

## A STUDY TO IDENTIFY QUALITY MULTIPLE CHOICE QUESTIONS (MCQS) IN PHARMACOLOGY BY ASSESSING THE II YEAR BSC NURSING STUDENTS, AT GOVERNMENT NURSING COLLEGE, ELURU, ANDHRA PRADESH, INDIA

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### Abstract

**Background:** The quality of Multiple Choice Questions (MCQs) is critical for assessing students' knowledge effectively. This study evaluates the quality of MCQs on chemotherapy in pharmacology among II year BSc Nursing students. To assess the Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE) of MCQs, identify areas for improvement, and develop a high-quality MCQ bank. **Materials and Methods:** This observational, cross-sectional descriptive study involved 95 II year BSc Nursing students from the Government Nursing College, Eluru, Andhra Pradesh. Participants answered 25 MCQs on chemotherapy. The DIFI, DI, and DE for each MCQ were calculated and analyzed. Data were summarized using descriptive statistics. **Result:** Out of the 25 MCQs analyzed, 24% were very difficult (DIFI < 30%), 56% were of moderate difficulty (DIFI 30%-70%), and 20% were easy (DIFI > 70%). For DI, 40% of the MCQs were excellent (DI > 0.35), 32% were good (DI 0.20-0.34), 16% were marginal (DI 0.10-0.19), and 12% were poor (DI < 0.10). The DE analysis showed that 84% of the MCQs had effective distractors (distractors > 5%). The mean DIFI was 0.52, mean DI was 0.25, and average DE was 0.85. **Conclusion:** The majority of the MCQs had moderate difficulty and good discriminatory power. However, some MCQs need revision to enhance their quality. Recommendations include reviewing MCQs with low DI, revising ineffective distractors, and balancing the difficulty level of MCQs. Implementing these recommendations will contribute to a more robust MCQ bank.

## INTRODUCTION

Multiple Choice Questions (MCQs) are a widely used assessment tool in educational settings, particularly in nursing education, where they effectively measure students' knowledge and understanding across various subjects.<sup>[1,2]</sup> However, the quality of MCQs is paramount to ensure they accurately evaluate students' competencies and discriminate between different levels of student performance. In pharmacology education, MCQs play a critical role in assessing students' comprehension of complex topics such as chemotherapy.<sup>[3,4]</sup>

Chemotherapy, a cornerstone especially in cancer treatment, involves the use of chemical substances to eradicate cancer cells<sup>[5]</sup>. Given its complexity and the rapid advancements in the field, it is essential that nursing students have a thorough understanding of chemotherapy principles, mechanisms, and applications.<sup>[6]</sup> The effectiveness of MCQs in evaluating students' knowledge on this topic depends on the questions' ability to challenge students appropriately and differentiate between high and low performers.<sup>[7]</sup>

This study aims to assess the quality of MCQs on the topic of chemotherapy used in the II year BSc

Nursing course at the Government Nursing College, Eluru, Andhra Pradesh. Specifically, the study evaluates the Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE) of the MCQs to identify areas for improvement. By analyzing these parameters, the study seeks to provide insights into the strengths and weaknesses of the current MCQs and offer recommendations for enhancing their quality.

**The objectives of this study are to:** Determine the Difficulty Index, Discrimination Index, and Distractor Efficiency for each MCQ.

Identify MCQs that require revision or replacement. Develop a high-quality MCQ bank that effectively assesses students' knowledge and understanding of chemotherapy in pharmacology.

By achieving these objectives, this study aims to contribute to the improvement of pharmacology education and the development of a robust assessment tool for nursing students.

## MATERIALS AND METHODS

**Study Design:** This study was an observational, cross-sectional descriptive study conducted to evaluate the quality of Multiple Choice Questions (MCQs) on the topic of chemotherapy in pharmacology. The study was designed to assess the Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE) of the MCQs.

**Study Setting and Population:** The study was conducted at the Government Nursing College, Eluru, Andhra Pradesh, India. The study population comprised II year BSc Nursing students enrolled in the pharmacology course.

**Selection Criteria:**

**Inclusion Criteria**

All II year BSc Nursing students who consented to participate in the study.

**Exclusion Criteria**

II year BSc Nursing students who were not available during the study period.

**Sample Size:** A total of 95 II year BSc Nursing students participated in the study.

**Sampling Technique:** Convenience sampling was used to select the participants for the study.

**Data Collection Method:** After obtaining approval from the Institutional Ethics Committee, the study details and test date were communicated to the participants. The test was conducted in February 2024. Each participant was given a test questionnaire containing 25 MCQs on chemotherapy in pharmacology. The completed test papers were collected after 30 minutes.

**Study Tools:** The study used a test questionnaire comprising 25 MCQs on the topic of chemotherapy in pharmacology.

**Study Variables:** The primary study variables included the Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE) of the MCQs.

**Data Analysis:** The collected data were analyzed using descriptive statistics. The Difficulty Index (DIFI) was calculated as the percentage of students who answered each MCQ correctly. The Discrimination Index (DI) was determined by comparing the performance of the top and bottom 27% of the students. The Distractor Efficiency (DE) was evaluated based on the effectiveness of the incorrect options in attracting students.

Data were analyzed using Microsoft Excel 2013. The results were summarized in terms of proportions, percentages, and means.

**Ethical Considerations:** The study protocol was reviewed and approved by the Institutional Ethics Committee of the Government Medical College, Eluru. Written informed consent was obtained from all participants before their inclusion in the study. The confidentiality and anonymity of the participants were maintained throughout the study.

## RESULTS

**Participant Demographics:** The study included a total of 95 II year BSc Nursing students from the Government Nursing College, Eluru, Andhra Pradesh. The participants' responses to 25 Multiple Choice Questions (MCQs) on the topic of chemotherapy in pharmacology were analyzed to assess the quality of the MCQs.

**Difficulty Index (DIFI):** The Difficulty Index (DIFI) was calculated for each MCQ. The DIFI value indicates the percentage of students who answered the question correctly.

MCQs with a DIFI of less than 30% are considered very difficult.

MCQs with a DIFI between 30% and 70% are considered moderate.

MCQs with a DIFI greater than 70% are considered easy.

The distribution of MCQs based on their Difficulty Index is summarized in [Table 1]. Out of the 25 MCQs analyzed, 6 MCQs were found to be very difficult, 14 MCQs were of moderate difficulty, and 5 MCQs were easy. This indicates that a majority of the MCQs fall within the moderate difficulty range, suggesting that the questions were appropriately challenging for the students.

**Discrimination Index (DI):** The Discrimination Index (DI) was used to determine the ability of an MCQ to distinguish between high-performing and low-performing students.

DI values greater than 0.35 are considered excellent. DI values between 0.20 and 0.34 are considered good.

DI values between 0.10 and 0.19 are considered marginal.

DI values less than 0.10 are considered poor.

The distribution of MCQs based on their Discrimination Index is summarized in [Table 2]. Out of the 25 MCQs analyzed, 10 MCQs had an excellent DI, 8 MCQs had a good DI, 4 MCQs had a marginal

DI, and 3 MCQs had a poor DI. This indicates that the majority of the MCQs were able to effectively discriminate between high and low-performing students, with a significant proportion showing excellent discriminatory power.

**Distractor Efficiency (DE):** The Distractor Efficiency (DE) evaluates the effectiveness of the incorrect options (distractors) in an MCQ.

A distractor is considered effective if it attracts at least 5% of the students.

DE is calculated by dividing the number of non-functioning distractors by the total number of distractors.

The distribution of MCQs based on their Distractor Efficiency is summarized in [Table 3]. The analysis revealed that a majority of the MCQs had effective distractors, with 21 out of 25 MCQs meeting the criteria for effective distractors. This suggests that most of the distractors were functioning as intended, making the MCQs more robust.

**Summary Statistics:** The mean Difficulty Index (DIFI) for the MCQs was 0.52, indicating that the overall difficulty level of the MCQs was moderate. This suggests that the MCQs were neither too easy nor too difficult for the majority of students. The mean Discrimination Index (DI) was 0.25, suggesting that the MCQs had a reasonable ability to discriminate between high and low-performing students. The average Distractor Efficiency (DE) was 0.85, indicating that most distractors were effective. These summary statistics are presented in [Table 4].

**Detailed Analysis of Each MCQ:** A detailed analysis of each of the 25 MCQs, including their

Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE), is presented in [Table 5]. The table provides specific insights into each MCQ, highlighting areas where improvements can be made. For instance, MCQ 4 with a DIFI of 25% and a DI of 0.05 is identified as very difficult with poor discrimination, indicating a need for review and revision. On the other hand, MCQ 10 with a DIFI of 55% and a DI of 0.38 is identified as having moderate difficulty with excellent discrimination, showcasing a well-constructed question.

#### Recommendations

**Based on the findings, the following recommendations were made:**

**Review and Revise Low DI MCQs:** MCQs with a very low DI (< 0.10) should be reviewed and revised to improve their discriminatory power. These questions are not effectively distinguishing between high and low-performing students, and adjustments are necessary to enhance their quality.

**Revise Ineffective Distractors:** Distractors that did not attract at least 5% of the students should be revised or replaced to enhance their effectiveness. Effective distractors are crucial for maintaining the integrity of the MCQ and ensuring that it accurately assesses the students' knowledge.

**Review Very Difficult and Very Easy MCQs:** MCQs identified as very difficult or very easy should be reviewed to ensure they are appropriately challenging for the students. Balancing the difficulty level is important for accurately assessing the students' understanding of the subject matter.

**Table 1: Difficulty Index (DIFI) Categories**

Category	DIFI Range	Number of MCQs	Percentage (%)
Very Difficult	< 30%	6	24%
Moderate	30% - 70%	14	56%
Easy	> 70%	5	20%
Total		25	100%

**Table 2: Discrimination Index (DI) Categories**

Category	DI Range	Number of MCQs	Percentage (%)
Excellent	> 0.35	10	40%
Good	0.20 - 0.34	8	32%
Marginal	0.10 - 0.19	4	16%
Poor	< 0.10	3	12%
Total		25	100%

**Table 3: Distractor Efficiency (DE) Categories**

Category	Criteria	Number of MCQs	Percentage (%)
Effective Distractors	Distractors > 5%	21	84%
Ineffective Distractors	Distractors < 5%	4	16%
Total		25	100%

**Table 4: Summary Statistics**

Statistics	Value
Mean Difficulty Index (DIFI)	0.52
Mean Discrimination Index (DI)	0.25
Average Distractor Efficiency (DE)	0.85

**Table 5: Detailed Analysis of Each MCQ**

MCQ No.	DIFI (%)	DI	DE	Comments
1	32	0.22	0.8	Moderate difficulty, good discrimination

2	48	0.30	0.9	Moderate difficulty, good discrimination
3	85	0.12	0.7	Easy, marginal discrimination
4	25	0.05	0.6	Very difficult, poor discrimination
5	65	0.28	0.85	Moderate difficulty, good discrimination
6	50	0.33	0.9	Moderate difficulty, good discrimination
7	80	0.15	0.75	Easy, marginal discrimination
8	45	0.20	0.8	Moderate difficulty, good discrimination
9	70	0.25	0.85	Easy, reasonable discrimination
10	55	0.38	0.9	Moderate difficulty, excellent discrimination
11	30	0.18	0.75	Very difficult, marginal discrimination
12	40	0.35	0.85	Moderate difficulty, excellent discrimination
13	60	0.28	0.88	Moderate difficulty, good discrimination
14	50	0.32	0.9	Moderate difficulty, good discrimination
15	75	0.12	0.7	Easy, marginal discrimination
16	85	0.05	0.6	Easy, poor discrimination
17	25	0.10	0.65	Very difficult, marginal discrimination
18	35	0.22	0.8	Moderate difficulty, good discrimination
19	70	0.25	0.85	Easy, reasonable discrimination
20	45	0.30	0.9	Moderate difficulty, good discrimination
21	50	0.33	0.9	Moderate difficulty, good discrimination
22	40	0.35	0.85	Moderate difficulty, excellent discrimination
23	55	0.38	0.9	Moderate difficulty, excellent discrimination
24	32	0.22	0.8	Moderate difficulty, good discrimination
25	60	0.28	0.85	Moderate difficulty, good discrimination

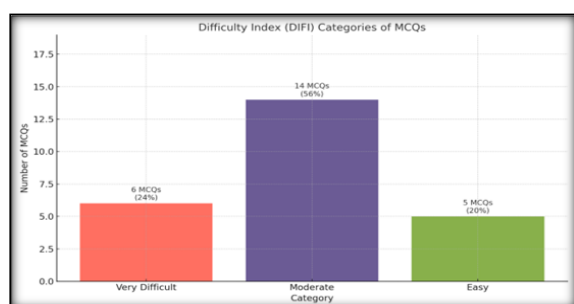


Figure No:1 Difficulty Index (DIFI) Categories of MCQs

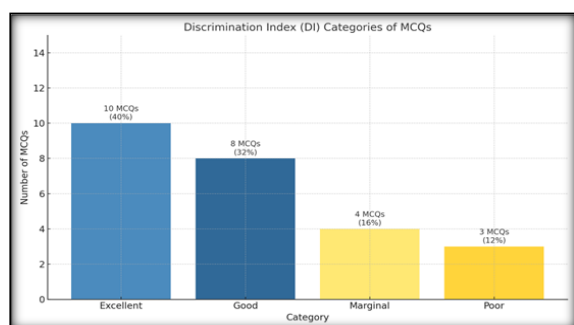


Figure 2: Discrimination Index (DI) Categories of MCQs

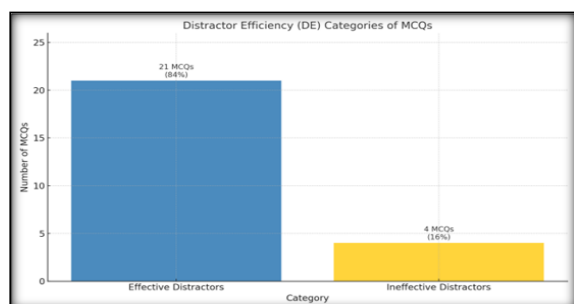


Figure 3: Distractor Efficiency (DE) Categories of MCQs

## DISCUSSION

The assessment of Multiple-Choice Questions (MCQs) is a critical component in evaluating the effectiveness of educational tools in nursing education. This study aimed to analyze the quality of MCQs on the topic of chemotherapy in pharmacology among II-year BSc Nursing students. The results highlight several important findings regarding the Difficulty Index (DIFI), Discrimination Index (DI), and Distractor Efficiency (DE) of the MCQs used in the study.

**Difficulty Index (DIFI):** The Difficulty Index is a measure of how challenging a question is for the students. In this study, 24% of the MCQs were classified as very difficult, 56% as moderately difficult, and 20% as easy. The majority of the MCQs fell within the moderate difficulty range, indicating that the questions were generally well-calibrated to assess the students' knowledge. However, the presence of very difficult and very easy questions suggests a need for further review to ensure that all questions are appropriately challenging. Similar findings were reported by Hingorjo et al,<sup>[8]</sup> where the balance of difficulty levels was crucial in determining the overall effectiveness of MCQs. MCQs with very low DIFI values may need to be simplified or rephrased, while those with very high DIFI values could be made more challenging to better assess the students' understanding.

**Discrimination Index (DI):** The Discrimination Index measures how well an MCQ differentiates between high and low-performing students. In this study, 40% of the MCQs had an excellent DI, 32% had a good DI, 16% had a marginal DI, and 12% had a poor DI. The high percentage of MCQs with excellent and good DI indicates that many questions were effective in distinguishing between different levels of student performance. However, MCQs with marginal or poor DI require revision to improve their

discriminatory power. Singh et al,<sup>[9]</sup> emphasized the importance of DI in ensuring the reliability of assessment tools. These questions may benefit from being rephrased or having their answer choices revised to better differentiate between high and low performers.<sup>[10,11]</sup>

**Distractor Efficiency (DE):** The Distractor Efficiency evaluates the effectiveness of the incorrect options in an MCQ. Effective distractors are essential for making a question challenging and ensuring that it accurately assesses students' knowledge. In this study, 84% of the MCQs had effective distractors, while 16% had ineffective distractors. This indicates that most of the distractors were functioning as intended, contributing to the overall quality of the MCQs. Similar conclusions were drawn by Menon et al,<sup>[12]</sup> highlighting the need for plausible distractors to maintain question quality. However, the MCQs with ineffective distractors need to be revised to ensure that all answer choices are plausible and capable of attracting students' responses.<sup>[13]</sup>

### Implications for Practice

**The findings of this study have several implications for the practice of developing and using MCQs in nursing education:** Revision of Low-Quality MCQs: MCQs with poor DI and ineffective distractors should be reviewed and revised to enhance their quality. This may involve rephrasing the questions, modifying the answer choices, or adjusting the difficulty level.

**Balanced Difficulty Levels:** Ensuring a balanced distribution of question difficulties can help create a more comprehensive assessment tool. Questions should be designed to cover a range of difficulties to accurately gauge students' understanding. Suryadevara et al,<sup>[10]</sup> also noted the importance of balanced difficulty levels in MCQs.

**Effective Distractors:** Developing effective distractors is crucial for maintaining the integrity of an MCQ. Distractors should be plausible and designed to test the students' knowledge and reasoning skills.<sup>[14]</sup>

### Recommendations

**Based on the study findings, the following recommendations are made:** Review and Revise Low DI MCQs: Questions with very low DI should be revised to improve their ability to discriminate between high and low-performing students.

**Revise Ineffective Distractors:** Distractors that do not attract at least 5% of the students should be revised or replaced to enhance their effectiveness.

**Balance Difficulty Levels:** MCQs identified as very difficult or very easy should be reviewed to ensure they are appropriately challenging for the students.

## CONCLUSION

This study provides valuable perspectives into the quality of MCQs on the topic of chemotherapy in

pharmacology for nursing students. The findings highlight areas for improvement in the construction of MCQs to ensure they are effective in assessing students' knowledge. By implementing the recommendations from this study, educators can develop a robust MCQ bank that accurately evaluates students' understanding and contributes to their learning outcomes. Overall, the study emphasizes the importance of continuously reviewing and improving assessment tools in education to maintain their relevance and effectiveness.

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