



Assessing Critical Thinking: Reliability Testing of an Analytic Rubric for Short Answer Responses in First-Year MBBS Students

Anita Rani, Heena Singh, Pratibha Shakya, Noor US Saba and Garima Sehgal
Department of Anatomy, King George's Medical University, UP, Lucknow
anitarani@kgmcindia.edu

ABSTRACT ID :
000146. 03.36

Background

In Competency-Based Medical Education (CBME), assessment emphasizes internalizing and applying key concepts.

Short Essay Questions (SEQs), designed to assess critical thinking through clinical vignettes, are commonly used.

However, SEQs often suffer from subjectivity and inter-rater variability.

This study tests the reliability of a pre-validated analytic rubric designed to enhance objectivity in grading SEQs in the first-year MBBS program.

Objective

To compare the consistency of scores awarded by teachers using conventional methods and rubric-based marking.

Methods

A neuroanatomy-based SEQ assessing critical thinking on upper and lower motor neuron lesions was evaluated for 50 randomly selected students.

Four independent raters evaluated the responses: two using conventional methods and two with the aid of a rubric.

Scores were analyzed for inter-rater reliability using the intraclass correlation coefficient (ICC).

Cohen's Kappa was used to assess the ability to categorize responses into satisfactory, or unsatisfactory.

Test Scores
N= 50

Teacher 1
Conventional Method

Teacher 3
Rubric Guided

Teacher 2
Conventional Method

Teacher 4
Rubric Guided

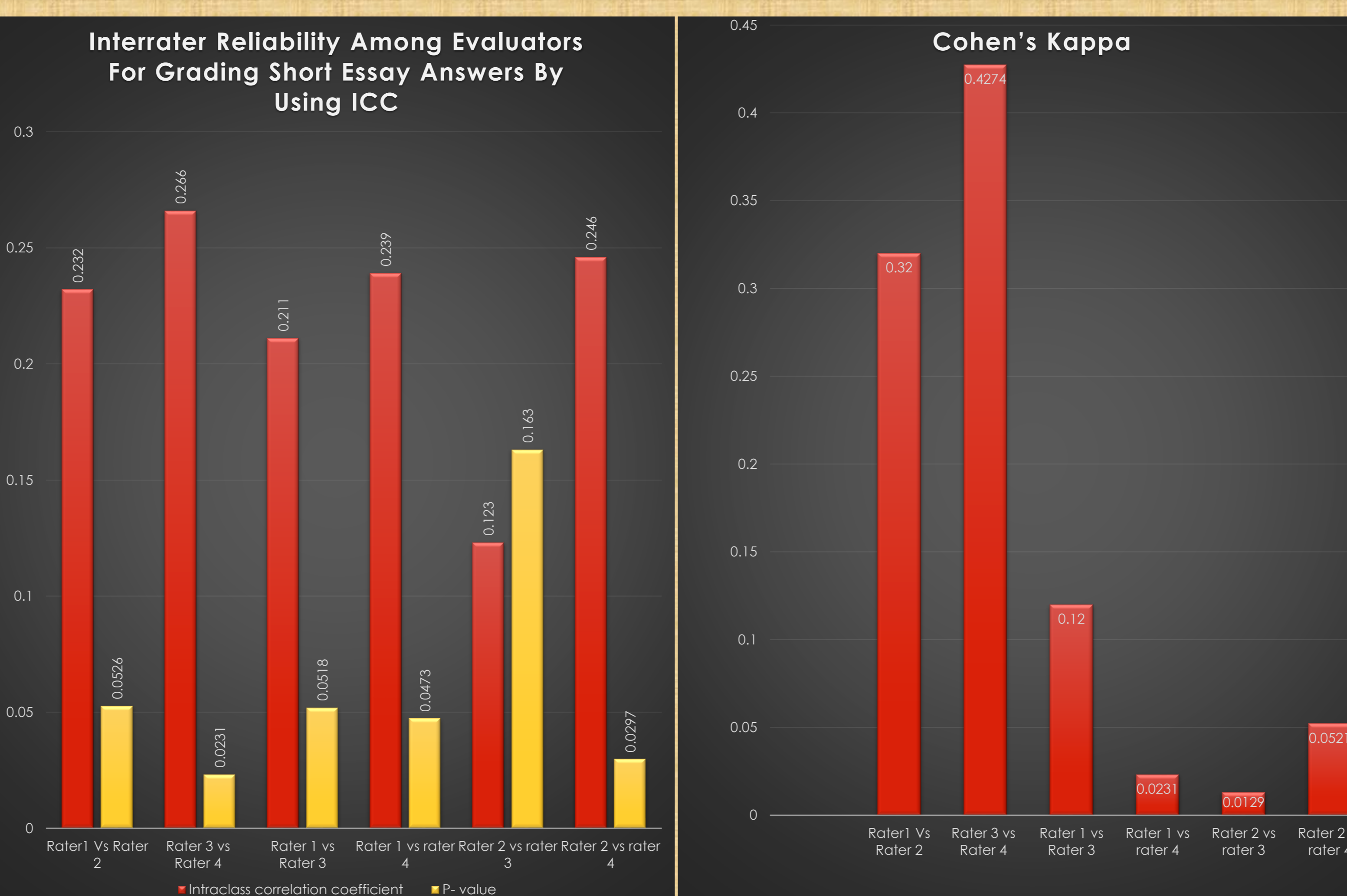
SN	Criteria / Levels	Good >75%	Satisfactory 50-75%	Unsatisfactory < 50%
1	Defining the condition [E.g.: Deformity/Sign/Symptom]	A: Proper explanation of all the key terms involved reflecting clear understanding of the given condition.	B: Some key terms related to the condition are partially explained but unable to express clear understanding.	C: Completely missed explaining the key terms related to the given conditions
2	Description of anatomical facts related to the given condition	A: Complete description of all the key anatomical facts involved in the given condition	B: Description of some key anatomical facts is unclear	C: Description of key facts missing Or Description of unrelated facts
3	Diagrams used for supporting/ replacing anatomical facts	A: Drawing of diagram to show the program to directly involves in the condition with correct labelling	B: Drawing accurate diagram but is disproportionate with minor mispositioning of Key structures with correct labelling	C: Drawing diagram unrelated to the anatomical facts related to the condition or with major defects in the location of structures with incorrect labelling
4	Expression of problem-solving ability	A: Reason/cause for all anatomical defects explained properly	B: Reason/cause for some anatomical defects explained properly.	C: Incorrect reason/cause for anatomical defects
5	Flow of information or thought process	A: Proper organization of thoughts, conveying a logical and clear explanation of all key issues	B: Proper organization of thoughts, conveying a logical and clear explanation of some key issues	C: Haphazard organization of thoughts unable to express a meaningful understanding
6	Writing conventions	A: All key terms spelled correctly, consistent meaning and proper use of punctuation	B: Some key terms spelled incorrectly, Use of correct punctuation and proper use of punctuation	C: Many spelling mistakes including key terms interfering interpretation of information. No sentences /Poor sentence structure impeding comprehension. Errors distract the reader.
7	Handwriting	A: Writing is Legible	B: Could read with effort	C: Very poor handwriting prevents from reading the text

Pre-validated Analytic Rubrics
• 7 Criteria
• 3 Levels of performance
• Good >75%
• Satisfactory 50-75%
• Unsatisfactory <50%

Criteria	Level Good	Level Satisfactory	Level Unsatisfactory
Description of key clinical terms	10	5	0
Description of related anatomical facts	8	4	0
Supporting Diagrams	7	3.5	0
Problem solving statements	10	5	0
Flow of Information	10	5	0
Writing Conventions	3	1.5	0
Handwriting	2	1	0
Total	50	25	0

Criteria	Level Good	Level Satisfactory	Level Unsatisfactory
Description of key clinical terms	10		
Description of related anatomical facts		4	
Supporting Diagrams			0
Problem solving statements		5	
Flow of Information		5	
Writing Conventions		1.5	
Handwriting		1	
Total	26.5/10= 2.65 out of 5 [Satisfactory]		

Grading Scheme



Interrater reliability by using ICC and Cohen Kappa

Interrater reliability among evaluators for grading Short Essay Answers

S/N	Teacher groups	Intraclass correlation coefficient	P- value
1	1 Vs 2	0.232	0.0526
2	3 vs 4	0.266	0.0231
3	1 vs 3	0.211	0.0518
4	1 vs 4	0.239	0.0473
5	2 vs 3	0.123	0.163
6	2 vs 4	0.246	0.0297

The intra class correlation coefficient was calculated to check the agreement between raters with the help of the two way ANOVA model by using R software version 4.3.0.

SN	Rater	Cohen's Kappa	Interpretation
			Agreement Level
1	1 vs 2	0.3200	Fair
2	3 vs 4	0.4274	Moderate
3	1 vs 3	0.1200	Slight
4	1 vs 4	0.0231	No
5	2 vs 3	0.0129	No
6	2 vs 4	0.0521	No

Table showing Inter-rater Reliability among 4 raters (rater1&2: conventional / Rater3 &4: By using Rubrics)

Results

The closer the scores are to each other indicates higher consistency between raters.

A higher Intraclass Correlation Coefficient (ICC) indicates greater inter-rater reliability among evaluators. This means that if one trained rater assigns a score, it is more likely that another similarly trained rater will assign a similar score.

Inter-rater reliability (ICC) was moderate for rubric-based assessments (0.266) compared to conventional methods (0.232).

Specifically, rubric-using raters showed improved consistency, suggesting the rubric reduced variability.

Differences in the ability to demarcate performance levels were more pronounced with the rubric, as shown by Cohen's Kappa.

Conclusions

The study demonstrates that the analytic rubric offers moderate reliability and enhances objectivity in assessing short answer responses.

It can provides both educators and students clearer insights into learning outcomes and can be utilized for self-feedback.

In CBME, use of an analytic rubric can provide a structured and objective tool to assess complex competencies, guiding both learner and educators in identifying specific skill levels and ensure transparent measurable progress.

Challenges

Willingness and Appropriate usage of Analytic Rubric by faculty for preparing sample answers and evaluation based on given criteria to reduce objectivity. To ensure adequate usage by students to enhance required reasoning skills for correlating basic concepts with patients presentation of sign and symptoms.

Acknowledgement: "I extend my heartfelt gratitude to my dedicated co-faculty, and the supportive Head of the Department of Medical Education at KGMU. Their collaboration and guidance have been instrumental in the success of this project, enriching our collective endeavor."

Key References:Rani A, Gupta S, Sehgal G, Singhal R. "Development of an Analytic Rubric for Assessing Written Assignments for Evaluating Higher Order Cognition in the First Phase Neuroanatomy Module." Natl J Clin Anat 2023;12:178-85. doi:10.4103/NJCA.NJCA_103_23.

National Medical Commission (NMC). "UG Curriculum." India: NMC; 2021. Available from: [NMC Website](https://www.nmc.org.in).