

## Evaluation of Outcomes of Blended Learning Approach in Teaching Pharmacology: A Mixed Methods Study

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**Abstract:** Today's medical educators are facing different challenges than their predecessors in teaching tomorrow's physicians. An Innovative teaching and learning method, Blended learning (Mixed methods learning) transforms the role of teachers and learners, where educators will become more involved as facilitators of learning and assessors of competency. The aim of this study was to evaluate the effectiveness of blended-learning approach in teaching. A study was conducted on 81 medical under-graduate students with the help of Bloom's taxonomy as a measuring tool for evaluating various levels of cognitive knowledge skills of learning. Initially a Pre-test comprising 15 multiple choice and one word answer questions, was conducted, followed by self learning, group discussions, peer group presentations and an interactive session, facilitated by a faculty member. At the end, a Post-test was conducted with the same questionnaire which was used for Pre-test. Finally changes in various levels of cognitive domain of study students were evaluated by comparing the percentages of rightly answered questions, wrongly answered questions and not answered questions in Pre-test and Post-test. In the study a gross improvement in Level-I, and moderate improvement in Level-II and level-III of cognitive knowledge skills of learning was observed in most of the study students.

**Keywords:** Blended learning, Bloom's taxonomy, cognitive domain, Pre-test, Post-test .

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### I. Introduction

Today's medical educators are facing different challenges than their predecessors in teaching tomorrow's physicians. In the past few decades, changes in health care delivery and advances in medicine have increased demands on academic faculty, resulting in less time for teaching than has previously been the case.[1]. Traditional instructor-centred teaching is yielding to a learner-centred model that puts learners in control of their own learning. A recent shift toward competency-based curricula emphasizes the learning outcome, not the process, of education.[2]. Innovations in teaching and learning methods point toward a revolution in education, allowing learning to be individualized (adaptive learning), enhancing learner's interactions with others by collaborative and Blended learning methods and transforming the role of teachers and learners.

In Blended learning approach where educators will no longer serve mainly as distributors of content, but will become more involved as facilitators of learning and assessors of competency. This type of learning activities provide students with opportunities not only to remember, understand, apply and also to analyse, synthesize, and evaluate their ideas together. This means facilitating discussion and interaction so that students are forced to go beyond mere statements of opinion.[3].

In the processes of thinking and learning, the first systematic method of classification for thinking behaviours of learners that were believed to be important in the processes of learning, was Bloom's Taxonomy (1956) which mainly presents three domains in learning process[4].

- **The cognitive** - knowledge based domain, consisting of six levels
- **The affective** - attitudinal based domain, consisting of five levels and
- **The psychomotor** - skills based domain, consisting of six levels.

In the Revised Bloom's Taxonomy (Anderson, & Krathwohl, 2001)the previous cognitive, knowledge based domain, consisting of six levels has taken the form of a two-dimensional table[5]. One of the dimensions identifies The Knowledge Dimension (or the kind of knowledge to be learned) while the second identifies The Cognitive Process Dimension (or the process used to learn).The Knowledge Dimension on the left side is composed of four levels that are defined as Factual, Conceptual, Procedural, and Meta-Cognitive. The Cognitive Process Dimension across the top of the grid consists of six levels that are defined as Remember, Understand, Apply, Analyze, Evaluate, and Create. Each level of both dimensions of the table is subdivided.

## II. Aim & Objectives

The aim of this study was to evaluate the effectiveness of a blended-learning approach in teaching Pharmacology to the medical undergraduate students and to know the changes in levels of cognitive knowledge skills in learning process by Blended learning approach.

## III. Materials & Methods

After obtaining an authentic permission from the research authority of the institution, a Blended-learning (mixed-methods) study was conducted on MBBS (III semester -Second MBBS) students at Guntur Medical college. 81 students, who attended Seminars session, which was one of the two practical sessions, as per the Pharmacology monthly teaching schedule, were assessed in this study. First, Students allocated to the blended-learning model received a Pre-test which contained 15 questions from the pharmacology topics selected for the blended learning. Out of 15 questions, some were Multiple Choice questions and some were one word answer questions to assess different levels of cognitive Knowledge. Later ample time was given to support self-directed learning and for small group (6-8) discussions on already scheduled topics. The discussions were facilitated by a faculty member. At the end of the discussions, four members each one from different groups who were assigned previously as per the monthly schedule, presented the topics orally and with the help of Chalk and black board. After every presentation, an interactive session involving questions, answers, explanations from all the students and also each presenter, was conducted. The entire session was facilitated by the faculty member. Finally, a Post-test was conducted, by using the same questions which were used in the Pre-test. At the end of study both the Pre-test and Post-test papers answered by the students were analyzed for the various levels of cognitive knowledge of learning process. The results were presented in an appropriate statistical forms.

## IV. Results

### 4.1 Results of Pre-test:

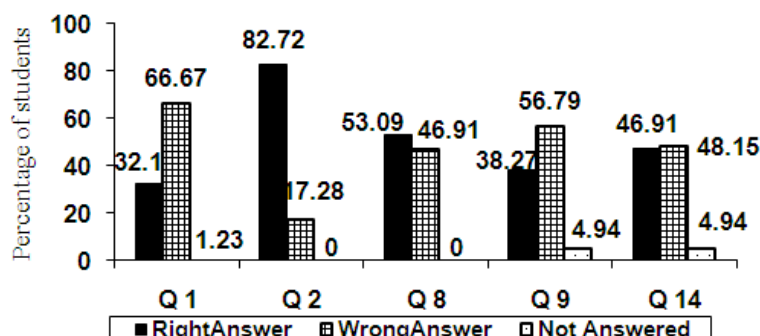


Figure-1- Pre-test- Level -I Questions

Among Level I questions of Pre-test : Out of 81 students, For Q1, 32% (26) of students rightly answered, 67% (54) wrongly answered and 1% (1) not at all answered. For Q2, 83% (67) of students rightly answered, 17% (14) wrongly answered. For Q8, 53% (43) of students rightly answered, 47% (38) wrongly answered. For Q9, 38% (31) of students rightly answered, 57% (46) wrongly answered and 5% (4) not at all answered. For Q14, 47% (38) of students rightly answered, 48% (39) wrongly answered and 5% (4) not at all answered.

Among all Level I questions of Pre-test, 83% was the maximum percentage of students with right answer and 32% was the minimum percentage of students with right answer. All 81 students (100%) answered Q2 and Q8 ("Fig.-1").

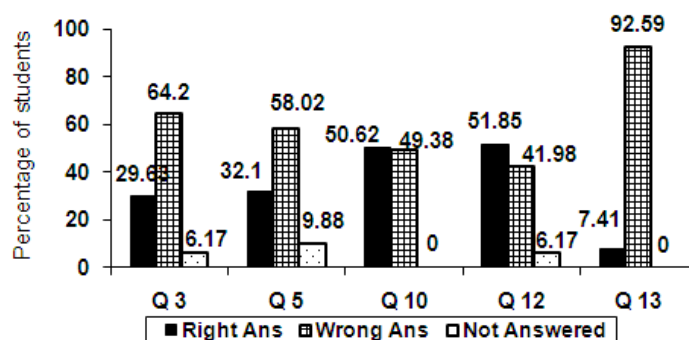
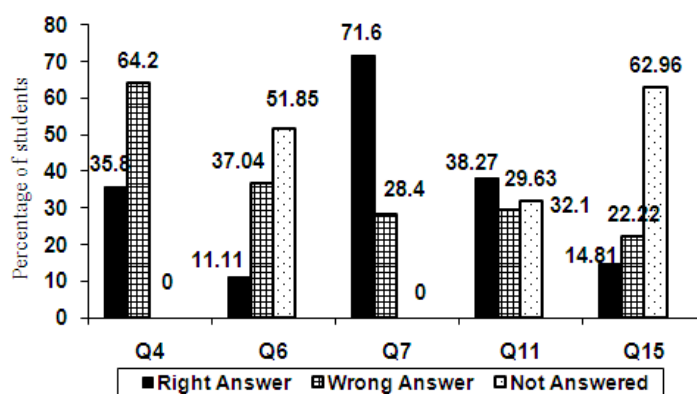


Figure-2 - Pre-test- Level -II Questions

Among level II questions of Pre-test : Out of 81 students, For Q3, 30% (24) of students rightly answered, 64%(52) wrongly answered and 6%(5)not at all answered. For Q5, 32%(26) of students rightly answered, 58%(47) wrongly answered, 10%(8)not at all answered. For Q10, 51% (41) of students rightly answered, 49%(40) wrongly answered. For Q12, 52% (42) of students rightly answered, 42%(34) wrongly answered and 6%(5)not at all answered. For Q13, 7% (6) of students rightly answered, 93%(75) wrongly answered.

Among all Level II questions of Pre-test, 52% was the maximum percentage of students with right answer and 7% was the minimum percentage of students with right answer. All 81 students (100%) answered Q10 and Q13 ("Fig.-2").

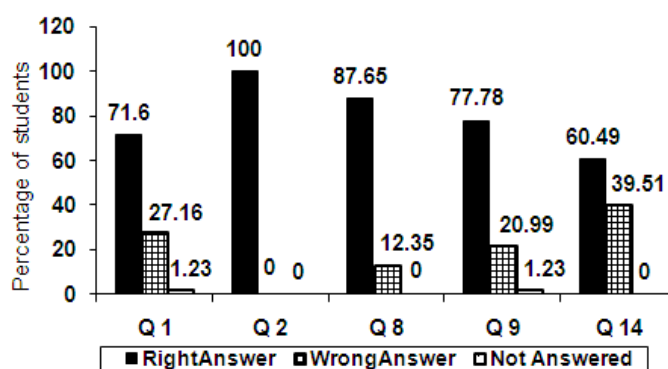


**Figure- 3 - Pre test-Level -III Questions**

Among Level III questions of Pre-test : Out of 81 students, For Q4, 36% (29) of students rightly answered, 64%(52) wrongly answered. For Q6, 11%(9) of students rightly answered, 37%(30) wrongly answered, 52%(42)not at all answered. For Q7, 72% (58) of students rightly answered, 28%(23) wrongly answered. For Q11, 38% (31) of students rightly answered, 30%(24) wrongly answered and 32%(26)not at all answered. For Q15, 15% (12) of students rightly answered, 22%(18) wrongly answered, and 63%(51)not at all answered.

Among all Level III questions of Pre-test, 72% was the maximum percentage of students with right answer and 11% was the minimum percentage of students with right answer. All 81 students (100%) answered Q4 and Q7 ("Fig.-3").

4.2 Results of Post-test :



**Figure- 4 - Post-test-Level - I Questions**

Among Level I questions of Post-test : Out of 81 students, For Q1, 72% (58) of students rightly answered, 27%(22) wrongly answered and 1%(1)not at all answered. For Q2, 100%(81) of students rightly answered. For Q8, 88% (71) of students rightly answered, 12%(10) wrongly answered. For Q9, 78% (63) of students rightly answered, 21%(17) wrongly answered and 1%(1)not at all answered. For Q14, 60% (49) of students rightly answered, 40%(32) wrongly answered.

Among all Level I questions of Post-test, 100% was the maximum percentage of students with right answer and 60% was the minimum percentage of students with right answer. All 81 students (100%) answered Q2, Q8 and Q14 ("Fig.-4").

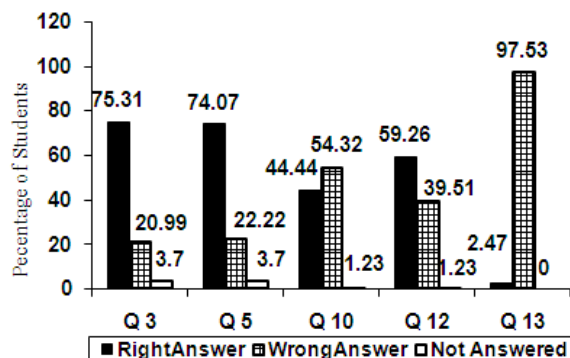


Figure- 5 - Post-test Level - II Questions

Among level II questions of Post-test : Out of 81 students, For Q3, 75% (61) of students rightly answered, 21%(17) wrongly answered and 4%(3)not at all answered. For Q5, 74%(60) of students rightly answered, 22%(18) wrongly answered and 4%(3)not at all answered. For Q10, 45% (36) of students rightly answered, 54%(44) wrongly answered and 1%(1)not at all answered. For Q12, 59% (48) of students rightly answered, 40%(32) wrongly answered and 1%(1)not at all answered. For Q13, 2% (2) of students rightly answered, 98%(79) wrongly answered ("Fig-5").

Among all Level II questions of Post-test, 75% was the maximum percentage of students with right answer and 2% was minimum percentage of students with right answer. All 81 students (100%) answered Q13.

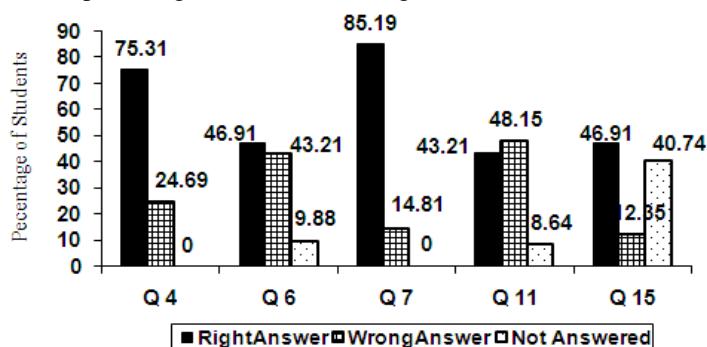


Figure- 6 - Post-test Level - III Questions

Among Level III questions of Post-test : Out of 81 students, For Q4, 75% (61) of students rightly answered, 25%(20) wrongly answered. For Q6, 47%(38) of students rightly answered, 43%(35) wrongly answered, 10%(8)not at all answered. For Q7, 85% (69) of students rightly answered, 15%(12) wrongly answered. For Q11, 43% (35) of students rightly answered, 48%(39) wrongly answered and 9%(7)not at all answered. For Q15, 47% (38) of students rightly answered, 12%(10) wrongly answered, and 41%(33)not at all answered.

Among all Level III questions of Post-test, 85% was the maximum percentage of students with right answer and 43% was the minimum percentage of students with right answer. All 81 students (100%) answered Q4 and Q7 ("Fig-6").

**4.3 Comparison of Average of percentages of students with right answers in each Level of Pre-test and Post-test:**

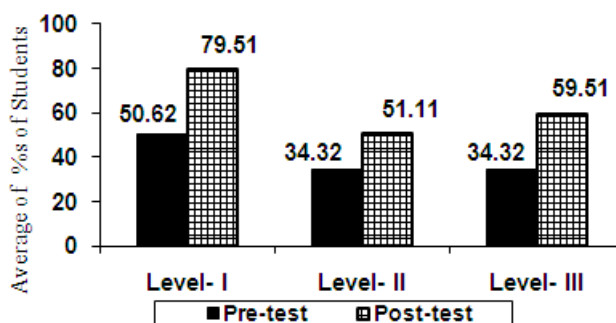


Figure-7- Average of %s of students with Right answers in each Level of Pre-test and Post-test

Among Level I questions of Pre-test and Post-test: Out of 81 students, in pre-test Average of percentages of students rightly answered was 51, and in Post-test Average of percentages of students rightly answered was 80.

Among Level II questions of Pre-test and Post-test: Out of 81 students, in pre-test Average of percentages of students rightly answered was 34 and in Post-test Average of percentages of students rightly answered was 51.

Among Level II questions of Pre-test and Post-test : Out of 81 students, in pre-test Average of percentages of students rightly answered was 34 and in Post-test Average of percentages of students rightly answered was 60

Among all Levels of questions of Pre-test and Post-test, out of 81 students 80 was the maximum Average of percentages of students with right answers in Post-test and 34 was the minimum Average of percentages of students with right answers in both Pre-test and Post-test ("Fig.-7").

## V. Discussion

Out of necessity, teachers must measure their students' ability, accurately doing so requires a classification of levels of intellectual behaviour which is important in learning. Revised Bloom's Taxonomy (Anderson, & Krathwohl, 2001) provided the measurement tool for this.

Bloom's Taxonomy is a multi-tiered model of classifying thinking according to six cognitive levels of complexity. The levels have often been depicted as a stairway, leading many teachers to encourage their students to "climb to a higher (level of) thought." The lowest three levels are: knowledge, comprehension, and application. The highest three levels are: analysis, synthesis, and evaluation. "The taxonomy is hierarchical; [in that] each level is subsumed by the higher levels. In other words, a student functioning at the 'application' level has also mastered the material at the 'knowledge' and 'comprehension' levels." (UW Teaching Academy, 2003).

**Level I - Remembering:** Retrieving, recognizing, and recalling relevant knowledge from long term memory.

**Level II - Understanding:** Constructing meaning from oral, written, and graphic messages through interpreting, exemplifying, classifying, summarizing, inferring, comparing and explaining

**Level III - Applying:** Carrying out or using a procedure through executing, or implementing.

**Level IV - Analyzing:** Breaking material into constituent parts, determining how the parts relate to one another and to an overall structure or purpose through differentiating, organizing, and attributing.

**Level V - Evaluating:** Making judgments based on criteria and standards through checking and critiquing.

**Level VI - Creating:** Putting elements together to form a coherent or functional whole; reorganizing elements into a new pattern or structure through generating, planning, or producing.

Dillenbourg (1999) refers to this as 'Horizontal division' that allows learners to shift roles among members, such as to be the 'teacher', 'active listener and 'leader'. In Blended learning, learners will perform activities like asking questions, providing explanation and navigating the interaction that triggers learning. This will eventually generate both cognitive learning outcomes and social competency.

So a study was conducted to evaluate the effectiveness of Blended learning approach in teaching pharmacology in a group of 81 undergraduate medical (III semester) students. Students allocated to the blended-learning model received a Pre-test which contained 15 questions from the pharmacology topics selected for the blended learning. Ample time was given to support self-directed learning and for small group (6-8) discussions. The faculty involved in the Blended learning approach acted as a facilitator rather than a tutor, in order to facilitate discussion within the group and promote peer to peer learning [6]. Peer to peer learning was facilitated through the use of individual oral presentation method, followed by an interactive session comprising, questions, answers, explanations etc.

In this study, the primary outcome - i.e. changes in levels of cognitive knowledge of the learners was measured by a pre-test and a post-test as measuring tools. This measuring tool was structured with the help of previously validated measuring tool, revised Bloom's Taxonomy, consisting of 15 multiple choice questions and one word answer questions. Out of the 15 questions, 5 questions were to assess the first level, another 5 questions to assess the second level and the remaining 5 questions to assess the third level of cognitive knowledge in learning process. Both the Pre-test and Post-test papers answered by the students were analyzed for the various levels of cognitive knowledge domain of learning process initially and for the changes that occurred after the blended learning approach respectively. In this study a gross improvement in the Level-I cognitive knowledge was observed in most of the study students. In most of the students Moderate Improvement in the Level-II and Level-III cognitive knowledge was noted.

Relatively few studies have empirically examined the effectiveness of blended-learning in medicine, with all studies focusing on the impact of blended-learning in a clinical discipline. Results of those published studies commonly report an increase in student satisfaction with the content, better use of time in class, increase in knowledge and promote self-directed learning [7,8,9].

Like other similar studies, this study has demonstrated the effectiveness of adopting a blended-learning approach to teach pharmacology and provides a framework that integrates with the existing steps of the teaching process.

## **VI. Conclusion**

The findings from this study suggest that a blended-learning approach promotes greater student appreciation and increase in self-confidence in using medical knowledge and principles. This direct application to the medical environment provides an opportunity to bridge the gap between theory and practice. This blended-learning approach was successfully implemented in a small teaching class. Future research is required to investigate whether similar findings are apparent in other branches of undergraduate medical education and the implementation of a such program among a large student cohort.

## **References**

- [1]. Ozuah PO. Undergraduate medical education: thoughts on future challenges. *BMC Med Educ.* 2002;2:8–10. Cited Here... | PubMed | CrossRef
- [2]. Leung WC. Competency based medical training: review. *BMJ.* 2002;325:693–96. Cited Here... | View Full Text | PubMed | CrossRef
- [3]. Constructing Knowledge Together (21–45). Extract from *Tele-collaborative Language Learning. A guidebook to moderating intercultural collaboration online.* M. Dooly (ed.). (2008) Bern: Peter Lang
- [4]. Buckwalter JA, Schumacher R, Albright JP. Use of an educational taxonomy for evaluation of cognitive performance. *J Med Educ.* 1981;56:115-121.
- [5]. Bloom B, Englehart M, Furst E. Taxonomy of educational objectives: The classification of educational goals. *Handbook I: Cognitive domain.* New York, Toronto: Longmans. 1956.
- [6]. Lincoln M, McAllister L: Peer learning in clinical education. *Med Teach* 1993, 15:17-25. PubMed Abstract | Publisher Full Text
- [7]. Lehmann R, Bosse H, Simon A, Nikendei C, Huwendiek S: An innovative blended learning approach using virtual patients as preparation for skills laboratory training: perceptions of students and tutors. *BMC Med Educ* 2013, 13:23. PubMed Abstract | BioMed Central Full Text | PubMed Central Full Text
- [8]. Grasl M, Pokieser P, Gleiss A, Brandstaetter J, Sigmund T, Erovic B, Fischer M: A new blended learning concept for medical students in otolaryngology. *Arch Otolaryngol Head Neck Surg* 2012, 138:358-366. PubMed Abstract | Publisher Full Text
- [9]. Woltering V, Herrler A, Spitzer K, Spreckelsen C: Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Adv Health SciEduc* 2009, 14:725-738. Publisher Full Text