

## Article

# Quality of research in residents of medical specialties after a standardized digital training program with rubrics.

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**Abstract:** Introduction: In the medical area, teaching is essential since it must offer the appropriate instruments to demonstrate that graduates have acquired the necessary skills. Objective: Evaluate the quality of research in residents of medical specialties after a standardized digital training program with rubrics. Methods: An observational, prospective research study in resident physicians of seven medical specialties first-year of an introductory program to methodology. It is integrated with the result variable through the quality of the final product and the quality variable will be measured with an ad hoc questionnaire validated by the Delphi method with a consistency level of 3-3. The data will be integrated into a base of the SPSS system and determined with the Chi-square test considering a minimum significance of 0.05. Results: 85 first-year medical residents (n=85) enrolled in the Research Seminar. The mean age was 31.34 years ( $\pm 3.96$ ). About gender Male 38 $\pm$ 31.13 Female 31.51 $\pm$ 3.83. The global final grade was 80.61 ( $\pm 9.59$ ) and the global satisfaction of the course was referred to as good by 62.2%. We observed a positive relationship between the scope of evaluation and the level of satisfaction. Conclusion: The research seminar implementation in a b-learning mode in response to the educational needs in medical residents for the field of health education showed a relationship between higher qualification, higher satisfaction, as well as determining that the comprehensive evaluation through the use of rubrics standardized allowed to delimit the deficiencies and strengths for timely feedback influencing the process of acquiring skills and the quality of the final product.

**Keywords:** Scoring Rubrics Health Personnel Program Evaluation Distance Education Residency Education Speciality

## 1. Introduction

Medical residency accordance to NOM-001-SSA3-2012 is the set of academic, assistance, and research activities that the resident doctor must carry out within the medical units receiving residents during the time corresponding operational programs [1]. Specialist doctors are part of the base of the National Health System in Mexico because they offer specialized services in complex health problems [2].

In this training period, in addition to fulfilling activities as stipulated in the hospital unit regulations, you must also be enrolled in a higher education institution and comply with academic and research activities regulated in a study plan [2,3]. Research is one of the fundamental aspects for the training of a doctor since it develops critical thinking and the classification of information in the academic programs of the medical residency, also institutions included the research module in a transversal way during the years of the formation of medical specialist.

Every research project should culminate in a publication in some indexed scientific journal.4 Herrera-Añazco4 et al evaluated 1,062 residents registered in the National

Council of Medical Residents (CONAREME) in 2016 11.1% of the population published an article during residency. Influenced by the year of residence [4]. Although most of the medical specialty centers teach subjects related to the development of skills and competencies in research, the residents assessment of the impact, training, and time spent is deficient [5].

Teaching in medicine is very important must offer the appropriate instruments to demonstrate that graduates have acquired the necessary skills [7]. Evaluation is one of the main bases of teaching, an essential component in the teaching-learning process since it can be carried out at any educational level [8]. They used the Miller pyramid, hierarchized with four steps that range from cognition to behavior in professional practice, the first step refers to "knowing", the second to "knowing how to apply", the third to "show how it will be done" and the fourth is to "do" as is the case of medical performance in practice [7]. The rubrics are a guide that lists the specific criteria, although used in the educational field for a wide variety of tasks, are most often used to evaluate the work of students and that of teachers [9].

There is currently a SARS-COV-2 pandemic, which limits the face-to-face teaching modality. About 200 countries activated maximum alert so that educational centers were partially or closed, as a consequence, the academic training of nearly 1.6 billion people at different levels of education was affected [11]. In the case of higher education and post-graduate courses, most universities had digital platforms that have been used for a long time as a complement for the development of teaching [10,11]. When evaluating resident doctors on the exposure to virtual education and simulation tools during the COVID-19 pandemic, 74.1% considered them adequate, however, 75.9% agreed that the decrease in practical activity had an impact in-hospital management of patients, particularly in invasive or surgical procedures [12].

The subject of health research has always represented an arid field for the student population, so its development is more related to the motivation of that acquisition, it represents a weakness in health systems that transversal competence is not acquired by the student or conceived on their behalf as something useful, reflected in the use, quality of their work and the final research project of the specialization course [13].

This study intends to evaluate the quality of research in residents of medical specialties after a standardized digital training program with rubrics.

## 2. Materials and Methods

It is an observational, prospective study carried out in the State of Quintana Roo in a public health services institution, which involves four residence halls and seven medical specialties during the first-year course and the research module.

### *Participants*

As a universe, the resident doctors of all degrees who are studying some specialty in the medical care units of Quintana Roo were considered, a degree of specialty was randomly chosen, the first year being the one selected. All first-degree medical residents from four residence halls, enrolled during the 2021-2022 academic cycle at the Mexican Institute of Social Security (IMSS) in the state of Quintana Roo, were included. The sample size calculation was not necessary since 100% of the first-year medical residency fellows were included.

### *Eligibility criteria sources for selection of participants.*

As inclusion criteria to participate in this study, it was considered to be a regular student of specialization courses of the IMSS OOAD Quintana Roo, to be enrolled in the first year research course in the CPEI Moodle platform. Non-inclusion criteria: those students who do not correspond to the grade, or who are external rotators in the unit, even if they are of the same grade. Elimination criteria: Those students who do not carry out academic activities in a proportion greater than 20%.

### *Variable*

The following variables were established and defined:

Research quality: variable composed of five dimensions:

1. Theoretical course. The theoretical course on the Moodle® platform lasted 8 weeks with a weighting of 50% of the final grade of the course, a total of 16 activities distributed with their corresponding evaluation rubric. Rubrics were subjected to a peer evaluation with a 100% agreement. Each activity had a defined time for its preparation and delivery with a minimum duration of 2 days and a maximum of 2 weeks (depending on the complexity of the activity).
2. Colloquiums. It consists of a face-to-face presentation of the research project that aims to demonstrate the theoretical knowledge acquired in front of experts, evaluated by peers (minimum 2 - through a standardized rubric, which is weighted for the final grade with 20%.
3. Final product. In the last stage of the seminar, the fellows delivered their completed research protocol, which was sent to the local research committee for approval and subsequent application of measurement instruments. It was evaluated with standardized rubrics for qualitative evaluation and to ensure the acquisition of knowledge and validated by research expert peers with a weighting of 30%.
4. Post-Seminar Cognitive Assessment. Finally, we applied a post-seminar test of 26 questions with the relevant topics that the fellows studied throughout the research seminar and thus evaluate the acquisition of skills and abilities that each fellow obtained.
5. Satisfaction survey. A satisfaction survey of 22 questions divided into 4 sections was also applied: satisfaction related to the student, satisfaction with the development of the course, satisfaction with the teachers of the course, and satisfaction related to the development of the program. This survey was designed and validated by pairs using the Delphi method with a 3/3 concordance. The survey allowed us to assess the level of quality and satisfaction that the fellows perceived about different aspects that made up the introductory research course.

As an intervening variable, the research background of the fellow: Determined by the experience referred by the student to a direct question, considering as background having completed a thesis, research project, or original articles in scientific journals before the specialty. Evaluation rubrics: Evaluation instrument previously reviewed by authorities and appropriate to the corresponding seminar, one designed for each topic and specific ability that includes the course program, standardized and validated by research experts using the Delphi-panel method. Post-seminar evaluation: Instrument that is used at the end of the seminar and allows evaluating the knowledge obtained. Sociodemographic variables were considered, such as age, medical specialty, course satisfaction.

### *Design and validation of academic content of the module*

A working group of experts made up of a teacher of more than 25 years of the research module, a doctor in research education of the national level I system, and a thesis student of the medical degree as a peer validator for the development of the seminar research. Electronic searches were performed in the Education Resources Information Center (ERIC) with a search strategy based on key concepts of interest to the objectives: evaluation rubrics, medical specialties, educational program, virtual learning, education in pandemic Restriction of publication dates was imposed with a range of 5 years old to the current year (2017-2021). The contents were added based on the training programs contemplated by the educational institutions, after reviewing five educational institutions

with medical specialty programs, standardizing the content of the "research methodology seminar". For the creation and subsequent standardization of evaluation rubrics, we carried out three rounds with feedback and corrections by each expert until a 3/3 concordance.

**Statistical Analysis:** We integrated the data into a base of the SPSS system. "Statistical Package for the Social Sciences" (SPSS version 21). Descriptive statistics applied: measures of central tendency: mean, median, standard deviation, proportions or percentages, and it was determined with the Chi-square test for qualitative variables, and as a hypothesis test the student's t statistic was used for bivariate and ANOVA analysis. of a factor for different groups, considering the grouping variables satisfaction considering a minimum significance of 0.05. The results are expressed in bar graphs, histograms, and tables.

**Ethical Aspects:** The procedures adhere to the ethical standards, the Regulations of the General Health Law on Research for Health, and the Declaration of Helsinki and its amendments. In the case of this investigation, following current national and international ethical guidelines, this investigation is without risk. In the present study, the institutional provisions and those of the General Health Law 18 and the Mexican Official Standard are adhered to. "All procedures will be per the provisions of the Regulations of the General Health Law on Health Research. Second Title, Chapter I, Article 17, Section I, research without risk, does not require informed consent because the educational process is evaluated without any intervention with the staff in training.

### 3. Results

85 first-year medical residents (n=85) enrolled in the Research Seminar with 100% participation in the period from August 14 to October 1, 2021, were registered, with a total of 100 hours of which 85 met the inclusion criteria.

The mean age was 31.34 years ( $\pm 3.96$ ). About gender Male 38 $\pm$ 31.13 Female 31.51 $\pm$ 3.833  $p>0.05$  Of the study population, 47 fellows (55.3%) were women and 38 fellows (44.7%) were men. When classifying the fellows by specialty, we have 11 (12.9%) for anesthesiology, 5 (5.9%) for Gynecology and Obstetrics, 9 (10.6%) for radiology, 35 (41.2%) for Family Medicine, 11 (12.9%) ) for Internal Medicine, 4 (4.7%) for Pediatrics, 10 (11.8%) for Emergency Physicians. **Table 1** No significant differences for sex and age according to specialty.  $p>0.05$ . **Table 1**

**Table 1.** Sex and medical specialty.

	Sex		Total
	Male	Female	
Anesthesiology	8	3	11
	21.1%	6.4%	12.9%
Gynecology and Obstetrics	1	4	5
	2.6%	8.5%	5.9%
Radiology	4	5	9
	10.5%	10.6%	10.6%
Family Medicine	16	19	35
	42.1%	40.4%	41.2%
Internal Medicine	5	6	11
	13.2%	12.8%	12.9%
Pediatric	1	3	4
	2.6%	6.4%	4.7%
Emergency Physicians	3	7	10
	7.9%	14.9%	11.8%
Total	38	47	85

	100.0%	100.0%	100.0%
	44.7%	55.3%	100.0%

The grades of the theoretical course in the Moodle platform were: the mean obtained from the studied population was 78.75 ( $\pm 10.45$ ), with family medicine being more relevant 83.31 ( $\pm 10.51$ ) and anesthesiology less performing with 71.71 ( $\pm 9.50$ ). For the category of colloquiums, an average evaluation of 75.25 ( $\pm 27.66$ ) can be observed, with internal medicine being the most relevant 92.48 ( $\pm 4.48$ ) and the one with the least performance being Emergency Physicians with 27.78 ( $\pm 35.95$ ). Regarding the category of the quality of the final product, the mean was 87.29 ( $\pm 7.96$ ) and better performance was observed for the specialty of pediatrics 92.50 ( $\pm 9.57$ ) and the lowest performance for medical-surgical emergencies with 80.00. The final grade, which was integrated from the theoretical course, colloquium, and final product items, had a global grade of 80.61 ( $\pm 9.59$ ) with a minimum of 49.16 and a maximum of 95.16, the best performance was pediatrics with 85.82 ( $\pm 4.37$ ) and the lowest performance in all items was Emergency Physicians with 67.36 ( $\pm 9.67$ ). The ratings of post-seminar cognitive evaluation by specialty are as follows: anesthesiology had an average of 70.63 ( $\pm 7.74$ ), gynecology and obstetrics 72.31 ( $\pm 9.58$ ), radiology 71.37 ( $\pm 9.25$ ), family medicine 77.58 ( $\pm 8.21$ ), internal medicine 72.73 ( $\pm 7.78$ ), pediatrics 75.96 ( $\pm 7.28$ ) and Emergency Physicians with 66.45 ( $\pm 11.88$ ). **Table 2** The Pearson correlation between the grade obtained issued by the professors and the post-seminar questionnaire was significant ( $p=0.001$ ) and the correlation coefficient was 0.709. **Table 2**

**Table 2.** Scores.

	Moodle $\mu (\pm)$ IC. LI-LS	Colloquiums $\mu (\pm)$ IC. LI-LS	Final Product $\mu (\pm)$ IC. LI-LS	Final Score $\mu (\pm)$ IC. LI-LS	Post-Seminar Cognitive Assessment $\mu (\pm)$ IC. LI-LS
<b>Anesthesiology (n=11)</b>	71.70 ( $\pm 9.5$ ) IC. 65.32-78.08	71.84 ( $\pm 24.38$ ) IC. 55.46-88.22	84.55 ( $\pm 5.22$ ) IC. 81.04-88.05	75.58 ( $\pm 9.95$ ) IC. 68.90-82.27	70.63 ( $\pm 7.74$ ) IC. 65.42-75.83
<b>Gynecology and Obstetrics (n=5)</b>	78.85 ( $\pm 6.27$ ) IC. 71.07-86.64	67.47 ( $\pm 9.98$ ) IC. 55.07-79.86	80.00 ( $\pm 0.00$ ) IC. 80.00-80.00	76.92 ( $\pm 2.64$ ) IC. 73.64-80.20	72.31 ( $\pm 9.58$ ) IC. 60.42-84.20
<b>Radiology (n=9)</b>	75.94 ( $\pm 9.5$ ) IC. 67.12-84.76	80.26 ( $\pm 30.45$ ) IC. 56.86-103.66	86.11 ( $\pm 7.82$ ) IC. 80.10-92.12	79.86 ( $\pm 6.44$ ) IC. 74.91-84.80	71.37 ( $\pm 9.25$ ) IC. 64.26-78.47
<b>Family Medicine (n=35)</b>	83.30 ( $\pm 10.51$ ) IC. 79.69-86.92	82.60 ( $\pm 16.66$ ) IC. 76.88-88.32	89.57 ( $\pm 8.61$ ) IC. 86.61-92.53	85.04 ( $\pm 7.81$ ) IC. 82.36-87.73	77.58 ( $\pm 8.21$ ) IC. 74.76-80.40
<b>Internal Medicine (n=11)</b>	75.98 ( $\pm 9.79$ ) IC. 69.40-82.56	92.48 ( $\pm 4.48$ ) IC. 89.46-95.49	91.82 ( $\pm 6.03$ ) IC. 87.77-95.87	84.03 ( $\pm 6.13$ ) IC. 79.91-88.15	72.73 ( $\pm 7.78$ ) IC. 67.50-77.95
<b>Pediatric (n=4)</b>	80.07 ( $\pm 10.47$ ) IC. 63.40-96.73	90.18 ( $\pm 2.67$ ) IC. 85.93-94.42	92.50 ( $\pm 9.57$ ) IC. 77.27-107.73	85.82 ( $\pm 4.37$ ) IC. 78.86-92.76	75.96 ( $\pm 7.28$ ) IC. 64.37-87.55
<b>Emergency Physi- cians (n=10)</b>	75.61 ( $\pm 7.40$ ) IC. 70.31-80.90	27.78 ( $\pm 35.95$ ) IC. 2.06-53.50	80.00 ( $\pm 0.00$ ) IC. 80.00-80.00	67.36 ( $\pm 9.67$ ) IC. 60.44-74.28	66.45 ( $\pm 11.88$ ) IC. 57.95-74.94
<b>Total (n=85)</b>	78.76 ( $\pm 10.46$ ) IC. 76.50-81.01	75.26 ( $\pm 27.67$ ) IC. 69.29-81.22	87.29 ( $\pm 7.96$ ) IC. 85.58-89.01	80.62 ( $\pm 9.59$ ) IC. 78.54-82.69	73.70 ( $\pm 9.27$ ) IC. 71.70-75.70

$\mu$ : Mean,  $\pm$ : Standard deviation, IC95%: Confidence Interval, LI: Lower Limit, LS: Upper Limit. ANOVA Test for Quality Components and Specialty Courses  $p=0.001$

It is noteworthy that 10.8% of the scholarship holders report having some type of publication before the seminar, 51.4% report only having studied subjects related to research methodology, 2.7% report having completed workshops or introductory courses on the methodology, and 35.1% report not having any type of background on research



methodology, without statistical significance ( $p>0.5$ ) that is related to the quality of the final projects.

When evaluating the quality of the final project through the rubric, a lower performance was observed in the section referring to "Material and methods" and in "Bibliographic references in Vancouver Format", in both cases, they were not structured according to the resources and guidelines granted on the Moodle® platform.

A satisfaction survey was applied with a consistency of 0.742 of Cronbach's alpha in which 74 (87.1%) participants. In the first section, 47 (63.5%) scholarship holders refer to satisfaction related to the student as "good". In the second section, 30 (40.5%) scholarship holders refer to their satisfaction with the development of the course as "bad". In the third section, 37 (50%) scholarship holders refer to their satisfaction with the teachers of the course as "good". In the fourth section, 44 (59.5%) scholarship holders refer to as "good" the satisfaction related to the development of the program. The global satisfaction of the course was referred to as good by 62.2%. We observed a positive relationship between the scope of evaluation obtained in the course and the level of satisfaction evaluated by the student. **Table 3**

**Table 3.** Frequency of satisfaction per dimension and global.

	Excellent $\mu$ (%) IC. LI-LS	Good $\mu$ (%) IC. LI-LS	Bad $\mu$ (%) IC. LI-LS
SATISFACTION RELATED TO THE STUDENT	14 (18.9%) IC. 10.8-27.0	47 (63.5%) IC. 54.1-75.4	13 (17.6%) IC. 8.3-25.4
SATISFACTION WITH THE DEVELOPMENT OF THE COURSE	18 (24.3%) IC. 13.7-35.1	26 (35.1%) IC. 24.3-47.3	30 (40.5%) IC. 26.4-50.9
SATISFACTION WITH THE TEACHERS OF THE COURSE	18 (24.3%) IC. 15.1-33.8	37 (50.0%) IC. 37.0-62.2	19 (25.7%) IC. 17.6-36.5
SATISFACTION RELATED TO THE DEVELOPMENT OF THE PROGRAM	24 (32.4%) IC. 21.6-44.6	44 (59.5%) IC. 47.3-68.9	6 (8.1%) IC. 2.9-13.5
COURSE SATISFACTION LEVEL	15 (20.3%) IC. 12.2-31.1	46 (62.2%) IC. 50.2-71.4	13 (17.6%) IC. 6.1-27.0

$\mu$ : Mean, %: Percentage, IC95%: Confidence Interval, LI: Lower Limit, LS: Upper Limit. ANOVA Test for Quality Components and Specialty Courses  $p=0.001$ .

#### 4. Discussion

The Research Seminar is part of the Unique Program of Medical Specialties (PUEM), in a transversal way it is located in the curricular map during the entire duration of the specialty program in question regardless of whether it is medical or surgical [14]. In this research it is proposed to prove that the exercise of education through a virtual classroom with the implementation of a course with b-learning modality and a standardized evaluation system with rubrics favorably affects the quality of the research products and improve the investigative skills of the specialist doctor who is being trained.

The UNAM School of Medicine carried out a study that exposed the experience with a b-learning program of the research seminar for medical residents taught from 2010 to 2016, it refers to a passing rate of 92.4% with an overall rating of 89.0 ( $\pm 1.09$ ). The program also included the implementation of didactic guides for the elaboration of the final product, continuous training for tutors to manage the Moodle platform, resource update for medical residents, and a tutoring model with a pedagogical reference Advisor-Tutor-Resident (ATR) to improve the phenomenon of online tutoring aimed at the teaching process.<sup>15</sup> Although there are already references that tried to prove the positive influence of

the research quality derived from distance courses, the global response of health institutions and educational institutions forced both systems to implement programs at distance in an emerging way, so it is important to evaluate the quality of the products that emanate from this type of distance education.

Research by itself is part of one of the three training pillars of the health professional and about the area of medicine and medical specialties it is present within the curricular maps of both undergraduate and specialty courses, however, it is a reference that only 4% of the undergraduate and specialties enrollment have scientific dissemination projects although 100% of specialists trained in the area of medicine have research projects, so when analyzing the quality of these research projects as a complex construct formed from the generation process during the research seminars allows us to get closer to understanding this phenomenon where there is a long stretch to work on so that research becomes an ability, dexterity, and competence applicable in a useful way by the specialist in medicine.

Comparing the results obtained in our study with those referred to [15], we have an overall score of 80.61 ( $\pm 3.96$ ), slightly lower than Ponce et al. A guide-manual for the development of the research protocol was also included; even though, observed weakness during the specialty programs the student ideally requires a clinical tutor accompanied by a methodological tutor, although there is clinical teaching staff, few have the training for the research area.

When evaluating the satisfaction of the course in our research, 50% of scholarship holders referred as "good" and 18 (24.3%) as "bad". It has been investigated in other studies where tested the teacher's satisfaction with the performance of the course, as in the study carried out by Gonzalez Martinez [16], likewise it is observed that by obtaining better results in the course the level of satisfaction increases ( $p < 0.05$ ).

The use of rubrics was essential for the timely evaluation of each activity in this research seminar, its application was from this year and even though certain rubrics were already applied in isolated modules, the evaluation of the final product was not concrete and disagreed both among tutors and interns. Urias et. [17], all in their study points out that the evaluation rubrics offer a positive impact on the learning process, due to the standardization of criteria, and Morales-Lopez et al. [18], pointed out that the rubrics are means to transmit quality criteria of the task and thus improve the quality of activities. In our study, the standardized rubrics were a resource with great educational potential, they allowed us to intertwine the relationship between the learning, teaching, and evaluation process, at the same time clarifying which phases of the elaboration of the final product were of less use.

It is noteworthy that as a strength in this study, having carried out the prior standardization of teachers, professors, and tutors with the rubrics allows the actors of the educational process to clarify the abilities, knowledge, and skills that are intended to be developed during the course.

The overall average of the final product rating was 87.29 ( $\pm 7.96$ ), so it is considered that the quality of the research protocols was good. There is a direct relationship between the degree of satisfaction and the final score because the higher the score, the higher the satisfaction, as is the case of family medicine and internal medicine. Flores K, et al. [19] mentions that it is necessary to pay attention to the multiple criteria that make up the quality of a b-learning course and its activities. In turn, the satisfaction survey allowed us to visualize the highlights that need to be fed back to improve the research seminar: the format and practicality of the contents, the clarity, and diversity of the activities, the structure of the course, and the interactivity between teachers and students.

## 5. Conclusions

Postgraduate education institutions, realizing that the educational needs and expectations of students and society, in general, cannot be adequately met in a face-to-face modality due to the epidemiological context in which we currently find ourselves, gender as an immediate response education with online modality. Although the relevance of this

modality continues to be studied, in this study we conclude teaching of the research seminar in b-learning modality as a response to the educational need in medical residents for the field of health education showed a relationship between higher qualification, higher satisfaction, as well as determined that the comprehensive evaluation through the use of standardized rubrics allowed to delimit the deficiencies and strengths for timely feedback influencing the process of acquiring skills and the quality of the final product. However, there are still deficiencies in the program, which thanks to a combination of the perspective of the student and the teacher, allows us to provide feedback and improve our research seminar to provide even higher quality in health education and research.

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