



האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM



Blended learning for elevating cognitive skills, engagement, and academic outcomes

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Pharmacology teaching at HUJI

- B.Pharm
- MD
- DMD
- **BSN**
- B.Sc.Med

Second year nursing students

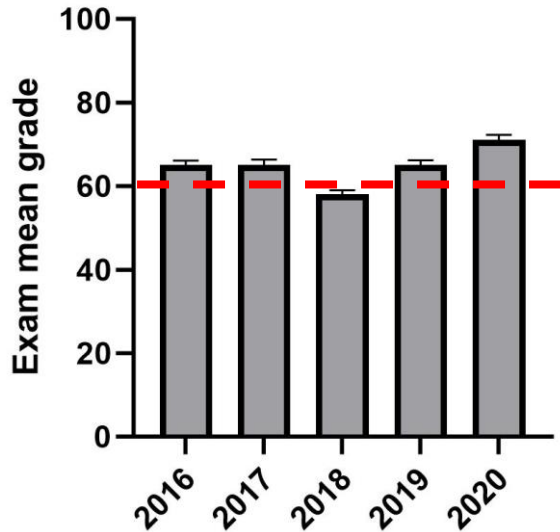
Pharmacology A – 1st semester
Pharmacology B – 2nd semester



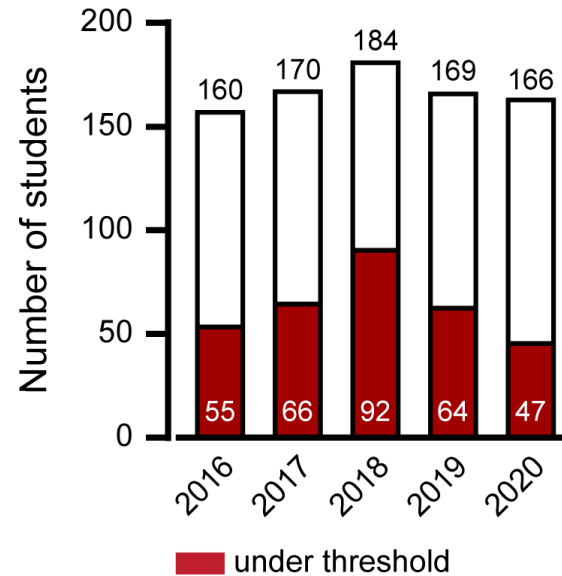
} Lecture-based learning + workshop

Course success evaluation – final exam

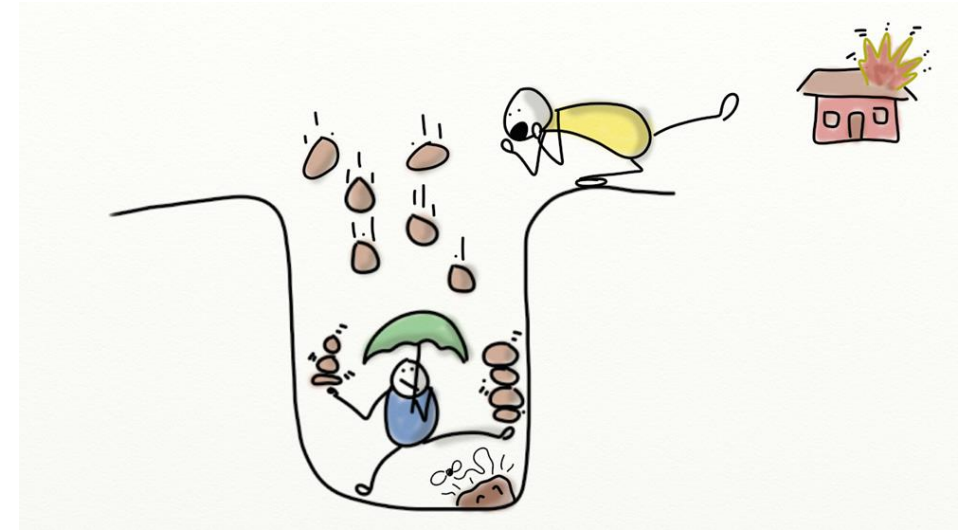
Final exam score
(~64 ± 16)



Failure rate
(~38 ± 16 %)



n=849 students



The problem?

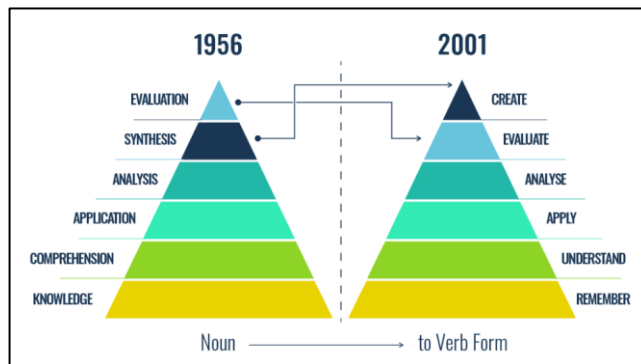
Knowledge?

Skills?

Competencies?



Bloom's Taxonomy of Educational Objectives in Pharmacology



American Journal of Pharmaceutical Education 2012; 76 (6) Article 114.

TEACHERS' TOPICS

Incorporation of Bloom's Taxonomy into Multiple-Choice Examination Questions for a Pharmacotherapeutics Course

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Submitted January 31, 2011; accepted September 28, 2011; published August 10, 2012.

Cognitive levels

1) Remember: Recognizing basic drug knowledge

- Identifying drug names

2) Understand: Interpreting pharmacological concepts

- Explaining how a drug's mechanism of action results in its therapeutic effects

3) Apply: Using theories in new situations

- Selecting a drug, based on a patient's condition

4) Analyze: Differentiating among drug effects

- Determining which of a patient's several drugs could cause a noted side effect

5) Evaluate: Judging therapeutic approaches

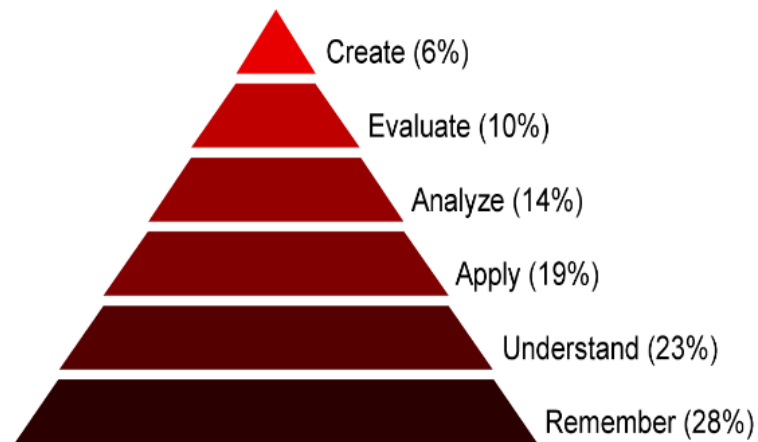
- Ranking drug choices by considering patient factors like age or kidney function

6) Create: Designing new solutions

- Design a new treatment plan to reduce potential drug interactions

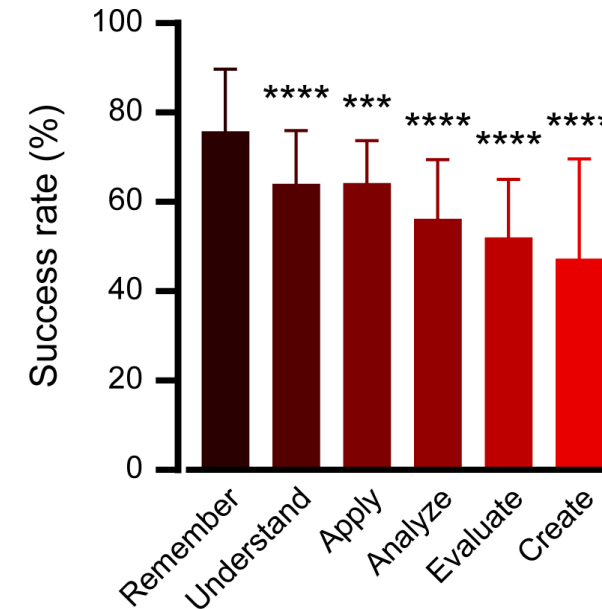
Course test success rates by cognitive question levels

Percentile of course questions in final exams



Years 2016-2020, n=200 questions

Success rates by cognitive question levels



Compared with "Remember". *** $p \leq 0.001$; **** $p \leq 0.0001$; one way ANOVA followed by multiple comparison test



Early implementation of question-based learning in pharmacology training, with a structured focus on all cognitive levels, will enhance student engagement and develop their problem-solving competencies in drug management

The drawback



The blended course model – first step: divisions structure

Learning Division I: Basic Principles

- Learning units:
- *Introduction to pharmacology*
 - *Fundamentals of pharmacokinetics*
 - *Fundamentals of pharmacodynamics and pharmacotherapeutics*
 - *Key types of drug interactions, adverse reactions & toxicity*
 - *Receptors as drug targets*

Learning Division II: Autonomic Nervous System drugs


- Learning units:
- *Introduction to autonomic pharmacology*
 - *Cholinergic drugs*
 - *Anti-cholinergic drugs*
 - *Adrenergic drugs*
 - *Anti-adrenergic drugs*

Learning Division III: Cardiovascular-Renal drugs

- Learning units:
- *Anti-hypertensive agents*
 - *Diuretic agents*
 - *Vasodilators & the treatment of Angina Pectoris*
 - *Drugs used in Heart Failure*
 - *Agents used in Cardiac Arrhythmias*
 - *Drug Therapy for Dyslipidemias*

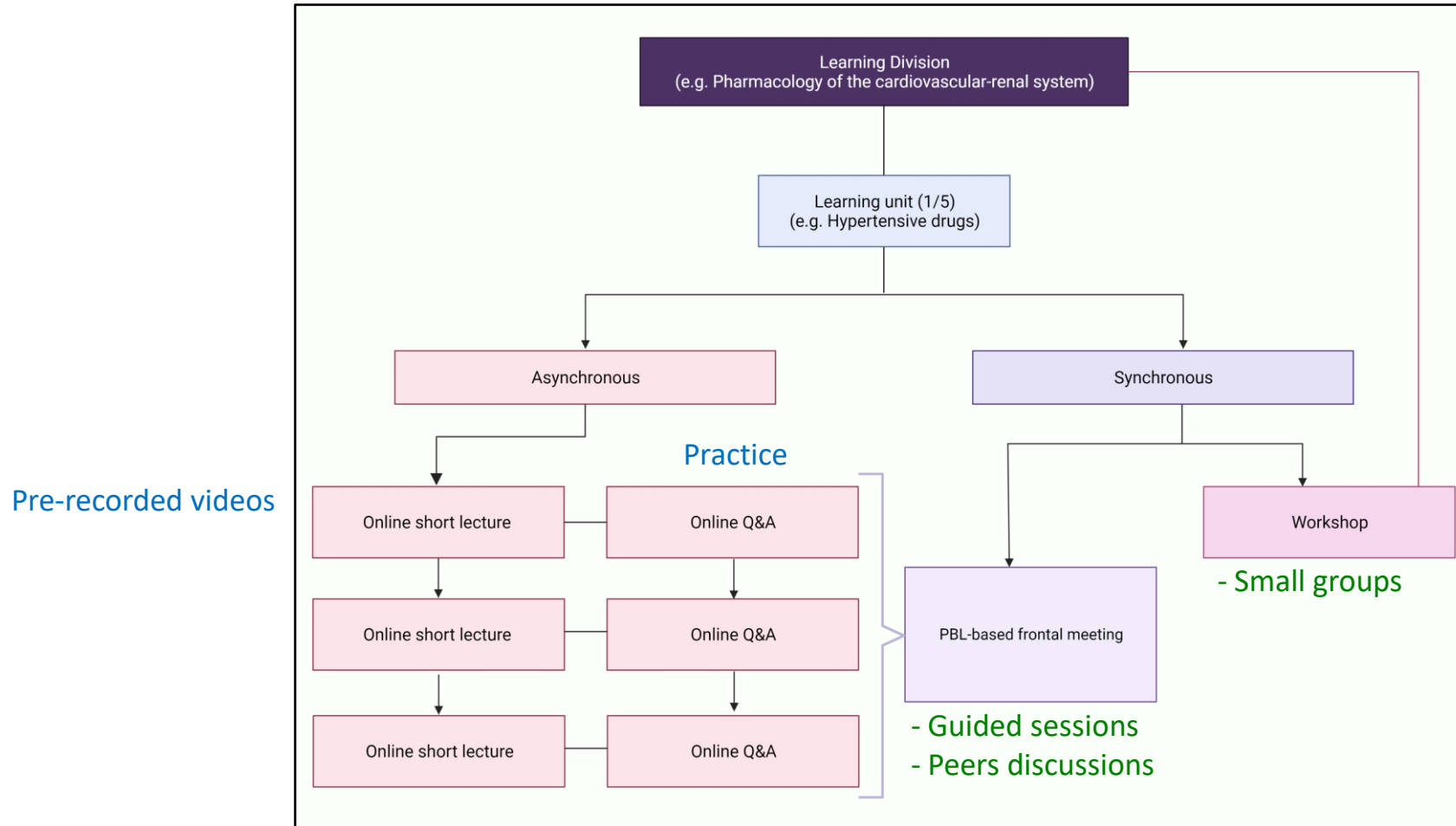
Learning Division IV: Hemostasis; Glucose balance; & Immunity system drugs

- Learning units:
- *Drugs Used in Disorders of Coagulation*
 - *Pharmacotherapy of Diabetes Mellitus*
 - *Anti-inflammatory, Anti-allergy, and Immunosuppressant drugs*
 - *Pulmonary Pharmacotherapy*
-

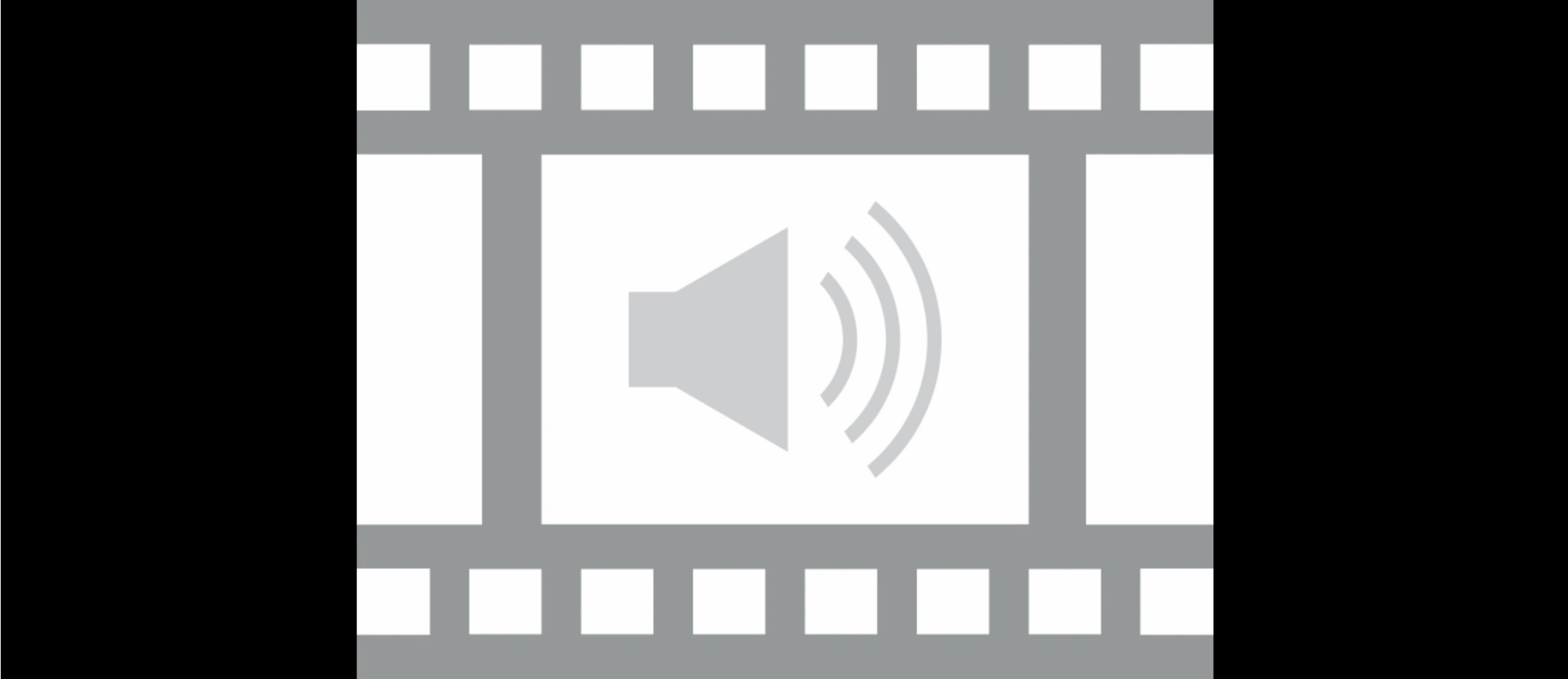


**Practicing all cognitive levels
in each learning unit**

The blended course structure – second step: asynchronous and synchronous activities



The blended course structure online engagement



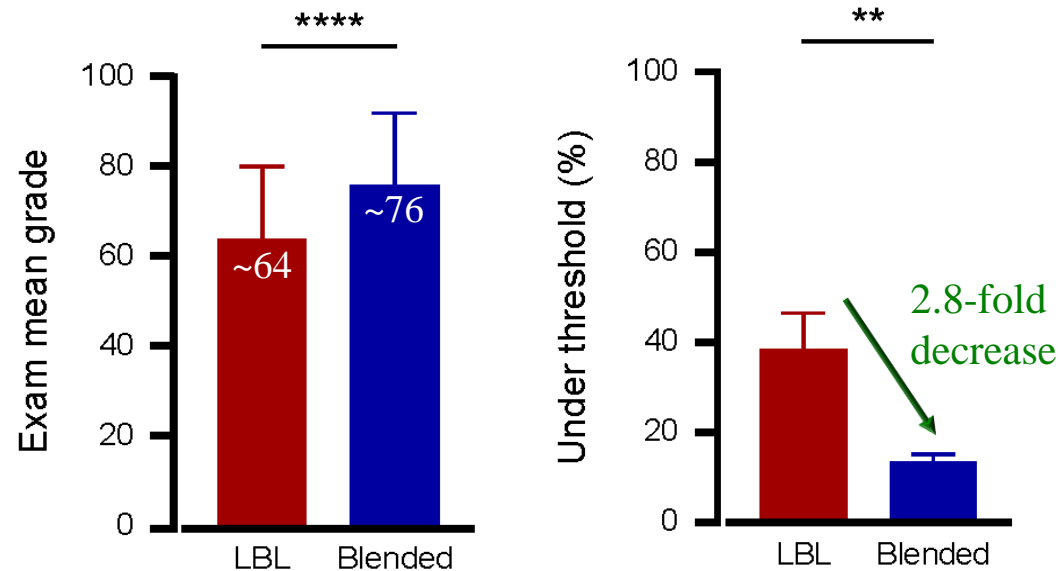
The blended course structure – third step: practice

The screenshot shows a Moodle quiz editor interface in Hebrew. A modal window titled "בחירת סוג שאלה להוספה" (Select question type for addition) is open in the center. The modal contains a list of question types with radio buttons for selection. The "רבי-בירה" (Multiple Choice) option is selected. To the left of the list, there is explanatory text in Hebrew: "שאלת 'רבי-בירה' (Multi Choice) מציגה בפני התלמיד אפשרות בחירה של פריט בודד או מספר פריטים מרשימה שהוגדרה בגוף השאלה. ניתן להציג תמונות ורכיבי מולטימדיה המשובצים בגוף התוכן של הפריטים השונים." Below the list are buttons for "ביטול" (Cancel) and "הוספה" (Add).

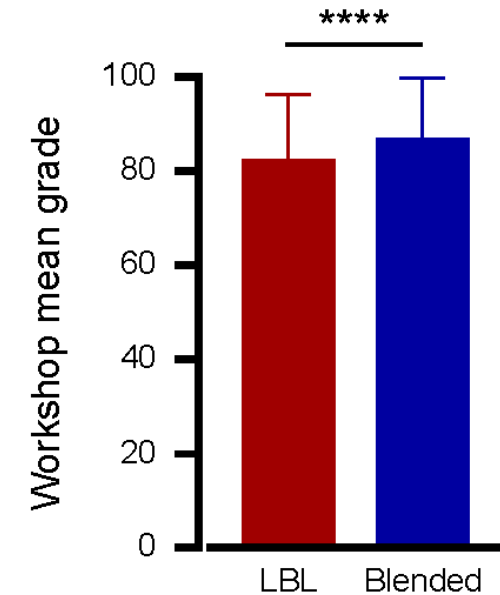
The background interface shows the Moodle course page for "הדר אריהן-זכאי" (Dr. Arieh-Zakai) in the 2022/23 semester. The page includes a navigation menu, a course title "דלת 2022/23", and a list of course activities. The quiz editor shows a question type of "שאלות" (Questions) with a score of 100.00 and a weight of 0.00. There are also options for "ערבוב שאלות" (Shuffle questions) and "הוספה" (Add).

Superior testing outcomes with blended vs. LBL course structures

Course final exams



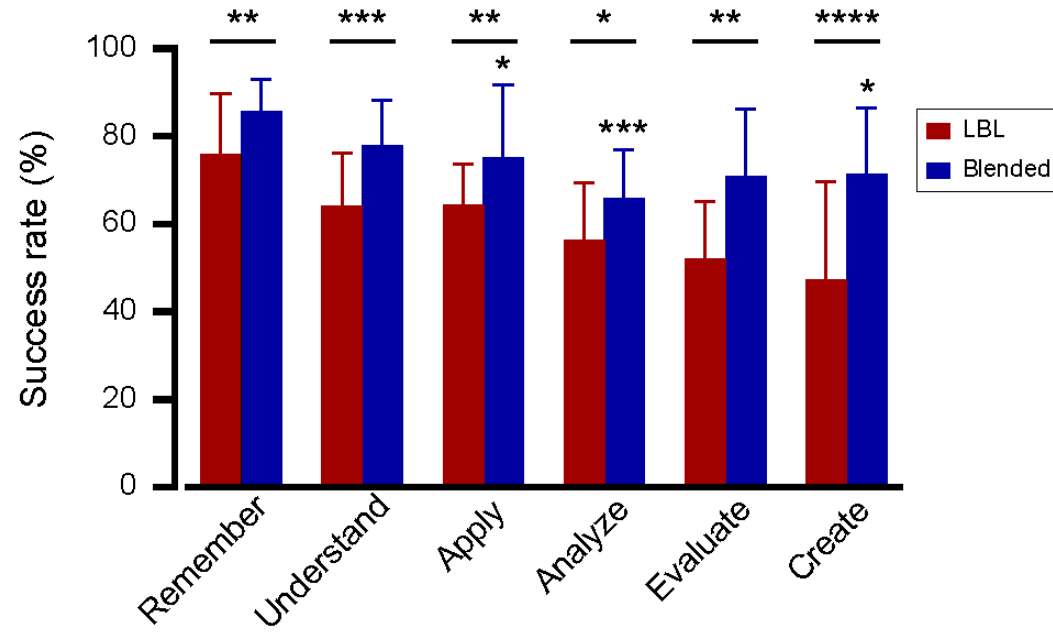
Workshop



Blended (n=424; two cohorts) vs. LBL (n=859; five cohorts);
** $p < 0.01$; **** $p < 0.0001$; Two-tailed unpaired t test

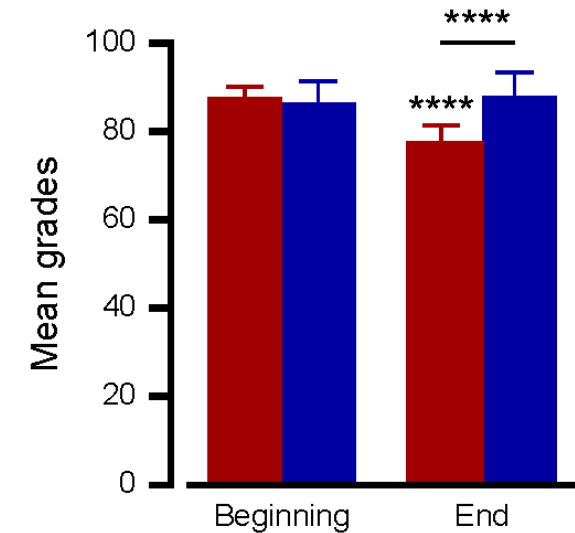
The Blended course structure significantly enhanced learning outcomes

Success rates across cognitive levels



Blended (n=80 questions in two cohorts) and LBL (n=200 questions in five cohorts) structures; *p< 0.05; **p< 0.01; ***p< 0.001; ****p< 0.0001; Two-tailed unpaired t test between each cognitive level

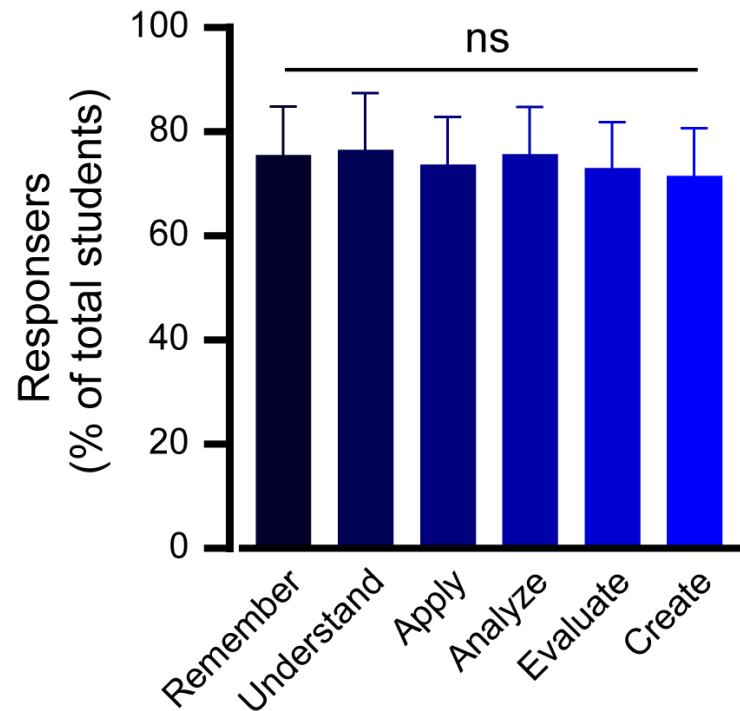
Workshop tests



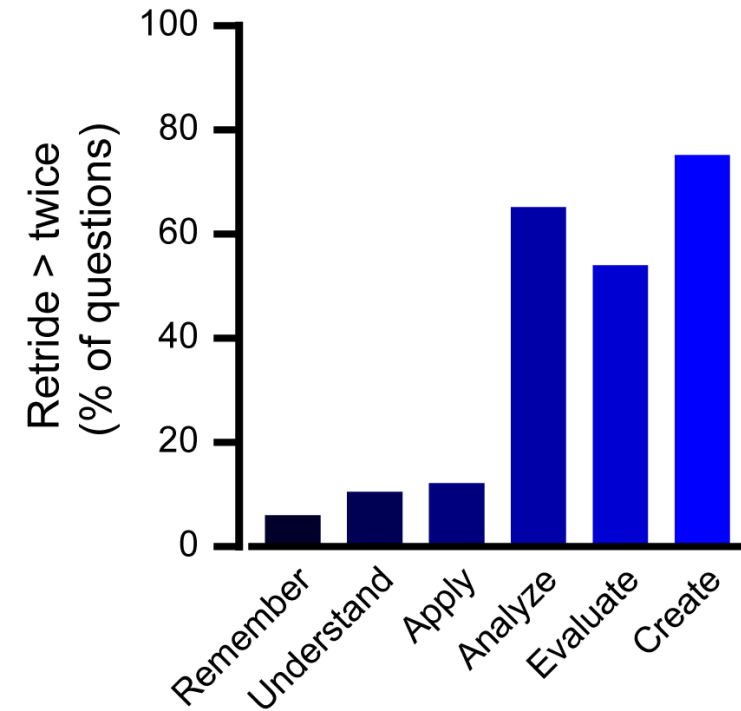
Beginning: lower cognitive skills (Remember, Understand, Apply)
End: higher cognitive skills in drug-based patient care (Analyze, Evaluate, Create)

High engagement pattern in the blended course structure

Participation rate in online quizzes



Online questions students attempted more than twice



Summary



Problem

Low success rate and insufficient learning outcomes in lecture-based pharmacology courses



Solution

A novel blended course:

- Question-based learning throughout the course
- Asynchronous and Synchronous Activities



Outcomes

1. Enhanced critical thinking across all Bloom's taxonomy cognitive levels
2. Improved success rate
3. Improved students' engagement

Acknowledgments

Collaborators

Jayne S Reuben, PhD

Texas A&M College of
Dentistry, USA

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Tel-Hashomer Medical Center

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Homer Stryker M.D. School of
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Funding



Dr. Adolf and Klara Brettler Center



Looking for MSc and PhD students

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Recommendations & guidelines



1. Define Short- and Long-term Learning Outcomes
2. Describe Cognitive Levels
3. Divide the Course into Learning Divisions and Units
4. Incorporate Self-Practice Questions at Each Cognitive Level within Learning Units
5. Implement Q&A Sessions for Discussion
6. Evaluate Student Success Across Cognitive Question Levels
7. Assess Student Engagement and Satisfaction
8. Consider Further Adaptations to Enhance Learning Outcomes