

Teaching and Reinforcing Pharmaceutical Calculations Through an Interactive Immediate Response Learning Program (IRLP)

Zachary Weinstein BA¹, Danielle M. Candelario PharmD, BCPS², Kristen Ahlschwede PhD³
Rosalind Franklin University, North Chicago, IL; Class of 2023¹; Department of Pharmacy Practice²; Department of Pharmaceutical Sciences³



Background

- ❖ Computer-assisted learning (CAL) is any computer-administered program that delivers interactive learning designed for specific subject areas.¹
 - Examples of CAL include video games, computer simulations, guided tutorials, and drill and practice software.
- ❖ CAL is used to enhance and apply students' knowledge in a pseudo-realistic environment and has been incorporated into many different levels of education, from elementary to graduate school levels.
 - This form of learning has been shown to be useful, valuable, and enjoyable for students.¹
- ❖ Previously, a CAL program using computerized patient simulations was implemented in an advanced therapeutics course as part of pharmacy school curriculum.²
- ❖ Our Pharmaceutical Calculations class is a required and challenging 3-credit course for the first-year pharmacy students.
 - Incorporating computerized patient simulations in a video game-like format into the course may reinforce difficult core concepts and provide additional calculations practice to improve students' pharmaceutical and mathematical comprehension.
- ❖ We created an IRLP, which is an interactive formative feedback learning tool that teaches intravenous (IV)-related pharmaceutical calculations via multi-step word problems as part of an interactive "game" that serves to emulate day-in-the-life hospital pharmacist scenarios.
- ❖ Student interest in and the potential usefulness of the addition of the IRLP to the pharmaceutical calculations course curriculum was unknown.

Objective

The objective of this study was to: 1) determine the potential usefulness of an IRLP and 2) determine the effectiveness and value of an IRLP as a learning tool when incorporated into a first-year pharmaceutical calculations course.

Methods

Inclusion Criteria:

- ❖ First-year Rosalind Franklin College of Pharmacy students enrolled in the pharmaceutical calculations course during the 2020-2021 academic year.

Exclusion Criteria:

- ❖ Failure to provide consent and/or repeating the course

Study Intervention:

- ❖ Students were emailed a link to a 19-item Qualtrics perceived value survey (PVS) at the end of the course.
 - Survey required approximately 20-25 minutes to complete and consisted of:
 - 2 demographic questions
 - 9 Likert-type questions, scale ranging from Strongly Disagree to Strongly Agree
 - 7 multiple choice questions
 - 1 fill-in-the-blank
- ❖ The survey was accessible for two weeks after receiving the link via email.
- ❖ The Consent Information Sheet was to be acknowledged prior to beginning the survey and informed the participants of the following:
 - Participation is voluntary.
 - All responses would be anonymous.
 - Student grades for past and future courses would not be affected by their choice to participate.

- ❖ The protocol was determined to be exempt by the Institutional Review Board (IRB).

Methods, cont.

- ❖ Students enrolled in the course were required to complete the IRLP (PHARMCAL) at least once as a homework assignment.
 - The IRLP consists of 21 IV calculation questions for 7 different, simulated patients
 - Utilizes Qualtrics® XM Platform "Skip Logic" to emulate answer outcomes

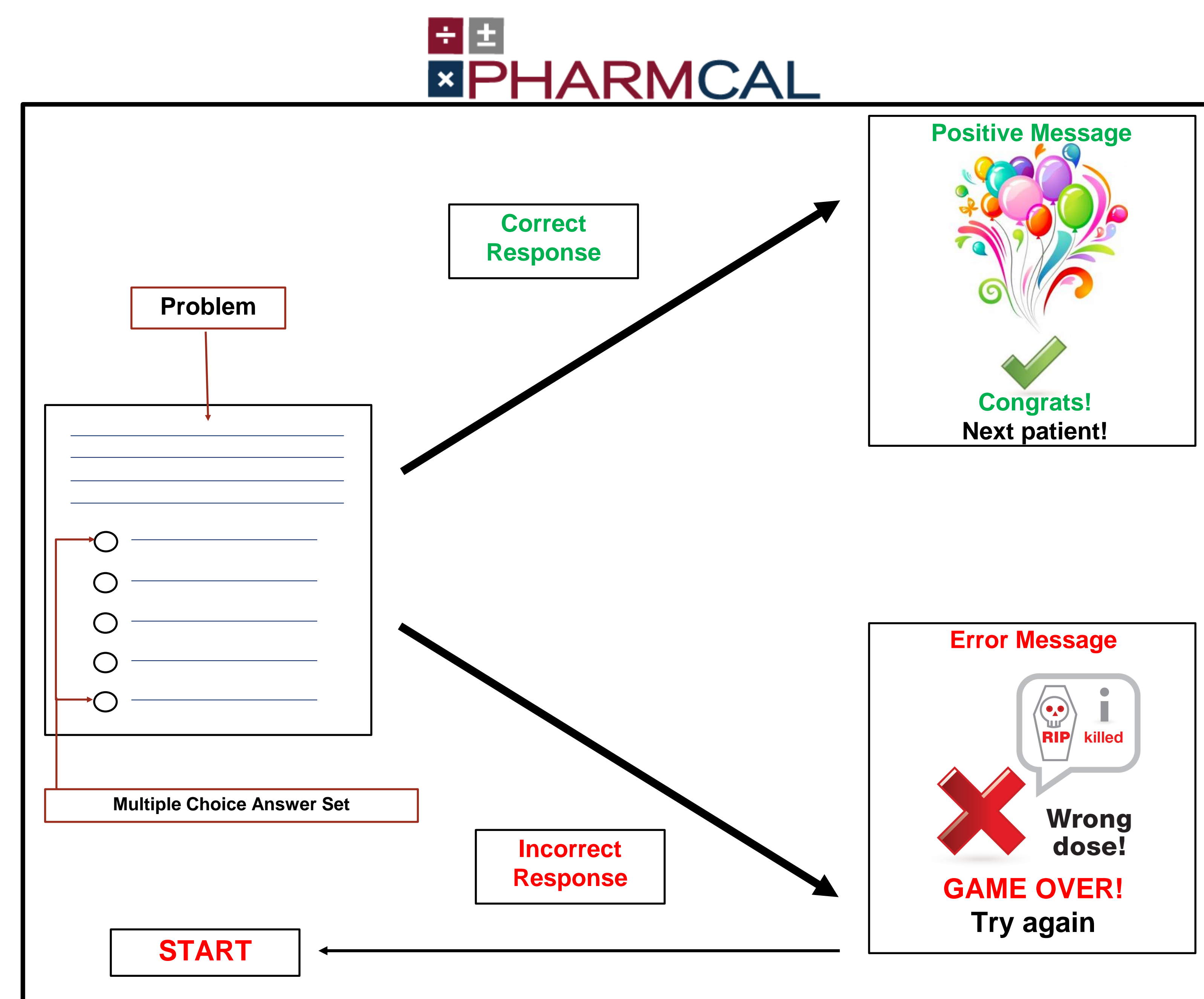


Figure 1: Simplified diagram depicting the immediate response system implemented in the PHARMCAL program. For every pharmaceutical calculation question posed, a multiple-choice answer set was provided. When selecting a response, a specific, individualized outcome prompt notified the user of whether they were correct or incorrect.

Results

Table 1. Student opinions on incorporating the IRLP into the pharmaceutical calculations course.

Statement Presented	Number of Student Responses, N (%)				
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The program is easy to navigate.	0 (0)	3 (11.1)	1 (3.7)	10 (37)	13 (48.2)
The number of problems provided in the IRL Program were appropriate.	0 (0)	1 (3.7)	0 (0)	15 (55.6)	11 (40.7)
The program allowed me to apply the knowledge learned in the course.	1 (3.7)	0 (0)	0 (0)	9 (33.3)	17 (62.9)
Answering the problems within the program improved my overall performance.	3 (11.1)	0 (0)	3 (11.1)	11 (40.7)	10 (37)
The program increased my interest in pharmaceutical calculations.	2 (7.4)	1 (3.7)	5 (18.5)	8 (29.6)	11 (40.7)

Results, cont.

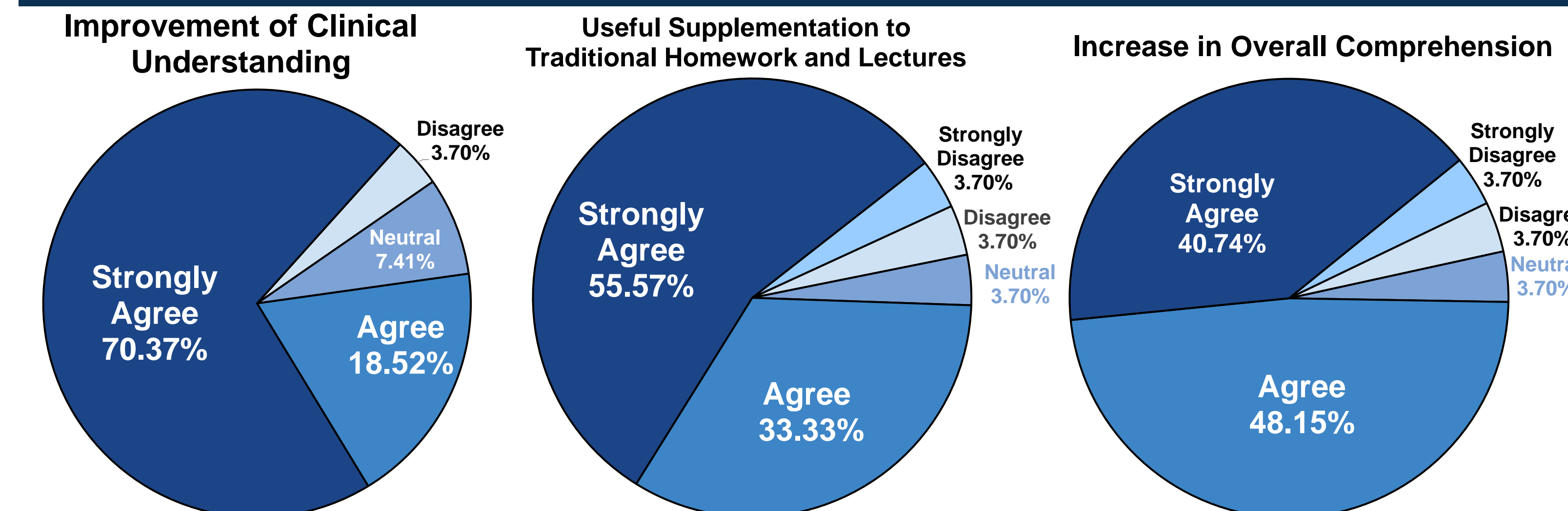


Figure 2: Pie charts with corresponding Likert-style question statements posed to former pharmaceutical calculations RFU pharmacy school students (class of 2024) in relation to the perceived value of the IRLP (N=27).

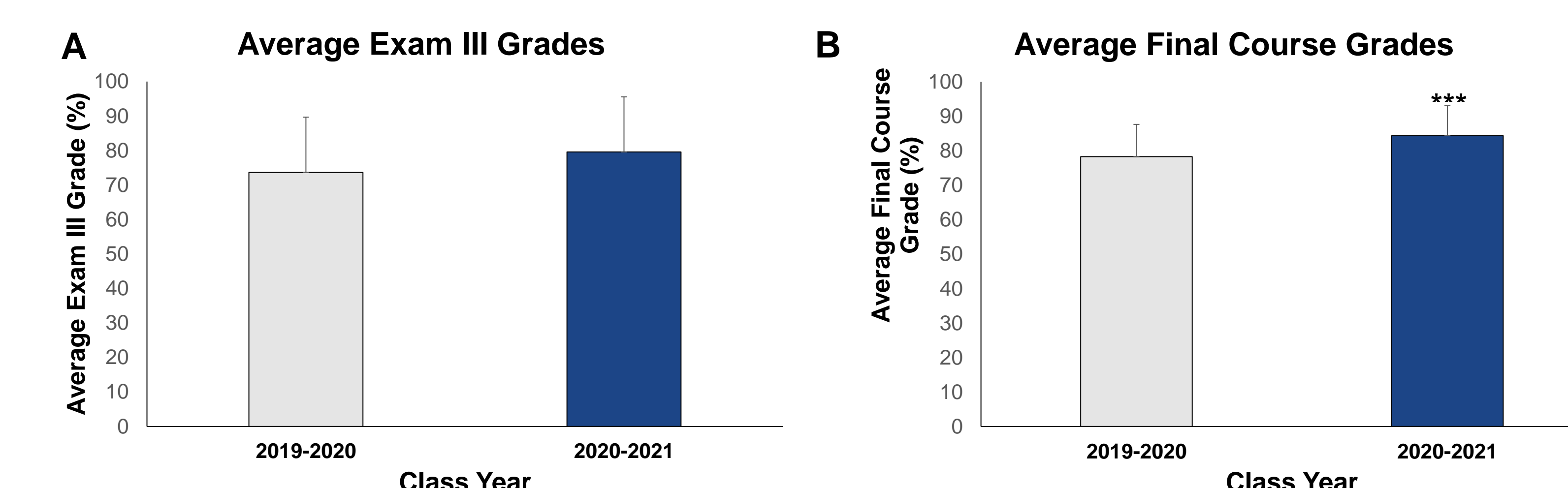


Figure 3: Histograms depicting pharmaceutical calculations course average exam III (A) and average final course grades of former students (B). A.) Average exam grades of students who completed the course in 2020 (73.66 ± 16.13%) (N=48) compared to the score achieved by students who completed the course in 2021 (79.58 ± 15.82%) (N=59) with IRLP access ($p=0.0571$). B.) Students who completed the course in 2020 (78.30 ± 9.39%) compared to students who completed the course in 2021 (84.38 ± 8.72%) with IRLP access ($p<0.001$).

Discussion

- ❖ Perceived value survey results demonstrated that the majority of participants agreed or strongly agreed that:
 - The IRLP improved their clinical understanding of IV calculations.
 - An IRLP is a useful supplementation to homework and lectures.
 - The IRLP increased overall material comprehension.
- ❖ An IRLP is a useful, low-cost, and novel supplement to traditional homework problems and lectures in a first-year pharmaceutical calculations course.
- ❖ The incorporation of an IRLP into the pharmaceutical calculations course curriculum positively impacted overall student performance when compared to the previous year.
- ❖ By providing students with clinical context for mathematical errors and incorporating real-time feedback through patient health outcomes, an IRLP can improve comprehension, performance, problem-solving ability, and subject matter interest.

Limitations

- ❖ Small IRLP participant sample size (N=59) and small PVS sample size (N=27)
- ❖ Traditional classroom model (2019-2020) versus flipped classroom model (2020-2021)
- ❖ Inclusion of five respondents who incorrectly responded to quality-control questions
- ❖ The IRLP only covers a single topic: IV calculations

References

1. Benedict N, Schonder K. Patient simulation software to augment an advanced pharmaceuticals course. *AJPE*. 2011;75(2):1-9.
 2. Al-Sallami H, Loke SK. Learning a complex dose-response relationship with the computer simulation CoaguSim. *Curr Pharm Teach Learn*. 2018;10(10):1406-1413.
- For more information regarding the research contact:
Kristen Ahlschwede, Ph.D. at Kristen.Ahlschwede@rosalindfranklin.edu