

No Pain, No Gain: Embedding Desirable Difficulties into Pharmacy Skills Laboratories to Strengthen Student Learning

Kimberley Begley, PharmD, FNAP and Kevin Fuji, PharmD, MA
Department of Pharmacy Practice



Introduction

- Pharmacy education is a dynamic field, and effective pedagogical strategies are essential to prepare future pharmacists with the knowledge and skills needed to excel.
- Traditional teaching methods, while effective to a degree, may not adequately prepare students for the rigors of the profession.
- Desirable difficulties are learning activities that are deliberately designed to challenge students and promote deeper understanding.

Objective

- This study presents the implementation of desirable difficulties, including spaced repetition, repeated testing, interleaving, formative assessment as learning, as well as thinking out loud strategies and real-life cases across pharmacy skills laboratories.
- These strategies aim to improve long-term retention, critical thinking, and problem-solving abilities.

Methods

- Pharmacy skills lab courses were redesigned to incorporate desirable difficulties throughout the series.
- These techniques were applied through various instructional methods, including group discussions and online learning platforms.

Results

- Longitudinal scores were utilized to assess the impact of these interventions on students' learning outcomes. Post-activity evaluations were used to gather qualitative data on students' perceptions and experiences with these innovative teaching methods.
- The results of this study demonstrated significant improvements in students' learning outcomes. Compared to traditional teaching methods, students exposed to desirable difficulties exhibited higher scores and retention rates of course material.
- Students reported positive experiences with embedded desirable difficulties. They noted that these techniques encouraged active engagement with the material, increased motivation to study, instilled confidence, and enhanced their problem-solving skills.

Spaced, Repeated Testing

- Spaced, repeated testing involved regular quizzes and assessments spaced over time to enhance the retrieval of information from memory.



Mean student scores for brown bag and patient counseling exercises for repeated trials within years and across years

Interleaving

- Interleaving required students to switch between different topics and concepts during their laboratory sessions rather than focusing on a single topic for an extended period.

EXAMPLE CASE

AD is a 1-year-old female presented by her parents to the free clinic for fussiness and inconsolability. AD had been in good health prior to this most recent episode. Her mother relates that, for the past 48 hours, AD had been increasingly fussy, not sleeping, and refusing to eat or drink. Her mother stated that AD has been tugging on her ear. The mother took her temperature once, and it was 101.9° F. AD lives at home with her parents and two brothers (3&1/2-years-old and 5-years-old). She attends day-care. Her mother smokes cigarettes but insists that she does not smoke in the house or near the child. AD was breast fed up to 2 months of age. Temperature: 101.8° F (temporal), Heart rate: 132 beats per minute, Respiration rate: 44 breaths per minute, Weight: 22 pounds. Tympanic membranes are red bilaterally, with the left tympanic membrane exhibiting dullness and bulging on otoscopic examination. Clear with moist mucous membranes. No discharge. Medication: None.

INTERLEAVING OF TOPICS

Topic addressed in case	Course introducing topic	Year Taught
Medication interview	Communications	P1 year
Recognizing symptoms	Patient Assessment	P2 year
Identifying common pathogens	Microbiology	P1 year
Identifying antibiotic treatment options	Pharmacotherapeutics	P2 and P3 year
Identifying dose, interval, and dosage form	Top 500 Medications	P1 to P3 year
Selecting appropriate analgesic/antipyretic	Nonprescription Products and Self-Care	P2 year
Weight-based dosing	Calculations	P1 year

- A focus group was held at the end of the semester, and discussion was recorded. Two themes emerged regarding the format and delivery of the interleaved activities:
 - These activities helped to make connections to prior learning
 - These activities helped to move beyond memorizing facts

Thinking Out Loud

- Thinking out loud verbalized thought processes and problem-solving strategies for students and if students actively listened, it promoted deeper understanding and better retention of the material.
- A systematic thematic analysis was conducted on free-text evaluations from brown bag exercises. Three themes emerged:
 - This activity provided an explanation on how to work through clinical problems
 - This activity imparted various ways to remember information
 - This activity made information digestible, comprehensible, and applicable

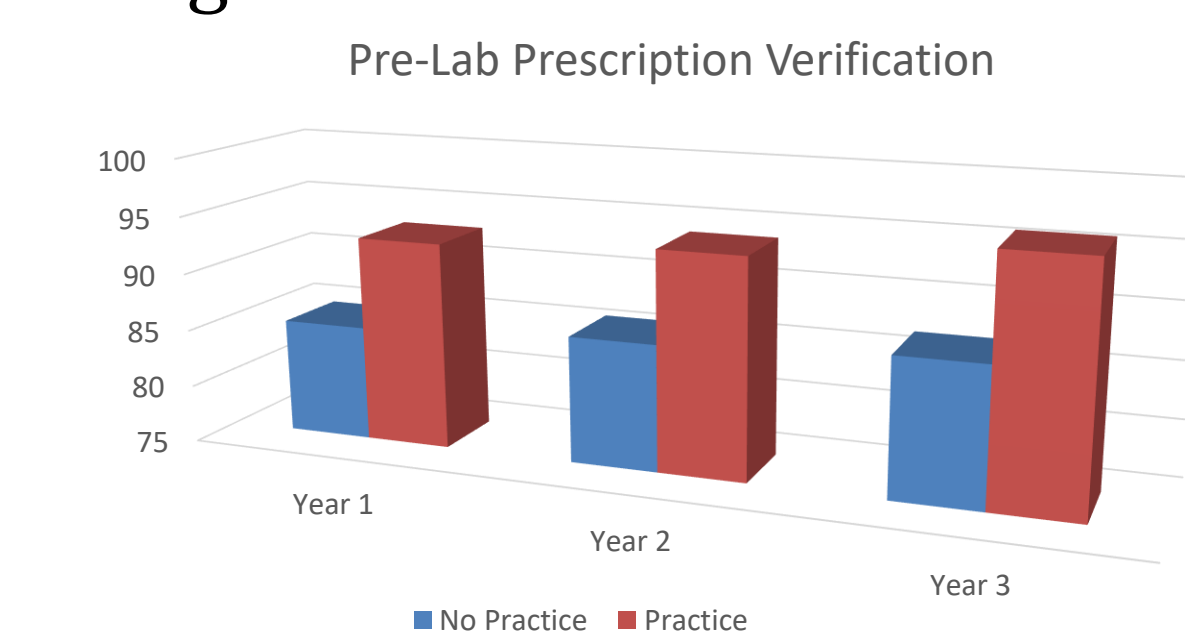
Real-Life Case Studies

- Connecting classroom content to real-life scenarios and practical applications deepened understanding and memory retention. Using case studies bridged the gap between theory and practice, making knowledge more relevant and memorable.

APPE Setting	Description of the Pharmaceutical Intervention
Ambulatory care	A student noted that they addressed drug-drug and drug-disease interactions that were highlighted in the course, particularly related to pain medications such as opioids and nonsteroidal anti-inflammatory drugs (which again, connected together over the counter and prescription medication knowledge).
Long-term care	A student shared that they were reviewing patient medication to adjust warfarin dosing after a high international normalized ratio (INR) reading, and they remembered from one of the brown bag reviews in the course that certain antibiotics could be contributing to the increased INR. They looked up antibiotics that were less likely to have a significant interaction with warfarin and made a recommendation accordingly.
Acute care	A student described that the course helped them to remember first-line agents for hypertension. They were able to recommend more appropriate first-line options for treatment and encouraged medical residents to use hypertension guidelines in making therapeutic decisions.

Formative Assessment

- Constructive feedback and formative assessment align with metacognitive principles. When students received timely feedback on their performance, they adjusted their learning strategies and addressed weaknesses effectively.



Pre-lab practice exercises, similar to what was done in the graded laboratory sessions, were added to BlueLine (Canvas). Students who completed three or more pre-lab practice exercises, had an average score 8 percentage points higher than their peers who did not complete the pre-lab practice exercises.

Conclusions

- While traditional teaching often prioritizes ease of learning, research in cognitive psychology suggests that some level of cognitive effort, when strategically applied, can enhance learning outcomes.
- The implementation of desirable difficulties into pharmacy courses not only led to improved long-term retention of course material but also enhanced critical thinking and problem-solving skills among pharmacy students.
- The findings emphasize the need for pharmacy educators to reconsider traditional teaching methods and embrace pedagogical approaches that challenge students to actively retrieve and apply knowledge. By doing so, educators can better prepare future pharmacists to flourish in a constantly evolving healthcare landscape.