by students in clinical practices.

## METHODOLOGY

The present study employed exploratory and correlational research. The work team was made up of eight professors who teach the subjects of Microbiology, Clinical Microbiology, Bacteriology or Clinical Microbiology Laboratory, from different Public Universities in the country. Through short *on line* sessions and a review of the literature, the evaluation system/instrument of the UA Clinical Microbiology Laboratory was designed, using rubrics: The content of the rubrics was validated using the calculation of reliability (by Cronbach's Alpha), with a pilot of 41 students (in two rounds of evaluation). Once the instrument reached an Alpha > 0.9, using the SurveyMonkey® *On line* platform, the relevance of the instrument was explored by collecting the opinion of 26 experts who work professionally as teachers or clinicians in government institutes, public institutions and private clinical diagnosis companies. Statistical analysis was performed using SPSS software, IBM Statistics®.

## RESULTS AND DISCUSSION

Through collaborative and cooperative work of eight teachers in short online sessions and a search of the literature, the rubric was built that will allow evaluating the Know-how to do and Know-how to be of the student integrated “in a work team” during the LMC practices ( see Table 2).

The piloting was carried out with 41 students (in two rounds of evaluation) and the reliability of the instrument was carried out. In the first round, a value of  $\alpha=0.892$ , which results in having “good” internal consistency, but it is desirable that the instrument reach a value  $\geq 0.9$  for it to be described as “excellent”. After this first round of data collection using the evaluation instrument, two items (6 and 7) were identified within the rubric, which reduced/limited the global internal

Aspects to evaluate	Excellent (5)	Satisfactory (3)	Incipient (1)	Not satisfactory (0)	Maximum score	Student evaluation
<b>ATTITUDES</b>						
<b>Items 1. Team behavior during practice</b>	The team shows perfect order during practice, respect for their teachers and classmates, care in the use of laboratory material and abides by the teacher's instructions.	The team shows order during practice, respect for their teachers and classmates, and shows carelessness in the use of laboratory material. Follow the teacher's instructions.	The team shows a lot of disorder during practice, they are called out for their behavior with their classmates but finally, they comply with the teacher's instructions.	The team shows absolute disorder and carelessness in the development of the practice. Shows a lack of respect for his classmates and, sometimes, does not heed the teacher's instructions.	5 points	
<b>PERFORMANCE OF ACTIVITIES IN THE LABORATORY</b>						
<b>Items 2. Prior preparation for the practice</b>	The team brings to the laboratory the practice script, its properly collected sample, the necessary calculations already planned and the necessary information.	-	The team brings an incipient script of the practice, its sample, some proposed calculations and part of the information sought.	The team does not bring the necessary material for laboratory practice.	5 points	
<b>Items 3. Organization and cleaning during practice</b>	The team shows excellent organization during practice. Keeps your work area clean and disinfects surfaces promptly. The responsibilities of each team member are well defined, and they know the activities to be carried out. The leadership and authority of the team leader is demonstrated.	The team shows organization during practice. Keeps your work area clean. They disinfected their work area. They appointed a team leader. However, there is confusion in the assignment of responsibilities and they do not clearly know the activities to be carried out.	The team shows incipient organization during practice. Keeps your work area untidy. There is confusion in the assignment of responsibilities. They do not clearly know the activities to be carried out. The person responsible for the team is not defined.	The team shows disorganization during practice, their work area is dirty, there is confusion in activities and responsibilities. The person responsible for the team is not defined.	5 points	
<b>Items 4. Student performance based on demonstrated knowledge</b>	The team performs the practice perfectly. They apply the knowledge acquired. Presents security in your actions and calculations.	The team performs the practice very well. They apply the knowledge acquired. Has difficulties in calculations.	The team performs the practice with difficulty. Apply the knowledge acquired but with insecurity. Has difficulties in performing calculations.	The team carries out the practice with great difficulty. He does not know how to apply the knowledge acquired. Has difficulties in performing calculations.	5 points	
<b>Items 5. Use of formats for work</b>	The student appropriately uses the worksheet format for the primary reporting of their results.	-	The student, although he has the worksheet format, decides to use another means to record primary data..	The student does not have the worksheet format.	5 points	

<b>Items 6. Delivery of material and cleaning of your work area</b>	The equipment leaves all the material clean, on top of absorbent paper ready to be used again. Clean and disinfect your work area. Cleans and arranges all equipment, instruments and utensils used.	-	-	The team does not leave all the material in order. Does not clean and does not collect. He ignores the instructions of the laboratory staff and his teacher.	5 points
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#### EXTRA CLASS COMPLEMENTARY ACTIVITIES

<b>Items 7. Elaboration of the report</b>	The team: - Considered primary sources of information. - Prepared an original report. - Delivered the report on time. - Provided additional information. - Contributed photographs to improve the report	-	The team: - He made his report. - Delivered your report on time.	The team did not submit its report on time.	5 points
<b>Items 8. Preparation of the results report</b>	The results report has the necessary elements. Patient data is displayed clearly and accurately. The results of the practice are correct. The team leader signs the report.	The results report does not have all the necessary elements. The patient's data is displayed, although not clearly. The results are partially correct. The team leader signs the report.	The results report does not have all the necessary elements. Patient data is not complete. The results are partially correct. The team leader signs the report.	The results report was not prepared or was not delivered on time.	5 points

#### TOTAL EVALUATION

Table 2: Rubric for evaluation of the student's Know-how to do and Know-how to be in the practices of the Clinical Microbiology Laboratory

consistency index ( $\alpha$ ) of the instrument. Therefore, these items were modified, particularly in their descriptors (quality levels). In the second round of evaluation, the overall value of internal consistency ( $\alpha$ ) of the instrument increased to 0.921. It is worth mentioning that the rubric shown in Table 2 is the modified instrument that has a reliability of 92.1%.

This rubric was presented in an *on line* session to 26 experts. After analyzing their opinions (reflected in SurveyMonkey®), the cognitive competencies (*Knowledge*) and techniques (Knowing how to be and *Knowing how to do*) that the Clinical Microbiology

Laboratory student must acquire were identified. The experts agreed that the first six are a priority (Items 1 to 6), they were even called "indicators" that will be identified as desirable qualitative indicators in a professional in the clinical laboratory area.

Overall, the expert response rate to the request for opinion was 92.31% (24/26). 68.89% rate the rubric designed and presented as "excellent/efficient", 26.3% as "good/acceptable" and less than 5% judge it "questionable/impractical". As an instrument, a "well" designed and "validated" rubric is seen as an efficient procedural tool in the evaluation stage of the student in training and

will always have good acceptance among the teaching community (ALFARO SAAVEDRA *et al.*, 2022).

In higher education, the work and evaluation of competencies, particularly those of a generic or transversal type, takes on special relevance (RAPOSO and MARTÍNEZ, 2011). In this work, an evaluation system has been developed for the competencies developed and demonstrated by the students in the Clinical Microbiology Laboratory practices, in the Bachelor of Biological Pharmaceutical Chemist, with the cooperation and collaboration of academic experts from various universities and by professionals. of

clinical microbiological diagnosis. Likewise, the specific criteria of interest in the practical training of the clinical microbiologist are established and ensure an efficient and fair evaluation of the attitudinal and procedural competencies of the professional in training.

## CONCLUSION

With collaborative and cooperative work by expert teachers in the development of rubrics and the professional discipline of the clinical microbiologist, it was possible to design and validate an efficient competency evaluation instrument, consistent with the nature of the transversal and generic competencies of the UA.

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