Drug Information Quizzes as Predictors of Student Success in Integrated Pharmacotherapy Courses

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ABSTRACT

Objective: To determine if drug quizzes (DQs) can serve as predictors of student success in pharmacy coursework.
Methods: De-identified student exam and DQ data from 2 courses of the pharmacy curriculum were evaluated over 3 years. One-way analysis of variance, Spearman’s rank correlation analysis, and Mann–Whitney U test were utilized to determine significant changes in student performance on exams and DQs over 3 years.
Results: Over 3 years, significant changes in exam performance were accompanied by significant changes in student performance on the respective DQ. A significant positive correlation was observed between student performance on DQ and their scores on respective major examinations in 22 of 24 datasets. Finally, students failing an exam had significantly lower DQ scores compared to students passing an exam in most analyzed datasets across 3 years.
Conclusion: Drug quizzes can serve as a predictor of student success or failure in pharmacy courses.

1. Introduction

Pharmacists are considered drug experts and it is no surprise that pharmacy students spend a significant amount of time during their doctor of pharmacy (PharmD) curriculum learning and memorizing drug names (brand and generic), mechanism of action, adverse effects, and approved indications. In fact, the North American Pharmacist Licensure Examination (NAPLEX) competency statement highlights the importance of adequate knowledge about drug characteristics (brand/generic name, mechanism of drug action [MOA], therapeutic class, etc.) for its exam takers. 1 Furthermore, in a study designed to identify factors that may predict success on the NAPLEX examination, inadequate drug knowledge scores on assessments were found to be a predictor for poor student performance on the NAPLEX. 2

Summative assessments constitute a substantial percentage of assessments in traditional PharmD curricula. The Accreditation Council for Pharmacy Education standards emphasize the inclusion of knowledge-based summative assessments as part of institutes’ assessment plan. 3 Better performance in knowledge-based exams has a direct influence on student success in their pharmacy coursework and, subsequently, their PharmD cumulative grade point average (cum. GPA). Critically, performance in the PharmD coursework and, in turn, the cum. GPA are established predictors of student success on the NAPLEX. 4,5 Cum. GPA during pharmacy coursework is a known predictor of student readiness and performance during Advanced Pharmacy Practice Experiences (APPEs) as well. 6–8 Additionally, higher scores in knowledge-based exams were found to be associated with better communication skills in students assessed via an Objective Structured Clinical Examination. 9 Although published studies indicate a strong correlation between student performance in pharmacy coursework and their success in clinical settings and the NAPLEX, curricular indicators of student success in pharmacotherapy-based courses are currently lacking.

Hence, the purpose of this study was to determine and quantify a possible correlation between students’ drug information knowledge, as assessed by drug quizzes (DQs), and their success in pharmacy coursework, represented by performance on knowledge- and application-based midterm and final exams. The hypothesis for the study was that students’ knowledge of drug information correlates with higher scores on major summative examinations and that DQ scores can serve as an indicator of student success in knowledge- and application-based summative examinations. The results of this study are expected to help educators formulate better strategies for improving students’ drug information knowledge.

2. Methods

A retrospective analysis of major assessments and DQs was conducted in 2 pharmacy courses offered at The University of Findlay. These 2 courses are team-taught modules focused on the cardiovascular system (cardio) and en-
Table 1
Mean ± SEM scores (%) on exams and DQs over 3 years in the Cardiovascular and Endocrinology courses.

<table>
<thead>
<tr>
<th>Cardiovascular course</th>
<th></th>
<th>Endocrinology course</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam 1</td>
<td>79.4 ± 1.8</td>
<td>DQ 1</td>
<td>91.3 ± 1.7</td>
</tr>
<tr>
<td>Exam 2</td>
<td>80.7 ± 1.8</td>
<td>DQ 2</td>
<td>88.6 ± 1.9</td>
</tr>
<tr>
<td>Exam 3</td>
<td>84.5 ± 1.5</td>
<td>DQ 3</td>
<td>88.0 ± 1.6</td>
</tr>
<tr>
<td>Final exam</td>
<td>78.0 ± 1.5</td>
<td>DQ 4</td>
<td>88.2 ± 2.2</td>
</tr>
<tr>
<td>Year 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam 1</td>
<td>77.1 ± 2.3</td>
<td>DQ 1</td>
<td>88.4 ± 2.2</td>
</tr>
<tr>
<td>Exam 2</td>
<td>78.4 ± 2.1</td>
<td>DQ 2</td>
<td>86.6 ± 2.1</td>
</tr>
<tr>
<td>Exam 3</td>
<td>78.4 ± 2.1</td>
<td>DQ 3</td>
<td>80.7 ± 2.6</td>
</tr>
<tr>
<td>Final exam</td>
<td>78.5 ± 1.9</td>
<td>DQ 4</td>
<td>93.2 ± 1.6</td>
</tr>
<tr>
<td>Year 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exam 1</td>
<td>84.9 ± 2.0</td>
<td>DQ 1</td>
<td>95.8 ± 1.1</td>
</tr>
<tr>
<td>Exam 2</td>
<td>81.8 ± 1.8</td>
<td>DQ 2</td>
<td>92.0 ± 1.7</td>
</tr>
<tr>
<td>Exam 3</td>
<td>82.5 ± 1.8</td>
<td>DQ 3</td>
<td>87.6 ± 2.2</td>
</tr>
<tr>
<td>Final exam</td>
<td>82.5 ± 1.6</td>
<td>DQ 4</td>
<td>92.2 ± 1.7</td>
</tr>
</tbody>
</table>

| Year 1                |   |                      |   |
| Exam 1                | 82.7 ± 1.5 | DQ 1 | 97.1 ± 0.8 |
| Exam 2                | 83.1 ± 1.8 | DQ 2 | 92.8 ± 0.9 |
| Exam 3                | 90.0 ± 1.3 | DQ 3 | 99.8 ± 0.2 |
| Final exam            | 75.4 ± 1.7 | DQ 4 | 98.7 ± 0.6 |

3. Results

The mean ± SEM scores (%) on exams and DQs in the module courses, over 3 years, have been summarized in Table 1. As part of this study, statistical analysis was conducted to compare the mean exam and DQ scores over year 1 to year 3 to (1) confirm the integrity of the assessment questions from year 1 through year 3, and (2) observe synchronous changes in scores of major assessments and the associated DQ from years 1 through 3 in both modules. As depicted in Fig. 1, between year 1 and year 3, no consistent (or significant) increase in student scores on major assessments was observed, thereby supporting the overall integrity of assessment questions over this period of time. More importantly, for the cardio module, a significant increase (P < .05) in mean score of exam 1 from year 2 to year 3 was accompanied by a concurrent significant increase (P < .01) in mean scores on DQ 1. Similarly, for the endo module, a decrease in exam 3 scores from year 1 to year 2 was accompanied by a sharp decline in student knowledge of drug information assessed on DQ 3.

Subsequently, as summarized in Table 2, Spearman’s rank correlation analysis was conducted to determine the overall correlation between student performance on DQs and the associated major assessment in the 2 courses. Collectively, 22 of 24 analyzed data sets showed statistically significant positive correlations between student performance on the DQ and the associated exam (P < .05). Overall, the correlation data suggests that students with better knowledge of key drug information (MOA, DTC, brand/generic names) were significantly more likely to be well-prepared for the drug knowledge- and clinical application-based questions in the associated major exam. To further evaluate the relevance of drug knowledge on major assessments, DQ scores (%) were compared between students who passed and failed the associated exam. Results from the Mann–Whitney U test confirmed a significant difference in drug information knowledge between students passing an exam and students failing an exam. On a substantial number of assessments over 3 years in each course—cardio (10 of 12 assessments) and endo (8 of 12 assessments)—students who failed a major assessment had a significantly lower DQ score (P < .05) compared to students who passed that assessment (Fig. 2).

4. Discussion

The retrospective data analysis from the present study clearly indicates a strong correlation between students’ knowledge of drug information and their performance on major assessments within the analyzed pharmacy courses.
Students demonstrating competency with drug information, as assessed in the DQ (MOA, DTC, generic/brand names), were significantly more likely to score higher on summative assessments. Conversely, students with inadequate knowledge of drug information pertaining to the course were significantly more likely to fail the associated major assessment. Because course grades typically include a variety of other low-stakes assignments, which may comprise up to 20% of the course grade, correlation analysis between student performance on DQ and the overall course grade was not deemed beneficial.

Fig. 1. Summary of mean ± SEM scores (%) on drug quiz and summative assessments over years 1–3 in cardiovascular and endocrinology modules. One-way analysis of variance (ANOVA) followed by Tukey's HSD post hoc test for multiple comparison was used for statistical analysis and levels of significance are marked accordingly - *p < .05; **p < .01. Ex, exam; DQ, drug quiz; Cardio, cardiovascular module; Endo, endocrinology module.

Ex = exam; DQ = drug quiz; Cardio = cardiovascular module; Endo = endocrinology module

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Pharmacy students have been shown to work collectively toward successfully reconstructing an examination. As reported in this published study, students were able to work collectively to recreate 90% of the questions on 2 examinations. Hence, it is critical to determine the integrity of exam questions in multi-year data analysis of summative assessments. In the present work, one-way ANOVA was conducted to rule out potential memorization of questions and to confirm the integrity of summative assessments over 3 years. Lack of adequate drug knowledge, hence, may serve as a predictor of failure in the evaluated pharmacy courses. Therefore, moving forward, the spacing of drug information assessments in the curriculum should be reviewed closely. Well-thought-out and proactive spacing of DQs can be adopted to better assist students who are struggling with summative assessments, while repeated testing of drug information should be encouraged within the pharmacy curriculum. Additionally, active learning strategies, including gamification, have demonstrated a positive impact on student re-collection of drug information and hence, can serve as a viable strategy to strengthen pharmacy students’ drug knowledge.

The presented data offers insight into the relevance of drug knowledge in the pharmacy coursework and the ability of students to benefit from adequate drug knowledge for major pharmacotherapy course assessments. Better scores on summative, knowledge- and application-based assessments can be expected to improve the cum. GPA for students in pharmacy programs. Although not studied directly as part of the present work, cum. GPA has been demonstrated to be an established indicator of APPE readiness and success on the NAPLEX. Therefore, strategic implementation of low-stakes quizzes on drug information within the pharmacy coursework can help to reinforce key aspects about drugs and thereby improve student readiness for their APPEs and beyond.

This study has a few limitations. The present analysis is restricted to a single institute and includes student data from only 2 required courses of the pharmacy curriculum. With adoption of a complimentary drug information assessment strategy in other courses, the sample size can be expected to improve in the future. In addition, the analyzed data is restricted to integrated pharmacotherapy courses and, therefore, does not offer an opportunity to determine the direct impact of the presented drug information assessment strategy on the clinical skills of pharmacy students.

5. Conclusion

In conclusion, the present study demonstrates the viability of utilizing knowledge-based DQs as a predictor of student success in knowledge- and application-based summative assessments. Devising better strategies to improve students’ knowledge of drug information can help them succeed in their pharmacy coursework.

Author Contributions

Shantanu Rao is the sole author of the presented work and was involved in the Conceptualization, Methodology, and Writing of this manuscript.

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References


