

# Trends in Students' Scores in an Asynchronous Pharmacy Calculations Course

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## BACKGROUND

- Each year, in the United States alone, 7,000 to 9,000 people die as a result of a medication error<sup>1</sup>. Errors in the use of dosage equations account for more than 15% of all medication prescribing errors<sup>2</sup>. Pharmaceutical calculation stands as an importance course taken by Doctor of Pharmacy students.
- The decline in pharmacy school applicants alongside an increase in California's pharmacy schools has resulted in institutions admitting potentially less prepared students<sup>3</sup>.
- At Western University of Health Sciences, the transition of the first-year pharmacy calculation class to an asynchronous format aimed to accommodate students' needs for additional time. However, pharmacy calculations remains a challenging subject with a high failure rate.
- The asynchronous nature of 5114 allows for consistent assessment of students' preparedness.

## OBJECTIVE

- Investigate trends in scores among first-year students in an asynchronous pharmacy calculation course.
- Examine factors that may be associated with the students' pharmacy calculation performance.
- Analyze the effect of a redesigned calculation class based on pharmacy students' performances.

## METHODS

### Study Design:

- Final examination grades (prior to dropped questions) from an asynchronous first-year pharmacy calculation course at Western University of Health Sciences were collected from 2019 to 2024.
- Pre-admission oGPA, sGPA, mGPA, oGPA, mGPA, HSRT scores, undergrad repeated courses, and undergraduate types were collected from the students and were blinded to the PI.
- SPSS was used to compare final exam scores based on matriculation year and associations between pre-admission data and final examination scores were explored.
- Between 2023 and 2024, three workshops, an additional quiz, point redistribution, a practice exam, and additional time on the final were added to the course.

### Inclusion criteria:

- Enrolled first-year pharmacy students who took the pharmacy calculation course during the study period.

### Exclusion criteria:

- International pharmacy students who did not participate in the first-year pharmacy curriculum.
- Students from other programs or academic institutions.
- Pharmacy students in advanced years of the curriculum beyond the first year.
- Students taking the course a second time.
- Students who had invalid/blank math, HSRT, sGPA, oGPA, sGPA, oGPA were excluded for their respective analyses.

### DATA ANALYSIS

- Kruskal-Wallis and Mann Whitney U tests were conducted to compare the average final calculation exam scores among different class years, students' undergraduate types, and whether students repeated classes or not.
- In addition to final exam scores, data including oGPA, sGPA, mGPA, oGPA, sGPA, HSRT score, and number of repeated course were collected and analyzed using Spearman correlation to examine their association with success on the final exam of the class.

## RESULTS

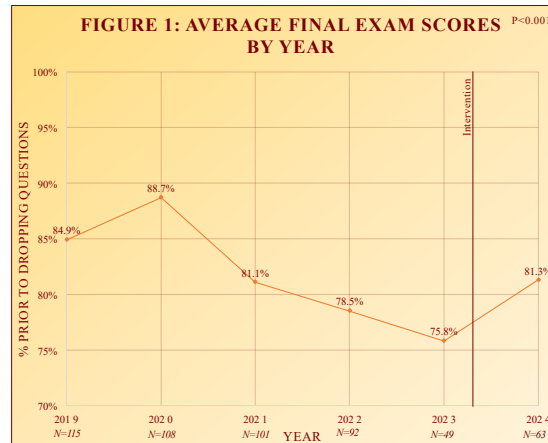


Figure 1 illustrates the trends in final examination scores in a first-year pharmacy calculations course. Raw data (prior to any dropping of questions) were used for more consistent grading across years. After 2020, there has been a dramatic decline in students' scores though a significant increase was seen in the class of 2024 after interventions were made to the course.

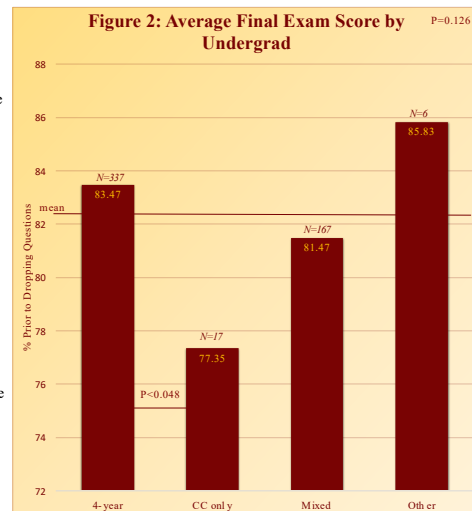
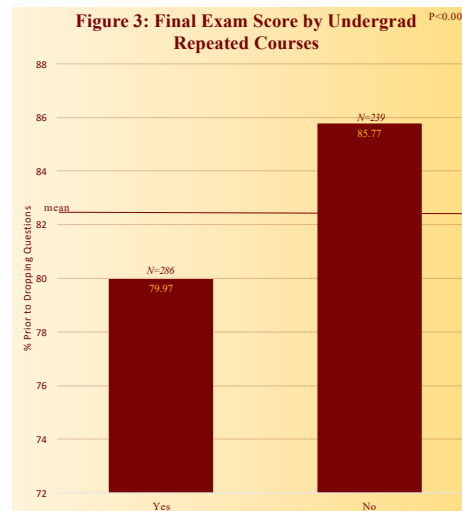


Figure 2 displays the average final exam scores of students based on their undergraduate study background. Differences between all groups were not statistically significant though differences between students with 4-year university undergraduate studies and community college only undergraduate studies were statistically significant. Overall, students with "other" undergraduate studies had the highest average score while those with community college only had the lowest average score.

Table 1: Correlations Between Final Exam Scores

Indicator	Spearman	P-Value
mGPA (n=525)	0.297	<0.001
sGPA (n=522)	0.275	<0.001
GPA (n=522)	0.274	<0.001
GPA <sub>r</sub> (n=526)	0.274	<0.001
sGPA <sub>r</sub> (n=526)	0.266	<0.001
HSRT (n=505)	0.258	<0.001
# repeated courses (n=526)	-0.225	<0.001

Table 1 shows the Spearman correlations between indicators of success in pharmacy calculations final examination. Correlation was statistically significant but modest. mGPA was the strongest predictor of success. All correlations were positive apart from the number of repeated courses which had a negative correlation with exam scores.



In addition to the Spearman coefficient, categorically, Figure 3 shows that students who had to repeat undergraduate courses performed more poorly than students who did not need to repeat undergraduate courses. Differences between the two groups were statistically significant.

## DISCUSSION

- A comprehensive analysis was conducted on a total of 528 first-year students.
- Final exam scores revealed a statistically significant difference between 2019 to 2024 indicating a concerning trend in overall student preparedness in the asynchronous pharmacy calculation class. This is a reliable predictor for assessing overall student preparedness, given the consistent nature of the pharmacy calculation course. The interventions made between 2023 and 2024 resulted in an increase in average final exam scores prior to dropping questions. Final exam scores were reliable as they were the most consistent and comprehensive between years.
- Student with higher GPAs and HSRT scores tend to perform slightly better in the final calculation exam. Higher math GPAs show the strongest correlation with final exam scores. On the other hand, students who repeated courses during undergraduate studies tend to achieve lower scores on the final calculation exam.
- There is no statistically significant correlation between the final exam scores with undergraduate school type ( $p=0.126$ ), suggesting that the institution where students completed their undergraduate studies did not significantly influence their performance in the pharmacy calculation course.

## LIMITATION

- Data is limited to first-year pharmacy students from Western University of Health Sciences, Pomona from 2019-2024, potentially restricting sample diversity and generalizability.

## CONCLUSION

- There has been a decline in students' calculation performance suggesting a need for redesigning asynchronous calculation classes. To counteract this trend, educators must implement various effective teaching styles and activities. This includes incorporating in-class workshops, providing additional quizzes for practice, updating pharmacy lecture recordings, and adding a practice final exam to ensure relevance and engagement.
- Additionally, by understanding how various factors impact students' performance, educators can effectively identify student at risk of underperformance. By providing tailored support such as after-class meetings, organizing study groups, or personalized tutoring sessions, educators can help students overcome obstacles and achieve success in the class.
- These additional changes to the class curriculum, including the incorporation of workshop and more quizzes, re-recording of videos with the new instructor, and the introduction of additional practice tests before quizzes and exams resulted in higher exam scores.
- Further considerations continue to be made to improve the course and strengthen students' knowledge of pharmacy calculations given its importance on board examinations such as NAPLEX and its importance for when students graduate and become pharmacists.
- For future studies, students' performance can be analyzed to predict the success not only in future calculation courses but also in the calculation portion of the board exams such as NAPLEX.
- Given the consistency of the asynchronous course, the trend may also extrapolate the overall preparedness of students entering pharmacy school.

## REFERENCES

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