Incorporating Evidence-Based Teaching into Pharmacy Education: A Case Study on the Use of Educational Theory in the Backward Design of a Drug Information Course

Christopher S. Wisniewski, PharmD, MSCR, BCPS[1]; Jennifer N. Wisniewski, PharmD, BCPS[1]; Rachel Whitney, MLIS, AHIP[2]; Emily P. Jones, MLIS, AHIP[3]

[1] Medical University of South Carolina College of Pharmacy
[2] Medical University of South Carolina Libraries
[3] University of North Carolina Health Sciences Library

Abstract

Background: One way to incorporate evidence-based teaching into healthcare education is through backward design, a pedagogical design process that starts with creating learning outcomes, then moves to assessments, followed by content creation. This study uses backward design as a framework to present an applied experience of evidence-based teaching in the design and refinement of an introductory drug information course presented in the first year of a traditional 4-year PharmD curriculum. *Case Description:* In addition to backward design, evidence-based teaching methods included scaffolding, pass-fail grading standards, formative assessments, flipped classroom, and gamification. Additionally, innovative assessment techniques and teaching activities were created. The full evolution of this course, along with student performance, student perceptions, faculty workload and faculty experience, are described. *Case Themes:* Overall, using evidence-based methodologies led to improved organization and enhanced faculty and student satisfaction. Data showed students performed well based on both assessment and course averages. Faculty workload was substantial during the initial development of the course and was mitigated once structure and organization had been better optimized over years of revision. *Impact:* This report provides a model for others to incorporate evidence-based teaching methods into course design in both incremental and large-scale changes. The incorporation of these ideas takes time and work from faculty but this effort has the potential to yield improved student learning and perception. Dedication to continuous review and revision of developed educational content is encouraged. Faculty found this experience rewarding and felt that it made them better and happier educators.

Keywords: drug information, pharmacy education, evidence-based teaching, backward design

BACKGROUND

Throughout the evolution of healthcare, the educational model has required more experienced practitioners to pass down their knowledge, starting with apprenticeship. As such, healthcare professionals are expected to teach as part of their daily responsibilities regardless of the audience, whether it be patients, persons who the patients trust, students, or colleagues.[1] To educate effectively, healthcare professionals must have a solid foundation in teaching and learning principles.[1-3] Unfortunately, healthcare professionals often lack formal training in these areas.[1,4-6] With good intentions, these professionals often rely on their own experiences and their own training to teach others, perpetuating the misconception that common practice is best practice. However, driven by learners and technology, education continues to evolve, and while "this worked for me" worked at one time, educators must adapt to these changes.

The primary role of the educator has evolved from teaching to promoting learning.[1] The dichotomy of teacher-centered versus student-centered learning is being replaced by a learning-centered approach, which has three necessary components: 1) learning outcomes (i.e., what should be learned), 2) grading standards (i.e., how learner achievement of the outcome is graded), and 3) assessment (i.e., how learner achievement will be tested). These are key to a learning-centered approach because these 3 components set the requirements for and assurance of learning. How well the content is learned is the goal, and all other components are a means to this end. In this way educators are forced to design educational environments that achieve the goal regardless of preference or trend.[7]

One way this transition can be facilitated is utilizing backward design, a pedagogical design process which begins at the end, specifically starting with learning outcomes.[7-10] In this approach, the first step is to determine the knowledge or skill the learner must demonstrate by the end of the activity, class, course, or curriculum at the standard determined by the educator(s). Subsequently, educators build assessments that map to those outcomes, followed by content students will learn. Figure 1 provides a stepwise approach to the backward course design process.[7,11] While not new to healthcare and pharmacy education, reports on the stepwise implementation and practical experience of utilizing backward design are limited in the literature.[8,9,12]

Corresponding Author:
Christopher S. Wisniewski
Medical University of South Carolina College of Pharmacy
Phone: 843-792-8443
Email: wisniews@musc.edu

DOI: https://doi.org/10.24926/iip.v15i3.5873

The purpose of this case study is to share how the authors utilized evidence-based teaching methods to develop an introductory drug information (DI) course taught in a pharmacy curriculum. Because backward design was the core element of course redesign, this report is intentionally organized and mapped to each backward design step as defined by Angelo, starting with the end goal of learning outcomes and then working backward from assessments through content.[11] Additionally, this case study will define and explain the use of other educational theories and techniques incorporated into the course during redesign.

DESCRIPTION OF THE CASE

Step 1: Program-Level Learning Outcomes

Introduction to DI is a 1-credit-hour course taught by a DI pharmacy faculty member and librarian in the first year of a traditional 4-year Doctor of Pharmacy curriculum at the Medical University of South Carolina (MUSC) College of Pharmacy. The curricular role of this course is to introduce new pharmacy students to the basic concepts of DI. These include essential DI resources available to them during their pharmacy education and important problem-solving skills used to answer DI questions. The course, which was taught via a traditional lecture format for several years, was revised using backward design when the opportunity to rethink delivery presented itself after the dissolution of a distance-education model.

Step 2: Course-Level Learning Outcomes

Faculty started by identifying four specific course-level learning outcomes that were applicable to the role of the course within the larger curriculum, achievable by students in the time allotted for the course, and appropriate for first-year pharmacy students: 1) apply the systematic approach to DI questions[13,14]; 2) utilize common and essential DI resources; 3) perform literature searches; and 4) provide basic responses to DI questions. While these outcomes are fairly broad, they were written intentionally. Faculty approached the revision of learning outcomes from a generalist perspective rather than an expert. Realistically, very few students taking this course will choose to go into DI as a specialty. This, combined with the early place of this course in the curriculum, caused a vital shift in teaching philosophy. Faculty increased focus on developing lifelong learning skills as opposed to mastery. For example, an earlier iteration of this course had a learning outcome stating students would become proficient in using the systematic approach to develop responses to DI questions. This was simplified to become familiar with the systematic approach and develop basic responses to DI questions, eliminating the unachievable expectation of proficiency this early in the students' learning experience.

Additionally, the revised outcomes were developed with consideration given to the potential for cognitive overload, which purports that learning is inhibited when learners become overwhelmed if given too much new information or too many tasks to complete.[15] In previous iterations, faculty tried to introduce dozens of DI resources to students in a short amount of time. This proved to be detrimental to the learning process as students never had time to truly practice with resources before moving on to new ones. Anecdotally, teaching so many resources added pressure to faculty as well, and reducing content has made a better experience for students and faculty.

Step 3: Assessments and Grading Performance Standards

Following the establishment of course-level learning outcomes, instructors determined assessment standards and grading standards, that would reflect student achievement.[16] The assessment standard used a competency-based approach and aligned with learning objectives previously determined. The course coordinators elected to use the pass/fail grading standard.

While the effectiveness of a pass-fail grading system on student learning is unsettled, there is support indicating that, for healthcare students, a pass-fail approach can reduce stress, decrease competition, improve learning enjoyment, and improve perception.[16-19] Furthermore, thus far, pass-fail grading systems have not been shown to adversely affect learning outcomes or decrease student motivation to learn. Based on these potential benefits and to encourage students to focus on learning rather than achieving a grade, instructors selected a pass-fail grading system as the standard for this course.

Using a competency-based approach to demonstrate student ability and aligning with the method of backward design and the pass-fail standard, summative assessments were created specifically for each course outcome. These four assessments, along with the aligned course outcome, subject matter, grading mechanism, and the weight of the grade, are listed in Table 1. In the interest of easing student burden and stress during summative assessments, class is not held the week assessments are due. This allows students to dedicate themselves to these summative assessments without worrying about grasping new content.

Step 4: Summative (Graded) Assessments

Tertiary resources and systematic approach multiple-choice quizzes

A 20-question systematic approach quiz, includes three short-answer questions that require students to document background questions they would ask any requester, specifically "Is this patient-specific or general?", "What resources have you consulted?", and "What is the urgency?". Seven questions ask students about the responsibility of pharmacists to provide DI and steps 1 through 3 of the systematic approach. The final 10 multiple-choice questions are broken into two cases, with the same premise as the tertiary resources quiz cases; these questions focus on application of taught concepts via hypothetical scenarios.

DOI: https://doi.org/10.24926/iip.v15i3.5873

For the tertiary resources quiz, students answer questions about the systematic approach, access appropriate online resources, and find basic information (e.g., lab values, dosage forms, drug interactions) in those resources. The questions are organized into three sections, with 11 stand-alone questions and 14 questions asked across two DI question cases.

Both assessments are administered as take-home quizzes in the college's learning management system (LMS). Students are instructed to work individually and given between 6.5 and 13.5 days to complete the quizzes, depending on the academic calendar and when events that restrict class from being held, like Research Day and Fall Break, occur.

Literature searching video assignment

Before the final assignment, students record and narrate a short, screen-capture video of themselves conducting a literature search for a DI question case. This case is the same as the final assignment; therefore, students will benefit later because they must incorporate the search results into the upcoming, high-stakes, written DI question response. This advantage is communicated to them to encourage effort. Details about this assignment have been published previously.[20] Students receive feedback on their performance via the graded rubric and a case-specific video of a successful search that summarizes trouble spots observed in student submissions.

DI question response

The final assignment for the course is to develop a written answer to an assigned DI question. This cumulative assessment incorporates all content taught throughout the semester. To encourage students to complete the assignment, it is weighted as 50% of the final grade, meaning students must demonstrate competence to pass the class.

Students are individually assigned one of eight case-based questions. These are directly answerable using the systematic approach taught over the course of the semester. Students are provided background information and the ultimate question as part of the final case assignment because: 1) they cannot ask questions of the hypothetical requester and 2) they have performed these processes multiple times during active learning sessions. There is also a future opportunity in the curriculum for each individual student to collect background information from a requester in the second-year health-system pharmacy laboratory course.[21] For the written DI response assignment, students are assessed across multiple elements including question categorization, response development, and appropriate referencing.

Step 5: Diagnostic & Formative Assessments

Diagnostic and formative assessments are no or low stakes assessments used by educators and students to determine the students' starting place in learning (diagnostic) or progress in learning (formative). Formative assessments may be used by students and teachers to determine areas of strengths and weaknesses in content. For students it may confirm areas which are understood or require renewed focus, and for teachers it may point out content which may need more or less attention during class time.

To encourage engagement, students are assigned formative, weekly pre-class quizzes throughout the semester and are given 6.5 days to complete them. Quizzes are participation-based, in that students receive credit for completing them regardless of providing correct answers. All pre-class quizzes include four multiple-choice questions and a fifth "gimme" question (eg, "Reviews and guidelines are examples of which type of reference?": A) Tertiary or B) Tertiary). to track completion. Between the deadline and class, the LMS releases correct answers and feedback to the students, allowing them to evaluate their grasp of the content prior to application in class. Students earn one point per quiz completion (n = 11) during the semester, which accounts for 10% of the students' final grade.

To encourage students to come to class, the last 10% of the students' grade is attendance-based. Though not explicitly a formative assessment, attendance is beneficial because skills are applied through active learning during class sessions.

Step 6: Learning Activities & Assignments

Learning activities, defined as specific work that students are assigned,[7] are organized in two ways, via pre-class content and in-class active learning. Active learning improves academic achievement, student-interaction quality, perceptions of social support, student attitudes, and retention.[22]

Furthermore, the course is flipped, an overarching educational concept in which students are encouraged to take ownership of their learning outside of class, contributing to self-directed learning.[23] Before class, students watch short, interactive video lectures between five and 10 minutes in length[24-29]; each video has an associated 1- to 2-page handout. Recording these videos (n = 35) took significant effort on the part of the teachers; however, research shows that healthcare students retain more information when taught using flipped methodology with pre-class recordings.[30] The video length is kept intentionally short to maintain student attention and encourage retention of content.

Students then complete the weekly formative quiz on presented concepts. Whether students view the videos is not tracked, but most students learn the value of the pre-class content early in the course. Students then apply learned information through active-learning class sessions via role playing, gamification, team-based activities, and interactive discussion (see Teaching strategies, techniques, & tools).

DOI: https://doi.org/10.24926/iip.v15i3.5873

Once in class, retrieval practice, which occurs when students attempt to retrieve, recall, or reconsider learned information from memory, is applied. Rather than "pump and dump," this technique forces students to stop, think, and consider the depth of their knowledge of the subject at hand.[31] Students are consistently asked to recall information they were taught prior to class. For example, when the instructor presents a new question case and asks for categorization, students must recall the possible categories and assign one to the current scenario.

Retrieval practice in this course is enhanced by deliberate practice, which is when a student intentionally repeats an activity to improve performance. The goal of deliberate practice is to improve the learning of basic skills and create automaticity, in that students do not need to think as they perform tasks which have become rote through repetition. When an activity is automatic, students are free to use cognitive resources on more complex tasks.[32]

Finally, students are educated via four cumulative cases spread across various pharmacy practice settings (i.e., DI Center, community, health-system, clinical) to demonstrate how workplace environment can influence DI requests. While the questions change each week, the process of exchanging information remains the same, compelling students to recall information and practice important steps of the systematic approach repeatedly.

Step 7: The Content

Content is presented using a scaffolding methodology, with the previously mentioned systematic approach to DI questions as the outline for the course (Table 2).[13] Scaffolding is an educational design principle used to teach material in distinguished segments that build on each other to help students develop schemata involving new content or a new skill. As learners' knowledge matures, educators gradually remove support until the learner is independent. This differs from independent learning, in which students navigate the material alone.[33] In theory, well-designed scaffolding can help minimize cognitive overload by putting novel information into long-term memory for retrieval, therefore allowing for more efficient and effective learning.

As this course advances, students are presented with more complex tasks and scaffolding is removed. For example, when the content is introduced, students are directed by the teacher on how to execute specific tasks within a literature search. As the semester progresses, students are expected to perform these steps independently and without direct oversight from educators. When combined with retrieval and deliberate practices, students become more independent and require less support from their teachers. As another example, students learn to ask the same set of background questions (step 2 of the systematic approach) repeatedly when encountering example DI questions throughout the semester to induce automaticity. As the course progresses, educator support is removed by decreasing the prompts on the questions students should ask.

In this course, students typically engage with three pre-class lessons per week, which are mapped to the upcoming session's activity. For example, during Week 1, students learn about background questions, categorization, and ultimate question development. The formative assessment asks students questions that will be asked in class, preparing them to participate. Subsequently, students work through scenarios in class and apply pre-class information. In Week 1, the teacher roleplays the requester, and the students act as the pharmacist receiving the question. Students ask background questions and receive answers, categorize the question, and develop an ultimate question, while the educator provides feedback throughout the interactive discussion.

Step 8: Teaching Strategies, Techniques & Tools

For the active-learning class sessions, teachers created a worksheet to be completed by the students before class. Each class session was developed by the course coordinator or the librarian, and the individual teacher dictates which active-learning technique is used. In addition to role playing, active-learning sessions are taught via interactive presentations where teachers and students access and demonstrate online resources. During these sessions, which are never lectures, students are encouraged to participate with rewards and positive feedback.

Another major tool used during class sessions is gamification, an active-learning technique that incorporates game design aspects to improve learning, rather than provide entertainment. Gamification has been organized into a conceptual framework, in which nine attributes are defined.[34] Of these nine, "assessment" (eg, using scoring or rewards during games) and "conflict/challenge" (eg, using competition during games) are the most widely studied; however, all aspects of gamification in healthcare education have been shown to improve student satisfaction and/or learning outcomes.[34] Faculty used both assessment and conflict/challenge attributes in this course while playing the following games once per semester: Poll Everywhere individual trivia game,[35] crossword puzzle,[36,37] escape room,[38-40] bingo,[41,42] and bar/pub trivia. Students are provided with the opportunity for prizes, such as food vouchers, school supplies, and candy for participation (eg, assessment) or winning (eg, conflict/challenge) depending on the game.

Step 9: Course & Teaching Evaluation/Program Review

The course is consistently evaluated after each iteration, both through voluntary anonymous student evaluations required by the university and a course-specific feedback survey that students must complete to access the final assignment. Survey results are reviewed by course coordinators and identified themes are discussed.

DOI: https://doi.org/10.24926/iip.v15i3.5873

Faculty also communicate during the semester, documenting potential adjustments noticed as the course is taught. For example, faculty saw the escape room game was too short or too long depending on the ability of the student group. To resolve this, faculty plan to stop the game at set times and ask students to demonstrate their solutions.

While this case study presents the current version of this course, it took seven years to move from a traditional lecture model to a flipped classroom while incorporating these various pedagogies. The evolved version of the course was developed using student feedback and the authors' deeper understanding and personal reflection of evidenced-based teaching practices. Changes were made incrementally and continuously evaluated, both formally and informally, as the backward design process requires. Major changes during the evolutionary process are presented in Table 3 to help educators envision course redesign.

ANALYSIS OF THE CASE

Evaluation of student performance and perception

Data from the 2021 and 2022 course offerings are presented because these are the most consistent iterations that occurred post-pandemic. Both years were conducted in-person and used the course design presented in this report. Outcomes collected include student performance, student perception, and faculty workload. Performance data from course assignments and overall course average were summarized using descriptive statistics.

Student perception data were generated from two data sets: 1) the optional University-mandated student evaluation surveys of the course and educator and 2) the incentivized course-specific feedback surveys. These data sets were summarized using descriptive statistics.

Statements from the University-mandated survey requested a response of 1 to 5 on a Likert scale, with 1 representing strongly disagree and 5 representing strongly agree. The course-specific feedback survey was written by faculty and designed for quality-improvement purposes. More specifically, the percentage of pre-class videos watched (0-25%, 26-50%, 51-75%, or 76-100%), and provided an open comment opportunity (data not provided here). This survey was not anonymous, though the LMS withheld student names when responses were downloaded. In other words, students knew their names were attached to submissions, but faculty avoided looking at them when reviewing the responses.

This project was deemed quality improvement by the Institutional Review Board for Human Research of the Medical University of South Carolina and therefore did not require approval nor informed consent from participants.

Student performance

Overall course average per student was 85.4% in 2021 and 89.9% in 2022. Four students in 2021 and one student in 2022 did not pass. In general, these students were unable to reach the required threshold because they received a 0 for incompletion on several components of their final grade. Averages per year for each assignment are included in Table 4.

Based on voluntary evaluations, students felt they grasped the material taught in the course (2021 and 2022 means both = 3.8) and that the activities contributed significantly to learning (2021 mean = 4 and 2022 mean = 4.3). Because the survey is voluntary, a low percentage of students completed the evaluation, specifically 32% (n = 22/68) in 2021 and 10% (n = 6/60) in 2022.

Course-specific feedback survey data

Excluding written-response questions and the estimation of pre-class videos watched, Table 5 presents questions and results from the feedback surveys. Results indicate that some students did not like the flipped classroom, though there was a moderate percentage of students each year who were indifferent [2021 n = 10 (15%), 2022 n = 14 (23%)]. Information collected on increasing video watching from the 2022 survey included adding Easter eggs (ie, hidden messages or images in electronic media), extra credit, bonus points, and encouraging video viewing by adding this as a graded course component.

Student estimates on percentage of videos watched during the semester were similar between 2021 and 2022 (Table 6). In general, most students indicated that they watched more than half of the videos.

Faculty workload

With the course better optimized since conceptualization began in 2016, time spent on developing content is less than initial development, which took roughly 200 dedicated hours during those early years. This was the result of the need to reorganize and prioritize the content so that it met the outcomes defined by the backward design process, which took 10 to 20 hours. Once the weekly topics were identified, further selecting and organizing preclass content was time-consuming and took another 20 to 30 hours. Identifying a content expert to record preclass lectures and write assessment questions required another 10 hours of effort. As the primary lecturers, creating and recording preclass content and handouts for assigned topics was also a major consumer of time and required approximately 50 hours to complete. The most time-consuming aspect was creating the weekly lectures that incorporate active learning, accounting for 60 hours of time. Finally, creating the core assessments, including writing questions and developing rubrics, consumed another 30 hours. Despite these numbers, it is unlikely that the amount of effort to create a course using backward design is greater than any other method an educator might use.

DOI: https://doi.org/10.24926/iip.v15i3.5873

With the course fully developed, faculty have little to no content creation, though as with all courses, lectures and assessments must be updated annually to reflect accuracy. Other annual tasks include setting the lecture schedule, contacting content experts to confirm continued participation, identifying replacements if needed, reminding content experts of deadlines, and reviewing case questions for both preclass and summative assessments. These are all tasks likely to be required of any course coordinator.

IDENTIFICATION OF CASE THEMES

This case study describes a way to incorporate backward design into teaching. The other evidence-based teaching tools described in this backward design-driven course revision include cognitive overload, pass-fail grading, active learning, formative assessment, flipped classroom, gamification, retrieval practice, deliberate practice, and scaffolding. While the course design presented in this paper is specific to DI education, the definitions and practical applications of these techniques can help other healthcare educators adopt these methods.

While the process of program review and continuous quality improvement can be time-consuming, using the backward design process allows for a methodological approach to the evolution of educational content. Data from both student performance and perception demonstrate that the course redesign has helped students learn and that they perceive the course as a good experience. Without comparative student performance data, it is difficult to make broad conclusions; however, data show that students engage with pre-class quizzes and attend class. Future research on the effect of incentives on student learning and faculty morale should be considered, as encouraging attendance with grades has recently been purported to reduce students' motivation for learning.[16] However, in this course, these methods stimulated attendance and student engagement during class, which has allowed faculty to assess how well students are learning from provided pre-class materials.

Student performance data on summative assessments show mixed results. Grade averages on the first two quizzes are marginal, though these obligations are being fulfilled. An improvement in performance on the literature searching assignment from 2021 to 2022 is noteworthy. This may be related to quality improvements made between 2021 and 2022, specifically providing students an example assignment video, modifying how these concepts are taught, and reinforcing the value to future assignments. The performance on the DI question response shows that students can achieve the cumulative course outcome of answering a basic DI question.

Student perception data are generally strong. The low response rate to the University-required survey makes it difficult to draw broad conclusions from the data generated, though it appears students feel the course contributes to their learning. The grasped material criterion scores could improve, though as an introductory course, students are told they will not master the information taught; this might affect their perspective on how well they feel they understood what they learned.

CASE IMPACT

This report demonstrates a mechanism for using backward course design in the development of an introductory DI course. While the course content is specific, the design methodology presented is not. This case study has shared one team's real-world experience with these processes, providing a roadmap on how others can successfully incorporate these concepts into their own teaching.

The most rewarding aspect of implementing this educational activity is the impact incorporating evidence-based teaching techniques has had on student performance, perception, and faculty's teaching experience. While this report was not designed to present a direct comparison with the previous iteration of the course, the authors anecdotally find that students are better at retaining information and enjoying class more with the current course design. The faculty can say that they enjoy the new design more than the lecture version and have grown as educators because of the incorporation of evidence-based teaching into their work. Furthermore, the authors feel that each step of this redesign over seven years has resulted in some observed improvement in either perception, performance, satisfaction, or some combination of all three with each iteration. While much effort has been expended to make these changes occur, seeing the fruit of this work has made the authors' investment in these changes meaningful and worthwhile.

The most challenging aspect of implementing this educational activity was the time investment to completely overhaul a course from a traditional, lecture-based format to one that is flipped with emphasis on active learning during in-class sessions.

A modest percentage of students did not like the flipped classroom. Given the evidence supporting the use of flipped classroom and the impact on student learning and retention,[30] it is difficult to justify changing the course structure; however, it is possible that results could improve if students experienced flipped classrooms in other courses. Students may not appreciate the flipped classroom because it is new to them, and they do not realize the in-class activities are a direct result of the flipped structure.

Since the change in grading structure, feedback has been consistent that having a pass-fail, 1-credit-hour course

DOI: https://doi.org/10.24926/iip.v15i3.5873

disincentivizes students to spend time on this class. This is not easily addressed, other than to explain to students the reason for the grading structure, which is to emphasize learning over focus on a grade. As pharmacy education explores competency-based education,[43] this course can serve as a model for how other curricula and DI courses might consider required competencies for pharmacy students.

Student-reported video viewing results demonstrate that pre-class content presented via recordings engages students; however, increasing these numbers is important so that students are prepared and able to participate during active learning sessions in the classroom. The high percentages earned on pre-class participation indicates that some students are likely completing the pre-class quizzes without engaging with the videos. Faculty are currently conducting a research project to determine if gamifying the course for the entire semester increases video viewing.

Because the course-specific survey is not anonymous, it is possible that the data generated are biased, as some students may not feel free to answer candidly. While students are told that there will be no repercussions for any responses, this requires students to trust the faculty conducting the survey, which cannot be guaranteed.

In addition to the de-anonymized survey data introducing potential bias, low response rates, the use of survey instruments that have not undergone high-level validation, and retrospective collection of data are limitations of this report. Furthermore, due to the focus on educational approaches, debate about the efficacy of certain techniques utilized (e.g., pass-fail grading, attendance incentivization) may exist. The authors have been sure to consider the literature and use evidence-based teaching throughout the process of developing and disseminating this course to the best of their ability.

CONCLUSION

While this report is not the first description of using backward design in pharmacy education, it can serve as a real-world example to others interested in making similar course adjustments, demonstrating that modifications can be introduced in small steps or in larger revisions. Furthermore, it offers additional context on the introduction of several evidence-based teaching methods that could be implemented by pharmacy and other healthcare educators. Utilizing backward design in the development of educational content supports a learning-centered environment, and faculty should strive to include this and other evidence-based teaching methods in their instruction. To optimize student learning, educators should combine learner feedback and faculty growth during the program review step of the backward design process. As students and technology continue to evolve, healthcare faculty should adapt their methods to incorporate evidence-based teaching to improve learning, engagement, and ultimately patient care.

Considerable time and effort are necessary for course revisions; however, when performed using an evidence-based approach, this effort is not in vain, as the literature supports that incorporating evidence-based teaching methods improves student learning and perceptions.

Acknowledgements: None

Funding/Support: None

Conflicts of Interest: None

Disclaimer: The statements, opinions, and data contained in all publications are those of the authors.

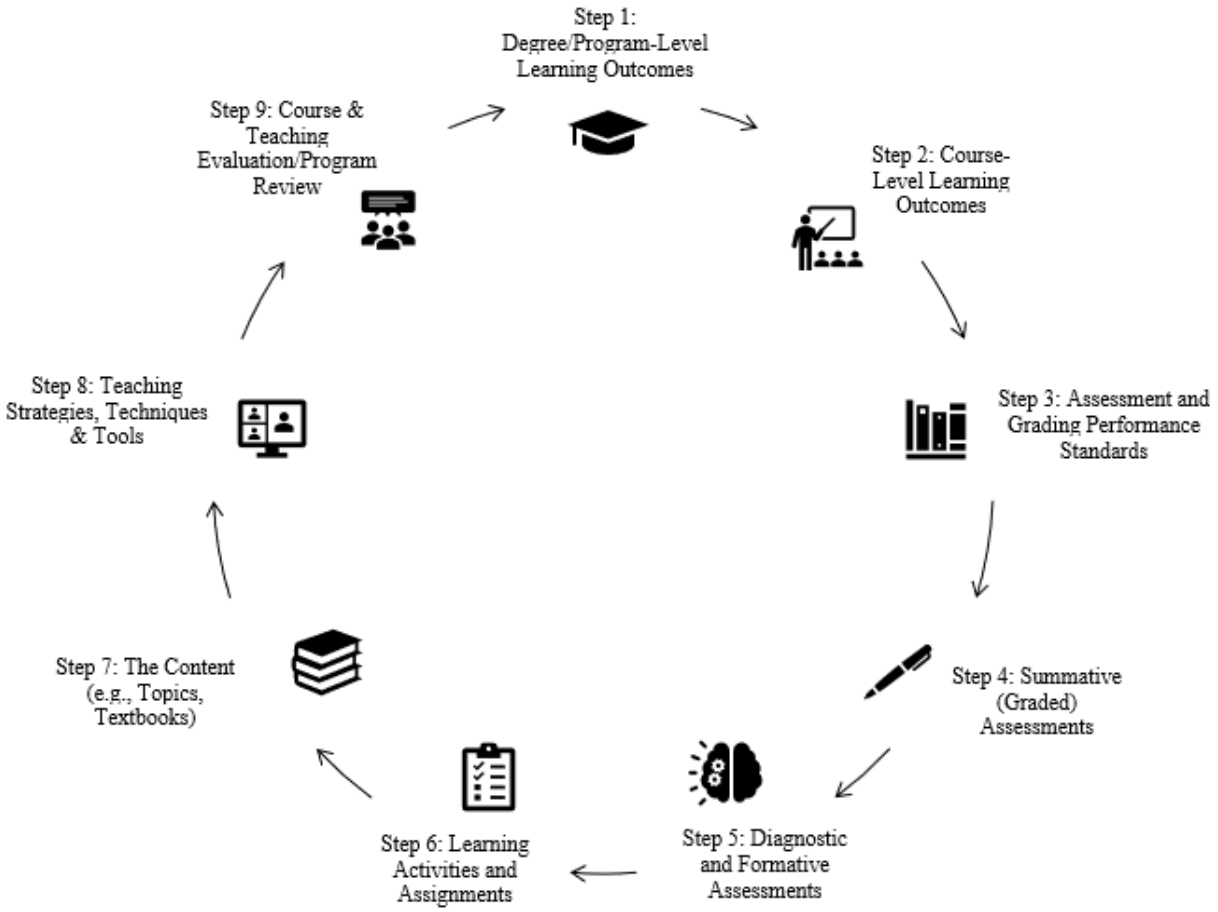
REFERENCES

1. Bastable SB, Gramet P, Sopczyk D, Jacobs K, Braungart M, eds. *Health Professional as Educator: Principles of Teaching and Learning.* 2nd ed. Jones & Bartlett Learning; 2020.
2. Davies P. Approaches to evidence-based teaching. *Med Teach.* 2000;22(1):14-21. Accessed July 17, 2024. doi:10.1080/01421590078751
3. Swanwick T. Introduction. In: McKimm J, Swanwick T, eds. *Clinical Teaching Made Easy : A Practical Guide to Teaching and Learning in Clinical Settings.* Andrews UK Limited; 2010:1-5. Accessed July 17, 2024. https://ebookcentral.proquest.com/lib/unc/reader.action?docID=3001941&ppg=12
4. Gubbins PO. The scholarship of teaching and learning: an opportunity for clinical faculty members in academic pharmacy and other health professions to develop a program of scholarship. *Int J Scholar Teach Learn.* 2014;8(1):3. Accessed July 17, 2024. doi:10.20429/ijsotl.2014.080103
5. Medina MS, Castleberry AN, Persky A. Evaluating pharmacy faculty's awareness of teaching and learning myths and misconceptions. *Am J Pharm Educ.* 2022;86(9):8751. Accessed July 17, 2024. doi:10.5688/ajpe8751
6. Wilkerson L, Irby DM. Strategies for improving teaching practices: a comprehensive approach to faculty development. *Acad Med.* 1998;73(4):387-396. Accessed July 17, 2024. doi:10.1097/00001888-199804000-00011
7. Angelo T. Designing subjects for deeper learning: practical research-based principles and guidelines. In: Hunt L, Chalmers D, eds. *University Teaching in Focus: a Learning-Centred Approach.* 2nd ed. Routledge; 2021:29-52.

8. Cline KM, Winhoven MM, Williams VL, Kelley KA, Porter BL. Backward design to combat curricular expansion in a large, interdisciplinary, team-taught course. *Am J Pharm Educ.* 2023;87(9):100052. Accessed July 17, 2024. doi:10.1016/j.ajpe.2022.12.009
9. Daugherty KK. Backward course design: making the end the beginning. *Am J Pharm Educ.* 2006;70(6):135. Accessed July 17, 2024. doi:10.5688/aj7006135
10. Wiggins GP, McTighe J. Backward design. In: *Understanding by Design.* 2nd ed. Association for Supervision and Curriculum Development (ASCD); 2005.
11. Angelo T. Doing assessment as if teaching and learning matter most. Presented at a half-day workshop for faculty and guests of Syracuse Univeristy. October 14, 2016. Accessed July 17, 2024. https://effectiveness.syr.edu/wp-content/uploads/2016/09/Doing.Assessment_Syracuse_14.Oct_.2016_Angelo.pdf
12. Wright BM, Hornsby L, Marlowe KF, Fowlin J, Surry DW. Innovating pharmacy curriculum through backward design. *TechTrends.* 2018;62:224-229. Accessed July 17, 2024. doi:10.1007/s11528-018-0283-8
13. Sheehan AH, Jordan JK. Formulating an effective response: a structured approach. In: Malone PM, Malone MJ, Witt BA, Peterson DM, eds. *Drug Information: A Guide for Pharmacists.* 7th ed. New York, NY: McGraw-Hill Education; 2022. Accessed July 17, 2024. https://accesspharmacy-mhmedical-com.libproxy.lib.unc.edu/content.aspx?bookid=3132&sectionid=262747038
14. Watanabe AS, McCart G, Shimomura S, Kayser S. Systematic approach to drug information requests. *Am J Hosp Pharm.* 1975;32(12):1282-1285. Accessed July 17, 2024. doi:10.1093/ajhp/32.12.1282
15. Kirschner PA. Cognitive load theory: implications of cognitive load theory on the design of learning. *Learn Instr.* 2002;12(1):1-10. Accessed July 17, 2024. doi:10.1016/S0959-4752(01)00014-7
16. Cain J, Medina M, Romanelli F, Persky A. Deficiencies of traditional grading systems and recommendations for the future. *Am J Pharm Educ.* 2022;86(7). Accessed July 17, 2024. doi:10.5688/ajpe8850
17. Lyboldt KE, Bach KD, Newman AW, Robbins SN, Jordan AJ. Impact of satisfactory/unsatisfactory grading on student motivation to learn, academic performance, and well-being. *J Vet Med Educ.* 2022:e20220020. Accessed July 17, 2024. doi:10.3138/jvme-2022-0020
18. Spring L, Robillard D, Gehlbach L, Simas TA. Impact of pass/fail grading on medical students' well-being and academic outcomes. *Med Educ.* 2011;45(9):867-877. Accessed July 17, 2024. doi:10.1111/j.1365-2923.2011.03989.x
19. White CB, Fantone JC. Pass-fail grading: laying the foundation for self-regulated learning. *Adv Health Sci Educ Theory Pract.* 2010;15(4):469-477. Accessed July 17, 2024. doi:10.1007/s10459-009-9211-1
20. Jones EP, Wisniewski CS. Video killed the multiple-choice quiz: capturing pharmacy students' literature searching skills using a screencast video assignment. *J Med Libr Assoc.* 2021;109(4):672-676. Accessed July 17, 2024. doi:10.5195/jmla.2021.1270
21. Wisniewski JN, Wisniewski CS, Jones EP, Van Cuyk MP. Incorporation of a mock drug information telephone call exercise in a health-systems pharmacy laboratory. *Curr Pharm Teach Learn.* 2020;12(4):450-458. Accessed July 17, 2024. doi:10.1016/j.cptl.2019.12.030
22. Prince M. Does active learning work? a review of the research. *J Eng Edu.* 2004;93(3):223-231. Accessed July 17, 2024. doi:10.1002/j.2168-9830.2004.tb00809.x
23. Bergmann J, Sams A. *Flip Your Classroom: Reach Every Student in Every Class Every Day.* International Society for Technology in Education; 2012.
24. Chang Y, Liu Q. Design and practice of the teaching mode of flipped classroom based on micro video. *Int J Technol Manag.* 2017;5:3-5. Accessed July 17, 2024. doi:10.12783/dtssehs/ssme2017/13022
25. Giuliano CA, Moser LR. Evaluation of a flipped drug literature evaluation course. *Am J Pharm Educ.* 2016;80(4):66. Accessed July 17, 2024. doi:10.5688/ajpe80466
26. Kim J, Guo PJ, Seaton DT, Mitros P, Gajos KZ, Miller RC. Understanding in-video dropouts and interaction peaks in online lecture videos. Paper presented at: 1st Association of Computing Machinery Conference on Learning at Scale; March 4-5, 2014; Atlanta, GA. Accessed July 17, 2024. doi:10.1145/2556325.2566239
27. Long T, Logan J, Waugh M. Students' perceptions of the value of using videos as a pre-class learning experience in the flipped classroom. *TechTrends.* 2016;60(3):245-252. Accessed July 17, 2024. doi:10.1007/s11528-016-0045-4
28. Wu YY, Liu S, Man Q, et al. Application and evaluation of the flipped classroom based on micro-video class in pharmacology teaching. *Front Public Health.* 2022;10:838900. Accessed July 17, 2024. doi:10.3389/fpubh.2022.838900
29. Yu Z, Gao M. Effects of video length on a flipped english classroom. *SAGE Open.* 2022;12(1):1-14. Accessed July 17, 2024. doi:10.1177/21582440211068474
30. Hew KF, Lo CK. Flipped classroom improves student learning in health professions education: a meta-

analysis. *BMC Med Educ.* 2018;18(1):38. Accessed July 17, 2024. doi:10.1186/s12909-018-1144-z
31. Sharpe B. Retrieval practice, scaffolding, and the socratic method. *The Scholarly Teacher* blog. January 26, 2023. Accessed July 17, 2024. https://www.scholarlyteacher.com/post/retrieval-practice-scaffolding-and-the-socratic-method
32. Brabeck M, Jeffrey J, Fry S. Practice for knowledge acquisition (not drill and kill): applications of psychological science to teaching and learning modules. American Psychological Association. Accessed July 17, 2024. https://www.apa.org/education-career/k12/practice-acquisition
33. Van de Pol J, Volman M, Beishuizen J. Scaffolding in teacher–student interaction: a decade of research. *Educ Psychol Rev.* 2010;22:271-296. Accessed July 17, 2024. doi:10.1007/s10648-010-9127-6
34. van Gaalen AEJ, Brouwer J, Schönrock-Adema J, Bouwkamp-Timmer T, Jaarsma ADC, Georgiadis JR. Gamification of health professions education: a systematic review. *Adv Health Sci Educ Theory Pract.* 2021;26(2):683-711. Accessed July 17, 2024. doi:10.1007/s10459-020-10000-3
35. Jones EP, Wisniewski CS. Gamification of a mobile applications lecture in a pharmacy course. *Med Ref Serv Q.* 2019;38(4):339-346. Accessed July 17, 2024. doi:10.1080/02763869.2019.1657728
36. Bawazeer G, Sales I, Albogami H, et al. Crossword puzzle as a learning tool to enhance learning about anticoagulant therapeutics. *BMC Med Educ.* 2022;22(1):267. Accessed July 17, 2024. doi:10.1186/s12909-022-03348-0
37. Shah S, Lynch LM, Macias-Moriarity LZ. Crossword puzzles as a tool to enhance learning about anti-ulcer agents. *Am J Pharm Educ.* 2010;74(7):117. Accessed July 17, 2024. doi:10.5688/aj7407117
38. Cole JD, Ruble MJ. Designing and evaluating game-based learning for continuing pharmacy education using an "escape room" activity. *Curr Pharm Teach Learn.* 2021;13(10):1293-1299. Accessed July 17, 2024. doi:10.1016/j.cptl.2021.07.007
39. Kavanaugh R, George S, Lamberton N, Frenzel JE, Cernusca D, Eukel HN. Transferability of a diabetes escape room into an accelerated pharmacy program. *Curr Pharm Teach Learn.* 2020;12(6):709-715. Accessed July 17, 2024. doi:10.1016/j.cptl.2020.01.022
40. Nybo SE, Klepser SA, Klepser M. Design of a disaster preparedness escape room for first and second-year pharmacy students. *Curr Pharm Teach Learn.* 2020;12(6):716-723. Accessed July 17, 2024. doi:10.1016/j.cptl.2020.01.037
41. Mueller BA, Carlstedt BC. Pharmacy-buzzword bingo. *Am J Health Syst Pharm.* 1999;56(23):2464. Accessed July 17, 2024. doi:10.1093/ajhp/56.23.2464
42. Tietze KJ. A bingo game motivates students to interact with course material. *Am J Pharm Educ.* 2007;71(4):79. Accessed July 17, 2024. doi:10.5688/aj710479
43. Medina MS. Does competency-based education have a role in academic pharmacy in the United States? *Pharmacy.* 2017;5(1):13. Accessed July 17, 2024. doi:10.3390/pharmacy5010013

Figure 1. Backward Course Design Stepwise Process[7,11]



DOI: https://doi.org/10.24926/iip.v15i3.5873

Table 1. Course Assessments and Associated Course Outcomes, Content, and Grading Criteria

Assessment	Course outcome	Subject Matter	Grading Mechanism	Weight of Grade (%)
DI Question Response	Develop basic responses to DI questions	Responding to assigned DI question	Rubric – 25 points	50
Literature Searching Video	Perform literature searches using PubMed	Performing a search in PubMed	Rubric - 20 points	10
Tertiary Resources Quiz	Familiarize oneself with common and essential DI resources	Online Compendia, Internet Resources, and Mobile Applications	Quiz - 25 points	10
Systematic Approach Quiz	Utilize the systematic approach to DI questions	Systematic approach to DI questions	Quiz - 20 points	10
Pre-Class Quizzes	N/A	Aligned with week's content	11 opportunities, 1 point each*	10
Attendance	N/A	N/A	11 opportunities, 1 point each*	10

*By offering 11 opportunities throughout the semester, students can earn 110% on this component of their grade; this allows them to miss a class or pre-class quiz without penalty
DI=drug information

Table 2. Course Content and Assessment Organized by the Systematic Approach to Drug Information

Systematic Approach Component	Course Schedule	Content	Summative Assessment
Identifying Genuine Need and Categorization	Week 0 – Week 2	Process of categorizing request and collecting background information to determine ultimate question	20-question multiple-choice quiz
Tertiary Resources	Week 3 – Week 6	Textbooks, online compendia, internet resources, and mobile apps	25-question multiple-choice quiz
Secondary Resources	Week 7 – Week 9	Basic and advanced searching techniques in PubMed	Literature searching video
Analysis and Synthesis	Week 10 – Week 15	Methods for evaluating and integrating identified information into cohesive and useful DI response	Written DI question response

DI=drug information

DOI: https://doi.org/10.24926/iip.v15i3.5873

Table 3. Summary of Changes Made to Course from 2017 through 2019

Course Aspect	2017	2018	2019
Educational theory/technique implemented	• Flipped classroom • Active learning • Short videos • Scaffolding	• Cognitive overload	• Backward design • Pass/fail for growth mindset • Cumulative assessment
Focus of course learning objectives (number of objectives)	Proficiency and efficiency (6)	Proficiency and efficiency (6)	Competency and familiarization (4)
Attendance	Required	Voluntary	Encouraged/Incentivized
Number of resources taught	18	9	9
In-class instruction techniques	Lecture	Primarily lecture with some active learning	Primarily active learning
Pre-class quiz grading based on	Correctness	Correctness	Completion
Total number of graded quizzes	26	26	2
Incorporation of competency-based assignments	No	No	Yes
Type and number of graded assignments (% of final grade)	• Pre-class quizzes ○ 7 (2.5) ○ 6 (5) • Post-class quizzes ○ 7 (5) ○ 6 (2.5) • 1 "Involuntary" feedback survey (2.5)	• Pre-class quizzes ○ 7 (2.5) ○ 5 (6) • Post-class quizzes ○ 7 (5) ○ 5 (3) • 1 "Involuntary" feedback survey (2.5)	• 11 Participation (10) • 11 Attendance (10) • 2 Quizzes (10 each) • 1 Literature Searching Video (10) • 1 DI Question Response (50)

DI=drug information

Table 4. Student Performance on Graded Components of Course

	Student Performance (Average %)	
Assignment	**2021 (n = 68)**	**2022 (n = 60)**
Pre-class quizzes	104.7	105
Attendance	100	105.5
Systematic approach quiz	76.2	78.6
Tertiary resources quiz	75.2	79.5
Literature searching video assignment	79.9	90.1
Drug information question response	83.5	89.6

University-administered evaluation data

DOI: https://doi.org/10.24926/iip.v15i3.5873

Table 5. Summative Data from Course-Specific Feedback Survey

	Number of Responses Marked Strongly Agree or Agree/Yes (%)	
Question or Statement	**2021 (n = 68)**	**2022 (n = 60)**
The information learned in Introduction to Drug Information was helpful in completing other classwork this semester	57 (84)	45 (75)
I enjoyed the flipped nature of Introduction to Drug Information	45 (66)	27 (45)
I feel that the syllabus for the course made the posting of videos and deadlines for assignments understood	65 (96)	55 (92)
I feel that the learning management system organization for the course made the posting of videos and deadlines for assignments understood	62 (91)	58 (97)
I feel that the pre-class materials (ie, videos, handouts) were helpful to learning*	58 (85)	56 (93)
I feel that the live sessions of the class were helpful to learning*	61 (90)	59 (98)
I felt that the gamification used during lectures was helpful to learning	-	55 (92)
I feel more confident in my literature searching skills and abilities than I did prior to taking Introduction to Drug Information	65 (96)	59 (98)
I feel that the pass/fail scale was appropriate for this course*	60 (88)	57 (95)
I feel that the pass/fail nature of the course helped me better learn the content*	55 (81)	44 (73)

*Yes/No response

Table 6. Student Self-Reported Viewing of Pre-class Videos

	Number of Responses (%)	
Percentage of videos watched	**2021 (n = 68)**	**2022 (n = 60)**
0-25%	8 (12)	4 (7)
26-50%	14 (20)	17 (28)
51-75%	25 (36)	20 (33)
76-100%	22 (32)	19 (32)

DOI: https://doi.org/10.24926/iip.v15i3.5873