Integration of Pharmaceutical Sciences Disciplines at the End of the Semester Through Gamification

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Introduction

In most pharmacy schools, PharmD students are introduced to several pharmaceutical science courses in their first year of their professional pharmacy education (1). Compared to pharmaceutical sciences, clinical sciences are reinforced during the last year of rotations (1). The increased emphasis placed on clinical sciences (2) is further echoed by the more weight (~67%) in licensure examination for clinical sciences (2). These factors partly explain why the retention of pharmaceutical sciences content is perceived by students and faculty to be less compared to clinical sciences content (1).

Nevertheless, it is well established that pharmaceutical sciences are the foundation for pharmacy practice and patient care (2).

Faculty at West Virginia University School of Pharmacy have been working diligently to improve student retention of pharmaceutical sciences and critical thinking through both modularization and integration of content within pharmaceutical courses during P1 year.

Objectives

To design, implement, and assess an integrated virtual escape room that integrates pharmaceutical sciences courses (pharmacokinetics, biopharmaceutics, principles of drug action, medicinal chemistry, and pharmacogenomics) at the end of the semester to improve students' interconnectivity among disciplines.

Methods

A capstone offered for 2 days (4 contact hours) was developed to reinforce key concepts in the disciplines listed above. Day 1 consisted of an escape room addressing key concepts and day 2, integrated patient cases. Coordinators met and developed integrated puzzles subsequently uploaded into a google form. Puzzles had to be correctly solved prior to advancing to the next level. This activity was offered to students at the end of the semester after completion of each of the specific discipline modules. Students worked in small groups in the classroom to solve puzzles. Students were asked to complete a pre- and post-survey to assess knowledge and perceptions of the capstone.

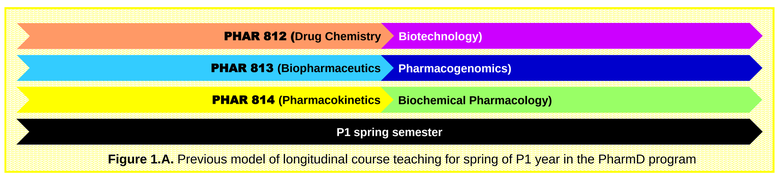


Figure 1.A. Previous model of longitudinal course teaching for spring of P1 year in the PharmD program

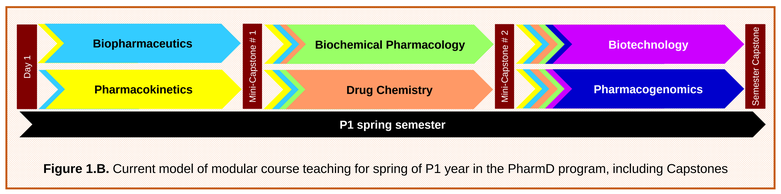


Figure 1.B. Current model of modular course teaching for spring of P1 year in the PharmD program, including Capstones

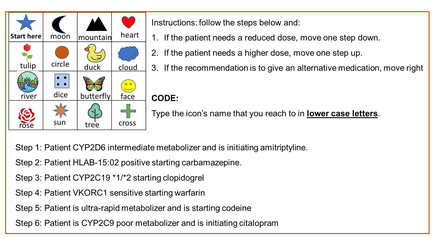


Figure 2.A. An example of a puzzle used in the virtual escape room activity

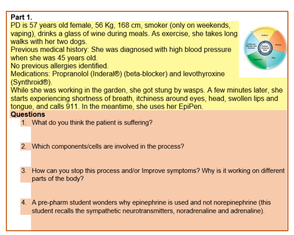


Figure 2.B. An example of a mini-case

Results

1. Students performed significantly better in the same test after completing the Capstone activities

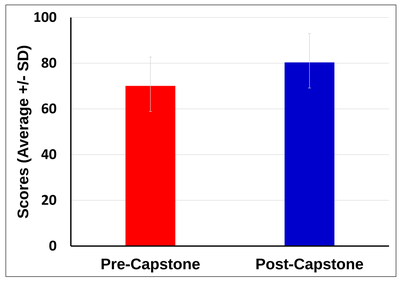


Figure 3. Average test score for pre- and post-Capstone test. $p<0.001$ – paired T-test comparing pre- and post-Capstone test results per student (n=40)

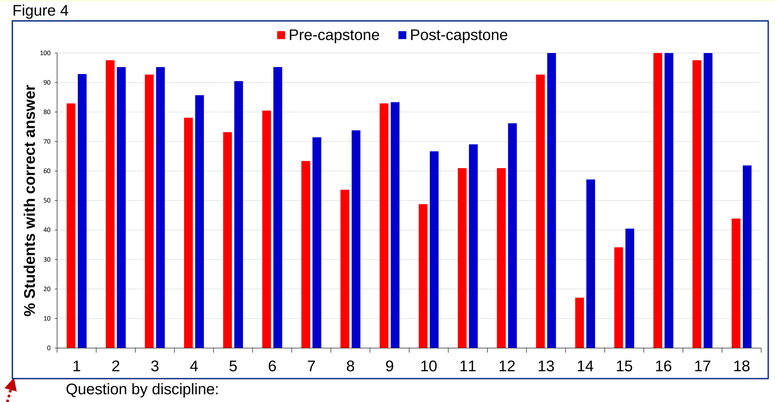
	Pre-Capstone	Post-Capstone
Highest score	94.44	100.00
Lowest score	38.89	55.56
Average	70.00	80.82
Median	72.22	77.78
STDEV	12.66	11.18

Table 1. Data of the pre- and post-Capstone test results. (n=40)

Students overall score in the post-Capstone activity test statistically significantly increased by 15.4% ($p<0.001$) compared to the pre-activity test.

2. Students' performance by discipline (module):

Figure 4



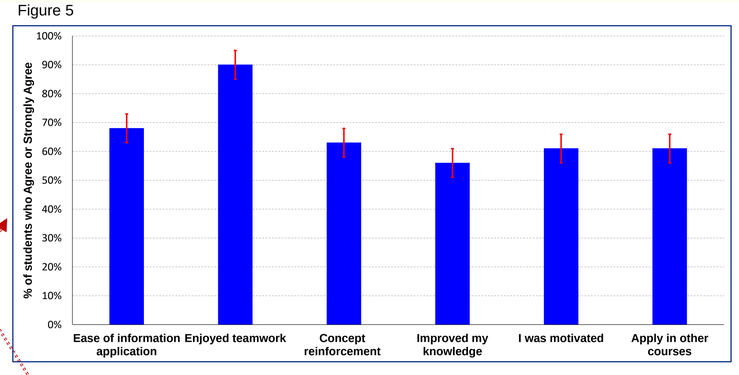
Question by discipline:

- Q 1, 4: Drug Chemistry
- Q 2-3, 17: Pharmacokinetics
- Q 6-9: Biopharmaceutics
- Q 10-14: Biochemical Pharmacology
- Q 16: Pharmacogenomics
- Q 5, 15, 18: Multi-discipline

Number of students who answered module-specific or integrated questions correctly was, in general, higher in the post-activity compared to the pre-activity test.

3. Students feedback on the Capstone activities:

Figure 5



Students reporting positive and beneficial experience with the end-of-semester Capstone activities.

Students were surveyed about the Capstone activities using the following points:

1. **The logistics of the capstone were amenable to applying information.**
2. **I enjoyed working through the capstone with my teammates.**
3. **The capstone helped to reinforce concepts learned along the semester.**
4. **My knowledge has improved as a result of working through the capstone with my teammates.**
5. **I was motivated to put forth my best effort on the capstone activities.**
6. **Capstone sessions should be implemented more throughout the curriculum to reinforce important concepts.**

Conclusions

Collaboration among faculty from different pharmaceutical sciences disciplines is key for the success of these types of educational activities.

Thoughtful modular design and shared final contact hours to develop integrated activities was welcome by students and faculty.

This educational approach was well received by the students and helped them to improve their knowledge, and integrate and reinforce concepts taught in multiple foundational courses as well as teamwork,

Students favor the idea of similar activities across the curriculum.

Implementation of additional mechanisms of assessment to develop fuller integration and critical thinking scenarios are being explored

Limitations / Future Directions

- Relatively small number of participants/one site
- **Future Directions:** Assess the impact of the mini-Capstones at the end of each sets of modules to enhance the students logical thinking for the need of pharmaceutical sciences as foundation for clinical applications

References: *(1). Knowledge retention of basic pharmaceutical sciences in a PharmD program. Currents in Pharmacy Teaching and Learning. Elizabeth J. Unni. 2016.*
(2) Learning Across the Curriculum: Connecting the Pharmaceutical Sciences to Practice in the First Professional Year. American Journal of Pharmaceutical Education. Bethanne Brown et. al. 2008
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