Student performance and perspective on repeated top drug information assessments in a pharmacy skills laboratory course

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Abstract

Background: A weekly drug quiz policy was implemented in a pharmacy skills laboratory course. **Objective:** To examine student performance and perspective on weekly top drug information assessments. **Methods:** Students in the second- and third-professional year of the pharmacy programme were assessed on top drug information through weekly drug quizzes and a final top drug exam in their respective pharmacy skills lab courses. Correlation between student performance in drug quizzes and major assessments in their pharmacy coursework was measured using the Spearman rank correlation analysis. Statistically significant change in student opinion through the term was determined using the Wilcoxon signed rank test. **Results:** Student scores on weekly quizzes and the final drug exam ranged between 85-99%. A strong positive ($\rho \geq 0.7$), significant ($p < 0.001$) correlation was observed between student performance on their drug information assessments and their scores in all pharmacy courses. Within the second-professional year, a significant improvement (17.7%) in students' perceived ability for the weekly quizzes to positively impact their course grades in the modules ($p = 0.03$). Student confidence in matching brand/generic drugs and identifying drugs' therapeutic classes improved over the term ($p < 0.01$). **Conclusion:** Students were overall accepting and had a predominantly positive perspective regarding the repeated top drug information assessment policy.

Introduction

Pharmacists play a critical role in the team-based, patient-centred approach to healthcare outlined within the Pharmacists' Patient Care Process (Joint Commission of Pharmacy Practitioners, 2014). As drug experts by training, pharmacists are expected to use their knowledge about medications to deliver excellent patient care as they conceptualise the optimal patient care plan. To determine the readiness of graduating Pharm.D. students, the North American Pharmacist Licensure Examination (NAPLE) board examination assesses the ability of graduates to identify drug characteristics, including the brand/generic name and therapeutic drug class (National Association of Boards of Pharmacy, 2021). Accordingly, the Accreditation Council for Pharmacy Education (ACPE) standards 2016 (Accreditation Council for Pharmacy Education, 2015a) and the guidance document to standards 2016 (Accreditation Council for Pharmacy Education, 2015b) underscore the development of foundational knowledge during the Pharm.D. curriculum with emphasis on pharmacy student ability to identify the generic and brand drug names.

Several studies have examined the factors that may impact knowledge retention among pharmacy students. It has been shown that students perceived

high confidence in their clinical skills despite a sharp decline in their performance on a knowledge assessment test (Valdez *et al.,* 2006). Skills-based lab courses provide an opportunity to bolster knowledge retention in pharmacy students by providing opportunities for clinical application of the taught information within the pharmacy curriculum (Rodin *et al.,* 2022). Pharmacy educators have explored strategies, including gamification of brand and generic drug names (Whitman, Tanzer & Nemec, 2019) and peer teaching models to discuss information about commonly prescribed drugs (Tsai *et al.,* 2021), to improve retention of top drug information. These two strategies were reported to improve student scores on top drug quiz and their confidence in recalling drug information. Interestingly, spacing of repeated practice opportunities has been shown to positively influence the retention of drug names in pharmacy students. Closely spaced quizzes on brand and generic drug names have been reported to improve long-term retention of drug information (Terenyi, Anksorus & Persky, 2019) and a repeated testing strategy is perceived by students to strongly improve their long-term knowledge (Coker *et al.,* 2018).

Over the Autumn of 2022, a weekly drug quiz policy was implemented in skills lab courses within the Pharm.D. curriculum to explore the impact of repeated assessment on student knowledge regarding top drug information. It was hypothesised that better preparation, through a weekly low-stakes assessment for top drug information, would positively influence student performance in the therapeutics coursework, which they concurrently undertake during the Autumn. In addition, pharmacy students enrolled in the skills lab courses were surveyed both at the start and the end of the term to understand their perspective regarding the implementation and academic impact of the new drug quiz policy.

Methods

Based on the University of Findlay curriculum, students in the second- and third-professional years of the Pharm.D. programme are enrolled in a pharmacy skills lab course during the Autumn term. Students are concurrently enrolled in three required therapeutic courses (modules) over the Autumn term of the second (cardiovascular, renal, and respiratory)- and third (neurology/psychiatry, gastrointestinal, oncology)- professional years as well.

A drug list was provided to students at the start of the term, with information regarding drugs covered in the modules intended to be assessed in a weekly drug quiz.

The drug list for each skills lab course was based on module topic outlines and aimed to help students recognise and get familiar with the drug information being discussed in their courses during that week. Each drug list for the term was developed in collaboration with course coordinators of modules and consisted of about 130-170 drugs. The weekly drug list comprised about 30-35 drug names (brand and generic) and the therapeutic classes of the drugs. The drugs discussed in the oncology module were not included in the described drug assessment policy. Over the Autumn of 2022, students were required to attempt a 15-minute weekly drug quiz at the start of their skills lab. The weekly quiz had 15 multiple-choice questions assessing student ability to identify the brand name, generic name, and therapeutic drug class of medication. Brand names included in the list were only those of the drug brand names emphasised in the NAPLEX prep book (Bombatch *et al.,* 2021). Weekly drug quiz scores amounted to 5% of the grade for the skills lab course. At the end of the term, students were required to attempt a final 1-hour drug exam comprising 60 multiple-choice questions. The final drug quiz accounted for 5% of the grade for the practice skills lab.

For the present study, student performance in the modules was determined by evaluating their mean scores on all midterms and the final exam of the therapeutic courses. Similarly, overall student performance in the drug quizzes was represented by the mean score of the weekly drug quizzes and the final drug exam in the practice skills lab. A survey (Appendix A) was administered during the first class of the skills lab course at the start of the term to assess students' perspectives and attitudes towards this new drug quiz policy. Students were requested to respond to comparable survey questions at the end of the term and assess changes, if any, in their perspective towards this weekly drug quiz policy.

Student surveys were reviewed by the Institutional Review Board of the University of Findlay and exempted from full review by the IRB committee (#1672).

The data collected regarding student performance over the Autumn term of 2022 was statistically analysed to determine significant differences using the SPSS V.28 software (IBM Corp., Armonk, NY). The Spearman rank correlation analysis was used to determine correlations between average student scores in skills lab drug quizzes (weekly and final drug quizzes) and average student scores on major module assessments. Statistically significant differences in student opinion between the surveys administered at the start and the end of the term were determined using the Wilcoxon signed rank test.

Results

Student performance on weekly drug quizzes

Student performance on weekly drug quizzes in the pharmacy practice skills lab remained high throughout the Autumn 2022 term (Figure 1). The average score on weekly drug quizzes and the final drug exam ranged between 86-97% for students in the second-professional year and between 85-99% for students in the third-professional year of the programme.
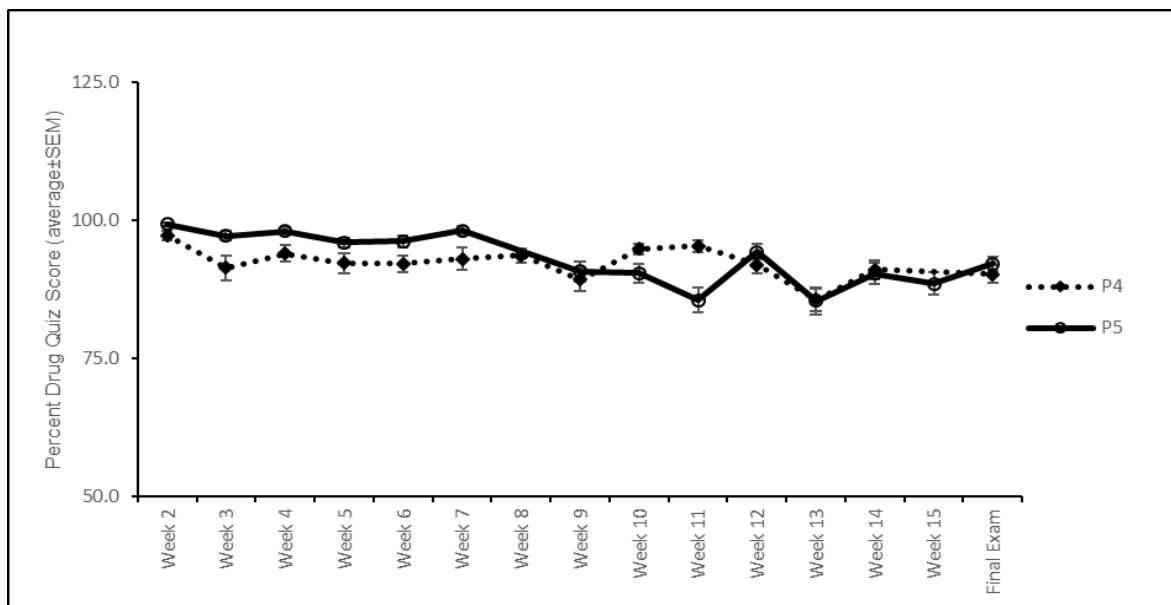

Figure 1: Average scores on weekly drug quiz for second- and third-professional year students

Correlation between student performance in drug quiz and modules

Results of the Spearman rank correlation analysis revealed a strong positive correlation between student performance in the drug quizzes within the skills lab and their performance in the major assessments of their respective modules. As summarised in Table I, for the second professional year students, a strong positive correlation was observed between their average score in the drug quizzes and their performance in major assessments of the cardiovascular (ρ = 0.825, $p <$ 0.001), renal (ρ = 0.723, $p <$ 0.001), and respiratory (ρ = 0.823, $p <$ 0.001) modules. Similarly, a strong positive correlation was observed between student performance in the drug quizzes and their performance in major assessments of the neurology/psychiatry (ρ = 0.763, $p <$ 0.001) and gastrointestinal (ρ = 0.778, $p <$ 0.001) disease state modules within the third professional year of the programme.

Table I: Spearman rank correlation between average drug quiz score in the pharmacy skills lab and performance on respective therapeutic module courses

Year	Modules		
Second-professional year courses	**Cardiovascular**	**Renal**	**Respiratory**
Spearman's rho	0.825	0.723	0.823
p-value	**<0.001**	**<0.001**	**<0.001**
n	44	44	44
Third-professional year courses	**Neurology/Psychiatry**		**Gastrointestinal**
Spearman's rho	0.763		0.778
p-value	**<0.001**		**<0.001**
n	47		47

Student perspectives and attitudes towards the weekly drug quiz policy

The survey results for students in the second professional year indicate a high degree of acceptance of the various aspects of the drug quiz policy at the start and the end of the term (Table II). Collectively, 44 and 49 students from the second and third professional years, respectively, participated in the survey. For most questions, compared to the start of the term, the acceptance by students either went up or remained comparable towards the end of the term. A high proportion of these students agreed or strongly agreed on the rationale and implementation of the drug policy and expressed their agreement with the ability of this new drug quiz policy to help them learn and retain drug information. Interestingly, a significant improvement (from 79.5% to 97.2%) in confidence was observed in second-year students regarding their perceived ability of the weekly drug quizzes to positively influence their course grades in the modules ($p = 0.03$). On the other hand, third-year students had a non-significant drop in their confidence regarding the positive impact of the drug quiz policy on course grades in modules (80% to 66%; $p = 0.43$). While 13.6% of respondents in the second professional year expressed their lack of confidence in matching brand and generic drug names at the start of the term, the number of respondents not confident went down to 0% ($p < 0.001$) at the end of the term. Similarly, the lack of confidence in identifying a drug's therapeutic class went down from 31.8% at the start of the term to 0% towards the end of the term ($p < 0.001$) for second-year students. Likewise, for the third professional year, a significant improvement in student confidence for matching brand and generic medication names was noted over the term (4.1% not confident in week 1 to 0% not confident in week 16; $p = 0.002$). The majority of third-year students remained confident regarding their ability to recall the therapeutic class of a brand or generic medication name at the start of the term. None of these students expressed a lack of confidence at the end of the term (2% not confident in week 1 to 0% not confident in week 16; $p = 0.19$).

Table II: Summary of Likert-scale responses at the start and end of the term surveys regarding the drug quiz policy

	Second-professional year students			Third-professional year students		
	First week survey (n=44)	Last week survey (n=36)	Significance (*p*-value)	First week survey (n=49)	Last week survey (n=44)	Significance (*p*-value)
Percent of strongly agree or agree responses						
Rationale for top drug quiz policy is clear to me	97.7	100	1.00	95.9	97.7	0.46
Implementation of top drug quiz policy is valuable to me	93.2	94.4	0.44	85.7	79.5	0.32
Weekly quizzes–Improve ability to learn and retain top drug information	93.2	94.4	0.87	85.7	72.7	0.12
The number of drugs per week is appropriate	65.9	80.6	0.82	71.4	47.7	**0.03**
Final drug quiz exam–Improve ability to learn and retain drug information	79.5	80.6	0.97	77.6	72.7	0.57
Confident–Drug quiz policy will positively impact my course grades in modules	79.5	97.2	**0.03**	79.6	65.9	0.43
Confident–Drug quiz policy will positively impact my clinical problem-solving skills	72.7	69.4	0.66	77.6	65.9	0.41
Weekly drug quiz–Help better follow along in the disease state modules	93.2	86.1	0.24	71.4	63.6	0.15
Weekly drug quiz–Improve my overall confidence as a pharmacy student	86.4	88.9	0.97	81.6	65.9	0.17
Percent of not confident responses						
Not confident of matching brand and generic medication names	13.6	0	**<0.001**	4.1	0	**0.002**
Not confident of recalling therapeutic class of a brand or generic medication name	31.8	0	**<0.001**	2.0	0	0.19
At the start of the term						
Percent of students with cumulative GPA >3.0	84.1			85.7		
At the end of the term						
Percent of students who found time spent preparing for weekly drug quizzes very burdensome		2.8			18.2	

Third-professional-year students accepted the rationale and implementation of the weekly drug quiz policy. A significantly high number of students strongly agreed or agreed to these questions at both the start and the end of the term. A significant drop ($p = 0.03$) in student agreement was observed regarding the number of drugs in weekly quizzes towards the end (48%) versus the start of the term (71%). This observation contrasted the opinion of second-professional-year students, who found the number of drugs for weekly quizzes more appropriate at the end (81%) versus the start (66%) of the term. Among third-professional-year students, 18% found the time spent preparing for the weekly drug quizzes very burdensome, versus only 2.8% for second-professional-year students.

Student comments regarding the weekly drug quiz policy

As part of the surveys, students from both professional years had the opportunity to comment on the perceived strengths of the weekly drug quiz policy and suggest ideas to improve the weekly drug assessment policy. Figure 2 displays the main themes identified within the comments provided at the end of the term. The majority of comments showed student confidence that the weekly drug quiz policy helped them with their therapeutic modules (38%) and that the drug quiz policy helped them memorise/retain/review drug information (27%). At the end of the term, almost half of all the comments included suggestions to improve the alignment between drugs quizzed weekly in the skills lab and the topic taught in the therapeutic modules (47%). A significant number of comments (35%) included suggestions for improving the drug quiz policy and/or the grading policy. Only 5% of the student comments reported burnout regarding the time spent preparing for the weekly drug quizzes.
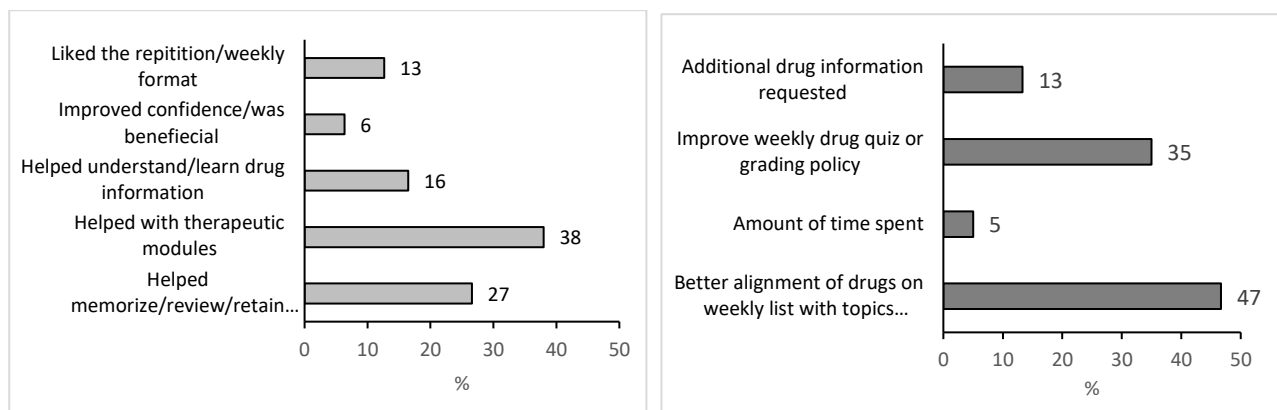

Figure 2: Major themes identified within students comments from surveys regarding the strengths (left) and suggestions (right) for drug quiz policy

Discussion

The results from the present study support the overall implementation of the weekly drug quiz policy. The average student scores on the weekly drug quizzes remained above 75% throughout the term, indicating the ability of students to learn new drug information. Students from both cohorts could successfully retain top drug information, as reflected by the final top drug exam scores. Additionally, a strong positive correlation was observed between student performance on drug quizzes in the skills lab and their performance in the therapeutic coursework, supporting the continuation of a similar policy in the future. Importantly, students had a fairly positive perception of the implementation of the weekly drug quiz policy at the start of the term. This perception improved further at the end of the term, with students reporting increased confidence in identifying the assessed drug information. The surveyed students suggested a better alignment of the drug list with therapeutic coursework and a possible reduction in the number of medications on the weekly drug list. It is surmised that students prefer the drug quiz list to align more closely with when topics are assessed in module exams.

Several studies have examined the potential predictors of student success during their Advanced Pharmacy Practice Experiences (APPEs) and student performance in NAPLEX. Compared with skills-based variables, knowledge-retention variables were more predictive of student success during APPEs (Nyman *et al.,* 2020). On the contrary, in a skills lab setting, critical thinking and patient case presentation were found to be more predictive of student scores in NAPLEX (Elder, Daugherty

& Malcom, 2019). Therefore, the present study design attempted to integrate the emphasis on top drug information while developing students' clinical and critical reasoning skills in pharmacy practice skills lab courses within the second and third professional years of the programme. Feedback collected from the surveys, administered as part of the current work, indicates that the majority of students believed that the weekly drug quizzes improved their overall confidence as pharmacy students and that the drug quiz policy positively influenced their clinical problem-solving skills. Future research is intended to correlate student performance on weekly drug assessments in the pharmacy skills lab to their performance over APPEs.

Previous studies have found that cumulative grade point average (GPA) in pharmacy coursework and student performance in pharmacotherapy courses were predictive of APPE performance (Heldenbrand *et al.,* 2018; Call *et al.,* 2020;). Since cumulative GPA in pharmacy coursework is also a predictor of student success in NAPLEX (Spivey., Chisholm-Burns & Johnson, 2020; Park, Phillips & Pavuluri, 2021), improving drug information knowledge-retention can be expected to improve student scores on NAPLEX as well. An attempt to determine the variables predictive of NAPLEX outcomes found that a high score on an exam assessing the drug information of the top 200 drugs was highly predictive of student success in NAPLEX, among other factors (Shah, Peng & Seifert, 2019). The data from the present work revealed a strong positive correlation between student scores on drug quizzes and their performance in the pharmacotherapeutic courses, suggesting that regularly spaced drug information assessments could positively influence student performance in pharmacy coursework. Indeed, as per the survey results, student confidence regarding the ability of the drug quiz policy to positively impact their grades in modules remained high throughout the term. Additionally, a significantly high number of students did not find the weekly top drug assessment policy to be very burdensome, thereby supporting the implementation of comparable policy throughout the curriculum.

Among the plethora of drugs marketed in the United States, the top drug list comprising the most prescribed medications is commonly used to assess student understanding of drug information and assist them in their practice (Fuentes, Pineda & Venkata, 2018). Intuitively, pharmacy programmes have incorporated various strategies within their curricula to assess and improve student knowledge about the top drug information. Peer-teaching (Tsai *et al.,* 2021) and spaced retrieval (Terenyi, Anksorus & Persky, 2019) are strategies that have been documented to improve student knowledge regarding top drugs. Receiving practical experience through community Introductory Pharmacy Practice Experiences (IPPE) was also found to positively impact student performance in a top 200 drug course (Mospan, Gillette & DeBerry, 2019). The new drug quiz policy implemented by the University of Findlay College of Pharmacy in the Autumn of 2022 combines spaced retrieval of drug information, using weekly low-stakes quizzes, with the alignment of assessed drugs with the therapeutic topics covered in the concurrent coursework to strategise repetition. This strategy was envisioned to help students retain the drug information on a weekly basis and assist them in their therapeutic coursework. While showing a tangible support for the weekly drug quiz policy, student comments from the current study indicated the need for a better alignment of drugs on the weekly list with the content covered in the therapeutic modules. Interestingly, recent research has revealed encouraging results using a retrieval strategy to better student retention of top drug information (Matthews *et al.,* 2022). Hence, a better alignment of the drug list used in this study with the course and exam content can be expected to further increase student satisfaction with the described drug quiz policy.

Limitations

This study has few limitations. As it was limited to one institution, its sample size (n=93) was dictated by the enrollment at the University of Findlay. Future iterations of the drug quiz policy are expected to help improve the sample size for any comparable data analysis. The long-term impact of the drug quiz policy and/or the clinical impact of the presented drug quiz policy is difficult to ascertain at this point. In the future, the researchers intend to track student performance during their capstone coursework, the Pharmacy Curriculum Outcomes Assessment (PCOA) scores, and/or APPE performance to determine the putative impact of the discussed drug quiz policy.

Conclusion

In conclusion, this study indicates good student performance on the weekly drug quizzes incorporated in the practice skills lab courses. This performance was found to have a strong positive correlation with student scores on major assessments of all concurrent therapeutic courses. Finally, student feedback and support for the weekly drug quiz policy were positive at both the start and the end of the term. A similar drug quiz policy is planned for the rest of the curriculum while ensuring more alignment between weekly drug lists and the content of pharmacotherapy courses.

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Appendix A: List of survey questions used at the start and at the end of the term for the present study

Start-of-term survey questions:

1) The rationale for implementation of the top drug information assessment policy in skills lab is clear to me.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

2) I believe implementation of the top drug information assessment policy in skills lab is valuable to me.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

3) I believe frequent, weekly quizzes will improve my ability to learn and retain top drug information.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

4) The number of drugs per week is appropriate.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

5) I believe a cumulative end of term assessment will improve my ability to learn and retain drug information.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

6) I am confident that the weekly drug quiz policy will positively impact my course grades in modules.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

7) I am confident that the weekly drug quiz policy will have a positive impact on my clinical problem-solving skills.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

8) The weekly drug quizzes will help me better follow along in the disease state modules.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

9) Implementation of the weekly drug quiz policy will improve my overall confidence as a pharmacy student.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

10) Rate your confidence with matching brand and generic medication names.
Very Confident
Moderately Confident
Somewhat Confident
Not Confident

11) Rate your confidence with recalling the therapeutic class of a brand or generic medication name.
Very Confident
Moderately Confident
Somewhat Confident
Not Confident

Additional questions for the Pre-Survey only
What is your Current Cumulative GPA?
3.5 – 4.0
3.0 – 3.49
2.5 – 2.99
< 2.5
I am not sure

In addition to IPPEs, have you worked as a pharmacy technician and/or pharmacy intern in any of the following pharmacy settings? Select all that apply.
I have never worked in a pharmacy except for my IPPEs
Independent Retail Pharmacy
Chain Retail Pharmacy
Hospital Pharmacy
Ambulatory Care Clinic
MTM Center
Long-term Care Pharmacy
Compounding Pharmacy
Other

If yes to the previous question, how many years have you worked as a pharmacy technician and/or pharmacy intern?
No additional work experiences
years
1-2 years
2-3 years
3-4 years
>4 years

End-of-term survey questions:
1) The rationale for implementation of the top drug information assessment policy in skills lab was clear to me.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

2) I believe implementation of the top drug information assessment policy in skills lab was valuable to me.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

3) I believe frequent, weekly quizzes has improved my ability to learn and retain top drug information.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

4) The number of drugs per week was appropriate.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

5) I believe the cumulative end of term assessment has improved my ability to learn and retain drug information.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

6) I am confident that the weekly drug quiz policy has had a positive impact on my course grades in modules.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

7) I am confident that the weekly drug quiz policy has had a positive impact on my clinical problem-solving skills.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

8) The weekly drug quizzes helped me better follow along in the disease state modules.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

9) Implementation of the weekly drug quiz policy improved my overall confidence as a pharmacy student.
Strongly agree
Agree
Neutral
Disagree
Strongly disagree

10) Rate your confidence with matching brand and generic medication names.
Very Confident
Moderately Confident
Somewhat Confident
Not Confident

11) Rate your confidence with recalling the therapeutic class of a brand or generic medication name.
Very Confident
Moderately Confident
Somewhat Confident
Not Confident

Additional Questions for Post-Survey Only
How burdensome was the time spent preparing for weekly drug quizzes?
Very burdensome
Somewhat burdensome
Not very burdensome
Not at all burdensome

What types of study techniques did you use? Select all that apply.
Paper flashcards/note cards
Electronic flashcards/note cards
Quizlets
Drug table provided
Other (please specify)

What were the strengths of the top drug information assessment policy in the skills lab?

What recommendations or suggestions do you have for improving the top drug information assessment policy in the skills lab?