

RESEARCH ARTICLE

Teaching information literacy concepts in pharmaceuticals through video

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Abstract

Objective: The objective was to determine if online, asynchronous video content could be used to teach information literacy concepts successfully to pharmacy students in a pharmaceuticals course. **Method:** An existing in-person lecture was transferred to a series of online videos. Students enrolled in the course who agreed to participate took a 13-question pre-test, watched videos, and completed the same post-test, along with a survey of their opinions towards the videos. Scores on each of the questions on the pre-and post-test changed positively and significantly. Students slightly preferred videos to in-person instruction. **Result:** The results suggest that asynchronous videos can be used to teach information literacy concepts to pharmacy students and this knowledge is retained for the duration of the course.

Introduction

The COVID-19 crisis forced many programmes to pivot to online learning, and concern over future outbreaks of disease is affecting plans for in-person classes for the future. Transferring content previously delivered in-person into asynchronous video tutorials offers a solution to the problem of the course schedule, but can all subjects be successfully learned from online tutorials? Previous research work has demonstrated that pharmacy students can learn skills and retain knowledge from asynchronous video tutorials in specific subject areas such as inhaler techniques (Erickson *et al.*, 2013), counselling for common drugs (Lean *et al.*, 2018), medication reconciliation (Abu Farha *et al.*, 2020), ambulatory care practices (Phillips, 2015), and pain management (Pick *et al.*, 2017). It is more difficult to find examples from the pharmaceutical area; however, manufacturing processes (Yellipeddi and Roberson, 2016) and compounding skills (Park & Shrewsbury, 2016) have been examined as well. In all these examples, students successfully demonstrated gains in knowledge about specific aspects of pharmacy

knowledge or work during the course of a single class or single term.

Success in pharmacy education in the United States requires mastery of all standards set out by the Accreditation Council for Pharmacy Education (ACPE). Standard one from ACPE encompasses selecting, accessing, interpreting, and using information from the foundational sciences to provide pharmaceutical care. While these exact standards are not used to assess the quality of pharmacy education across the world, the idea of finding, selecting, and using the information as a major component of global pharmacy education is well-described in the literature. For instance, Abdel-Halim (2020) discussed the use of information in a pre-pharmacy course in Jordan, Costabile and authors described the benefits of problem-based learning in Australia (2020), and Banji and authors (2020) discussed the use of information in pharmacy education in Saudi Arabia.

Selecting, accessing, interpreting, and using information is part of the definition of skills for information literacy according to the Association of

College and Research Libraries (2015), a group that sets standards for academic librarian performance and also serves as a professional group of practice for librarians. Clearly, there is a significant overlap between the interests of pharmacy educators in ensuring students are able to meet standards for information-literacy related knowledge and the interests of academic librarians in advancing information literacy across all disciplines. Partnerships between the faculty of pharmacy and librarians have previously identified this overlap and conducted studies of different in-person instructional techniques to successfully enhance student learning in information literacy. Lapidus and authors (2009) focused on drug information skills in upper-level pharmacy students, Haworth and authors (2012) covered a selection of supporting scientific information, and Jones and Wisniewski (2019) recently focused on drug information mobile apps.

However, there is little published about using videos to teach pharmacy students information literacy concepts. Vaughan's report (2009) supports the idea that students are willing to use videos to help learn and understand concepts in information literacy. Larger projects which integrated these videos into courses have been used successfully in other populations. For example, video tutorials can improve information literacy skills in undergraduates in a biology course (Craig & Friehs, 2013), social work graduate students responded well to a tutorial about information literacy in their discipline (Gall, 2014), and undergraduates in a kinesiology course also gained skills immediately after watching videos (Matlin & Lantzy, 2017), this leads to the question as to whether pharmacy students could experience similar gains. Understanding whether pharmacy students can learn broader and more general information literacy concepts such as database selection, database searching, differentiation between tertiary sources, and differentiation between the content of primary sources through course-integrated asynchronous video tutorials would allow curriculum planners to better apportion limited class time to concepts that can only be learned in-person.

Methods

Pharmaceuticals is taught in a series of three team-based learning courses at the University of Southern California, progressively introducing concepts in pharmaceuticals. The pharmacy subject librarian provides an in-person, fifty-minute-long lecture near the beginning of each pharmaceuticals course to introduce specific sources and search techniques relevant for the cases in that course. There is little overlap in the information literacy instruction throughout the pharmaceuticals courses, as there are a significant number of sources, techniques,

and modes of thinking that are specifically relevant to different content covered in the courses. In the 2019 offering of the 15-week-long Pharmaceuticals III course, students worked in small groups to select, identify, and use primary literature to investigate, describe, and review and/or design modified drug delivery systems for various drug targets. Students were expected to spend approximately five hours per week performing coursework outside of scheduled course meetings. In addition, students received participation points for completing eight in-class assignments, which were worth about 10% of the total class grade.

The 2020 offering of the Pharmaceuticals III course would follow the same overall structure, points, and course length. The librarian and course faculty were interested in determining whether the librarian-led lecture could be successfully transferred to an online video format and viewed by students outside course work time, which would preserve scheduled course meetings for collaborative team-based work and class assignments. After the research was ruled exempt by the University of Southern California's institutional review board in February 2020, the librarian recreated the lecture for Pharmaceuticals III into a series of four asynchronous videos resulting in a total of fifty-three minutes in length.

To measure learning, a 13-question knowledge-based pre-and post-test was developed; the pre-test results were intended to serve as the control, allowing measurement of the change in knowledge after viewing videos. An optional three-question survey to gain student feedback was also included in the post-test. Appendix A provides the 13 questions, survey, and objectives. The questions were developed based on learning objectives for the course, librarian and faculty expertise in how to locate and use appropriate information to demonstrate the achievement of the learning objectives. For example, one objective for the course was "*Be familiar with the applications of biotechnology products such as peptide, protein, and oligonucleotide drugs, and be able to describe, discuss, and assess these various methods.*"

In order to give students an opportunity to achieve this objective, one course assignment asked students to find a structure of a protein, peptide, or oligonucleotide, visualise and manipulate it with software, find similar structures, and discuss the structures. The librarian and faculty perceived the *Protein Data Bank database* to be an excellent source for finding original research reports, including visualised proteins, peptides and oligonucleotides, and also for finding structures similar to a given structure. Two questions on the test focused on the goals, purpose, and uses of the Protein Data Bank. Other questions on the test focused on the content of other specific databases and information products, differentiating between the purposes and uses of

different kinds of publications, comparing the depth and quantity of information provided by different sources, and comparing search techniques and their value for finding relevant information quickly. Each resource, database, or search technique asked about in the pre- and post-test was directly covered within the videos, and questions were organised based on the organisation of content within the videos. The appendix shows the course and assignment objectives mapped to each question.

This content and the informed consent form was available through the course blackboard site, which ensured access for only enrolled students and allowed the pre-test, post-test, and videos to be integrated alongside other online course content. The pre-test was available for the first week of class. Videos were made available for viewing after the pre-test and after the first week of class and were visible until the 13th week of class. The post-test was made available during the 13th week of the course. Students received participation points for taking the pre-test, viewing each video, and taking the

post-test. Participation points from this video and seven other activities were equal to 10% of the course grade, matching the points available in the fully in-person version of this course. The optional survey was available in the last two weeks of the course; students did not receive any points for completing this survey. A paired sample t-test was conducted to compare the students' pre-test and post-test scores and for each of the 13 pre-test and post-test questions. A *p*-value of less than 0.05 was used to assess significance.

Results

One hundred and ninety-two students were enrolled in the Pharmaceuticals III course. The majority of students chose to view the videos. Table I includes the number of videos viewed by each subgroup, the number of students in each subgroup, their pre-test and post-test scores, and their significance.

Table I: Number of videos watched by students and their mean percentage of pre-test and post-test scores (n=184)

Number of videos watched	Number of students	Mean percentage score of pre-test (SD)	Mean percentage score of post-test (SD)	<i>p</i> -value
0	10	42 (2)	83 (3)	0.001
1	4	50 (2)	96 (0.6)	0.01
2	1	31*	77*	*
3	2	54*	100*	*
4	167	48 (2)	86 (2)	<0.001

Only students who answered all 13 questions of the pre- and post-test were included. The average score for each set of students showed a greater than 40% improvement. A paired sample t-test was conducted to compare the pre- and post-test scores. There was a significant difference in the pre-test scores and the post-test scores for 0, 1, 4 videos watched; *p* < 0.05.

*Not enough students to calculate the SD or *p*-value for two videos watched. For the three videos watched, the two students had the same score.

The majority of students viewed all four videos, and their scores on the pre- and post-test changed significantly when calculated with *p* < 0.05. Students who viewed no videos and who viewed one video also had significant changes in scores on the pre- and post-test; not enough students viewed two or three videos to allow for the

calculation of significant differences in scores. One hundred and eighty-eight students chose to take the pre-test, and one hundred and eighty-four students chose to take the post-test. There were large differences in scores in all questions on the pre-test and post-test (Figure 1).

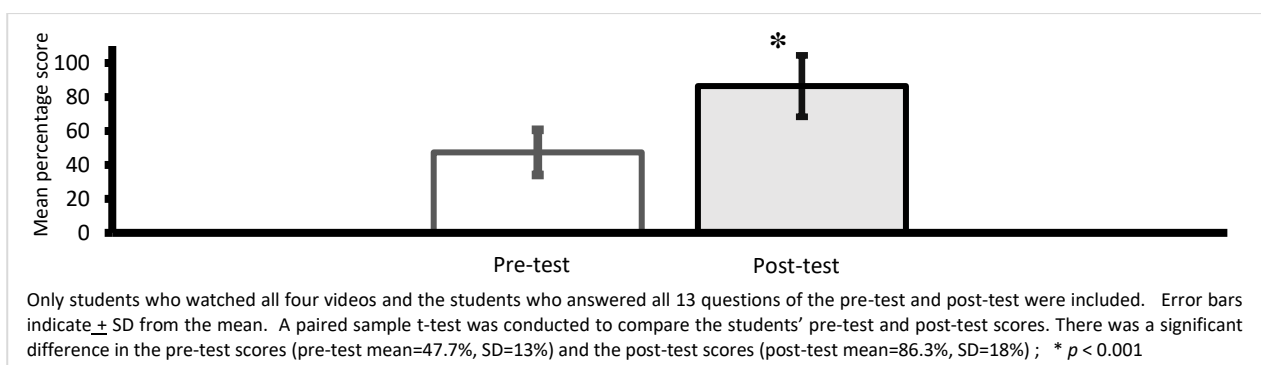


Figure 1: Mean scores of the students' pre-test and post-test (n=167)

A paired sample t-test was conducted to compare the students' pre-test and post-test scores. The difference in scores for each of the 13 pre-test and post-test

questions was statistically significant and changed positively, with a gain of more than 40% for each question (Figure 2).

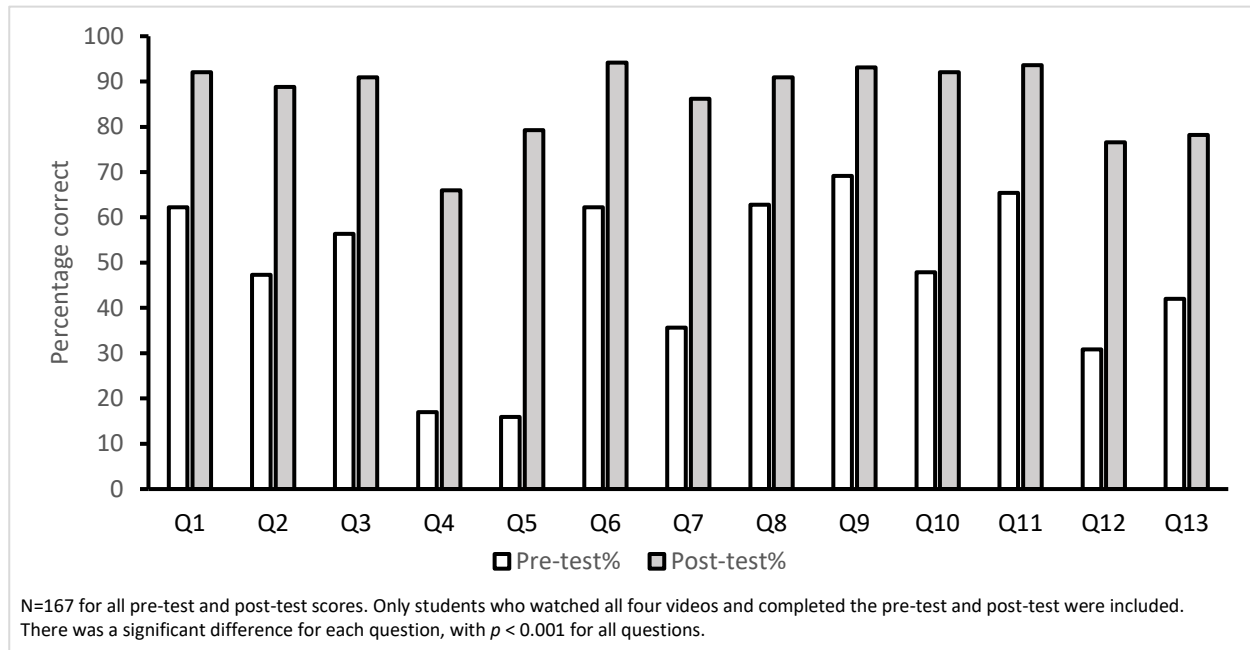


Figure 2: Correct answers on each question from the pre-test and post-test

One hundred fifty-three students chose to complete the survey. Ninety-eight per cent of respondents stated they used skills, knowledge, or information gained from the videos during the class. In terms of format preferences, 63% (96/153) preferred watching videos,

12% (19/153) would have preferred an in-person lecture, and 25% (38/153) had no preference. Thematic analysis of the few open-ended answers indicates that students perceived they used techniques in the videos frequently while watching the videos and perceived that their research processes were more efficient due to the video content.

Discussion

One difficulty with teaching and measuring information literacy is that concepts taught in the videos could have been learned elsewhere: one video included a discussion of conducting detailed searches in the *clinicaltrials.gov* database, several questions on the pre-and post-test focused on *clinicaltrials.gov*, and it is possible that students viewed the *clinicaltrials.gov* help files and tutorials instead of or alongside these course-integrated videos.

Additionally, students worked in groups for many course assignments and may have shared information with each other outside of the videos. Indeed, ten students did not view any videos and participated in the pre-and post-tests, suggesting they learned this information from another source. The videos were the only source within the course for information literacy instruction. It is difficult to ensure access to this information is only done through the intervention; however, the pre-test could be seen as a “control,” offering a snapshot of student knowledge very near the start of this class, and the post-test (made available in the last two weeks of the class) measuring the difference from this baseline.

To attempt to minimise students seeking out this information outside of the videos, sharing information with each other, or otherwise seeking this knowledge elsewhere, the students did not earn points for answering the pre-and post-test questions correctly, only for participating and completing the test. Therefore, there was no incentive to get a “correct” answer on any test measures. Additionally, students had eight participation activities from which to choose (56 points possible), requiring completion of 90% of the points (50 points), to have all 56 participation points applied towards the final grade.

Conclusion

After watching four videos covering information literacy concepts, student scores on a knowledge-based test improved by an average of 40%. The magnitude of the change measured on the pre-and post-tests was unexpectedly large, despite there being no incentive to answer the questions correctly on the post-test, supporting our hypothesis that students would successfully learn information literacy concepts from a series of asynchronous videos. Based on the survey results, students also preferred learning this content via video, which supports further investigation into whether this style and content of instruction can be integrated into additional courses.

Further research with different methodologies is required to determine if these gains came directly from these videos alone and if information can be retained past the boundaries of this single course, but it seems clear that information literacy concepts can be successfully taught via asynchronous videos within one course. Overall, students preferred videos to in-person lectures for this content. Open-ended responses from the survey indicate that adding interactivity or building time for practice into the videos could better meet student preferences, offering additional avenues for further research or further perfection of video content to meet needs.

References

- Abu Farha R.K., Rashad, M., Hasen, E., Mukattash, T.L., Al-Hashar, A., Bashedi, I.A. (2020). Evaluation of the effect of video tutorial training on improving pharmacy students' knowledge and skills about medication reconciliation. *Pharmacy Practice*, **18**(1),1711. <https://doi.org/10.18549/PharmPract.2020.1.1711>
- Abdel-Halim, H. (2020). Distant learning challenges and solutions: Incorporation of 3D protein visualisation in an undergraduate pharmacy medicinal chemistry course. *Pharmacy Education*, **20**(2), 17-18
- Accreditation Council for Pharmacy Education. (2015). *Accreditation Standards and Key Elements of the Professional Program in Pharmacy Leading to the Doctor of Pharmacy Degree*. <https://www.acpe-accredit.org/pdf/Standards2016FINAL.pdf>
- Association of College and Research Libraries. (n.d.) *Information Literacy Glossary*. Retrieved June 22, 2020 available at: <http://www.ala.org/acrl/issues/infolit/overview/glossary>
- Banji, O.J.F., Machanchery, S., Banji, D., Albarraq, A. A., Makeen, H. A. (2020). A survey on student pharmacists' knowledge, attitude and perceptions about drug and poison information elective rotation in Saudi Arabia. *Pharmacy Education*, **20**(1), 287-294
- Costabile, M., Day, C., Garg, S., Aldous, G. (2020). Development, implementation and evaluation of an innovative, project-based assignment for final year pharmacy students, relating to novel drug delivery systems. *Pharmacy Education*, **20** (1), 67-75
- Craig, C.L., Friehs, C.G. (2013). Video and HTML: testing online tutorial formats with biology students. *Journal of Web Librarianship*, **7**(3), 292-304
- Erickson, S.R., Chang, A., Johnson, C.E., Gruppen, L.D. (2003). Lecture versus web tutorial for pharmacy students' learning of MDI technique. *Annals of Pharmacotherapeutics*, **37**, 500-505. <https://doi.org/10.1345/aph.1C374>
- Gall, D. (2014). Facing Off: Comparing an In-Person Library Orientation Lecture with an Asynchronous Online Library Orientation. *Journal of Library & Information Services in Distance Learning*, **8**(3-4), 275-287
- Haworth, J.A., Chatfield, A.J., Romero, R.M. (2012). Information intervention in the pharmaceutical sciences. *Medical Reference Services Quarterly*, **31**(2), 188-201
- Jones, E.P., Wisniewski, C.S. (2019). Gamification of a Mobile Applications Lecture in a Pharmacy Course. *Medical Reference Services Quarterly*, **38**(4), 339-346
- Lapidus, M., Kostka-Roskosz, M.D., Dvorkin-Camiel, L. (2009). Librarian-Lead Tutorial for Enhancement of Pharmacy Students' Information-Searching Skills in Advanced Experiential Rotations. *Medical Reference Services Quarterly*, **28**(4), 351-362
- Lean, Q.Y., Ming, L.C., Wong, Y.Y., Neoh, C.F., Farooqui, M., Muhsain, S.N.F. (2018). Validation of online learning in pharmacy education: effectiveness and student insight. *Pharmacy Education*, **18**(1),135-142
- Matlin, T., Lantzy, T. (2017). Maintaining Quality While Expanding Our Reach: Using Online Information Literacy Tutorials in the Sciences and Health Sciences. *Evidence Based Library and Information Practice*, **12**(3), 95-113
- Park, H.L., Shrewsbury, R.P. (2016). Student evaluation of online pharmaceutical compounding videos. *American Journal of Pharmaceutical Education*, **80**(2), 30. <https://doi.org/10.5688/ajpe80230>
- Phillips, J.A. (2015). Replacing traditional live lectures with online learning modules: effects on learning and student perceptions. (2015). *Currents in Pharmacy Teaching and Learning*, **7**, 738-744. <https://doi.org/10.1016/j.cptl.2015.08.009>
- Pick, A.M., Begley, K.J., Augustine, S. (2017). Changes in teaching strategies to accommodate a new generation of learner: A case study. *Pharmacy Education*, **17**(1), 95-99
- Vaughan, K.T.L. (2009). Development of targeted online modules for recurring reference questions. *Medical Reference Services Quarterly*, **28**(3), 301-305
- Yellipeddi, V.K., Roberson, C. (2016). The use of animated videos to illustrate solid oral dosage form manufacturing in a pharmaceuticals course. *American Journal of Pharmaceutical Education*, **80**(8), 141. <https://doi.org/10.5688/ajpe808141>

Appendix A

Thirteen-item questionnaire used as the pre- and post-test, a list of objectives from the course mapped to the questions, and the optional three-question survey.

Thirteen-item Questionnaire

1. Select the best definition and goal of Protein Data Bank.
 - a. Repository of images of proteins from living beings, taken from published articles, with annotated links between proteins and biological functions. The goal is to visualize proteins and list the functions of these proteins in living beings.
 - b. List of every protein in the human body, along with a description of every disease these proteins might cause. The goal is to identify proteins that are linked to chronic diseases in humans.
 - c. Repository of articles describing proteins that specifically relate to health and disease. The goal is to identify all proteins that could cause disease and identify all articles that describe how proteins could be manipulated to serve as drug targets.
2. What content is included in a Protein Data Bank (PDB) molecule of the month entry?
 - a. Synonyms for the protein; links to individual entries in PDB that visualize the protein in multiple views; description of diseases and other biological processes in which the protein plays a role.
 - b. Description of diseases and biological processes in which the protein plays a role; citations to further articles about this protein and diseases; name of the first individual to discover this protein.
 - c. Synonyms for the protein; descriptions of all drugs developed using this protein as a targeting or delivery system; links to free websites about drug targeting systems.
3. Which drug compendia's monograph source includes the richest descriptions of drug formulation and action, including chemical and pharmaceutical data not found in other monographs?
 - a. Micromedex
 - b. LexiComp
 - c. Clinical Pharmacology
 - d. Facts and Comparisons E-Answers
4. You need to read a textbook to learn about diabetes mellitus type 1. You want to find very detailed information on diagnostic tests used, cells and organs affected, complications, and current treatments. Which textbook within AccessMedicine would be the best first choice to learn all this content?
 - a. Goodman and Gilman's Pharmacotherapy: a Pathophysiologic Approach
 - b. Harrison's Principles of Internal Medicine
 - c. Tintinalli's Emergency Medicine
 - d. Greenspan's Basic & Clinical Endocrinology
5. Literature review articles summarize the results of many original articles. How do literature review authors select original articles to summarise?
 - a. They follow a specific process: at least two reviewers to evaluate each article based on its methodology, appropriate use of statistics, and clear presentation of results.
 - b. There are no rules for selecting articles for inclusion in a literature review. One sign of a well-conducted literature review is an explanation of selection processes used.
 - c. Literature reviews include every article published on a topic; no selection is required because every article found by the authors is summarized in the literature review.
6. What is the best definition of a clinical decision support tool, such as UpToDate or BMJ Clinical Evidence?
 - a. A single website consisting of summaries describing the etiology, diagnosis, treatment, and prognosis for hundreds of common diseases. Authors continually survey the published literature for new scientific advances and add information to summaries as it is discovered.
 - b. A single website that collects all known textbook chapters about a disease. By using this tool, you can see the historical record of how this disease was treated from its discovery until now.
 - c. A summary of all known information about a single drug, organized into categories for easy access to information about administration, dosing, storage, etc.
7. Select the best definition of clinicaltrials.gov.
 - a. A database of citations to every clinical trial ever conducted from 2000-present
 - b. A database including citations and results to every clinical trial conducted in the United States from 2000-present.
 - c. A database of records of clinical trials planned to be undertaken; companies designing new drugs, devices, and medical procedures must deposit a plan of their trial prior to enrolling people.
 - d. A database of full-text articles reporting on the results of clinical trials relating to drugs (that is, excluding clinical trials testing devices or medical procedures).
8. If PubMed and other databases include articles reporting on the results of clinical trials, why does clinicaltrials.gov exist?
 - a. Only a small number of clinical trials publish results in articles. Clinicaltrials.gov allows registration of trial records, allowing you to see all clinical trials that have been planned to be undertaken, not just clinical trials that have completed and been published.
 - b. PubMed (and other medical databases) only include English language clinical trials, whereas clinicaltrials.gov includes trials in all languages, increasing your search results to include trials conducted globally.
 - c. PubMed and other databases only include articles reporting on clinical trials where there is no conflict of interest reported between the investigators and company who is making the new drug.

Clinicaltrials.gov includes all drug-related trials, with or without conflict of interest.

9. If you can find reports of clinical trials that test new drugs, why would you need to use a patent to learn about a specific drug targeting or delivery system?
 - a. Patents register intellectual property like a new idea or method for drug delivery. It is more important for companies to register their ownership by preparing patents than to conduct and publish clinical trials.
 - b. Patents are always written after clinical trials are conducted, so they allow examination of even newer knowledge.
 - c. To get a patent, you need to test your idea in more than 500 people; clinical trials do not have this same guarantee of study power.
10. What value can indexed databases provide when searching for information about diseases, proteins, and pharmaceutical concepts like new dose forms, new routes of administration, etc.?
 - a. Searching using an indexing term or subject heading retrieves all materials about that concept in the database, even if the authors used a different word to describe the concept in their article.
 - b. Indexing is where links are added to allow access to the full text of an article. Using an indexed database makes it easier to find the full text of articles.
 - c. Searching a database using an indexing term or subject heading retrieves only the newest articles added to the database in the past year. The terms change frequently to accommodate new language and new concepts.
 - d. Searching a database using an indexing term or subject heading provides translation services, ensuring that your results will all be articles in the English language, even if the original article was written in a different language.
11. How do you add an indexing term to a search in Embase?
 - a. There are no indexing terms in Embase; this database does not use indexing.
 - b. Type a keyword into the search box; related indexing term will appear below the search box for you to select.
 - c. The indexing terms in Embase and PubMed are the same. You must look up a term in PubMed, then copy and paste it into Embase.
 - d. Type your entire search strategy into the search box, then type the phrase "search as Embase indexing terms" into the search box.
12. Which of these databases are indexed?
 - a. PubMed, Embase, International Pharmaceutical Abstracts
 - b. PubMed, Web of Science, Embase
 - c. Google Scholar, Embase, PubMed
 - d. Scopus, Web of Science, PubMed
13. Below are titles and a few sentences of abstracts from four articles. Which of these articles is most likely to thoroughly describe the targeting strategy used by the drug etanercept, which uses a protein called TNF-alpha as the targeting strategy for rheumatoid arthritis?
 - a. Biologics beyond TNF- α inhibitors and the effect of targeting the homologues TL1A-DR3 pathway in chronic inflammatory disorders. A number of anti-tumor necrosis factor alpha (TNF- α) biologics have been developed in recent years. However, up to 40% of RA and IBD patients do not respond to anti-TNF- α treatment and a possible explanation may be the involvement of the TL1A gene. Here, we describe the current knowledge of TL1A immunobiology and TL1A involvement in inflammation.
 - b. Etanercept: A Review of Its Use in Autoimmune Inflammatory Diseases. With its approval more than 15 years ago, subcutaneous etanercept (Enbrel[®]) was the first biological disease-modifying antirheumatic drug and the first tumor necrosis factor inhibitor to be approved for use in rheumatic diseases. This article reviews the extensive clinical experience with etanercept covering efficacy, safety, costs, and integration into guidelines for care.
 - c. Targeting TNF for Treatment of Cancer and Autoimmunity. Tumor necrosis factor-alpha (TNF-alpha) was first isolated two decades ago as a macrophage-produced protein that can effectively kill tumor cells. The proinflammatory activities link TNF-alpha with a wide variety of autoimmune diseases. This paper includes a description of the suppression of TNF expression and TNF signaling by etanercept and other drugs.
 - d. Origins of rheumatoid arthritis. While the exact cause of rheumatoid arthritis is unknown, several mechanisms have been described extensively. The genetic predisposition for this autoimmune disease is largely attributed to MHC class II genes, especially the main polymorphism in the HLA shared epitope. Inflammatory cytokines such as TNF- α , IL-1 and IL-17, are certain implicated, but environmental factors such as pollution, diet, and infections can affect inflammation as well.

Course objectives mapped to each question

Course Learning Objectives, mapped to relevant questions from the 13 item questionnaire:

- Be able to describe, discuss, and evaluate the methods and strategies used in the principles of modified, controlled, and targeted drug delivery. (1, 2, 4, 5, 6).
- Be able to evaluate compare, and assess biotechnology products such as peptides, proteins, and oligonucleotide drugs used as therapeutic agents. (1, 2, 10, 11, 12).
- Be able to identify new pharmaceutical products that are being developed and may be used in the future, and be able to describe, discuss, and evaluate these products. (6, 7, 8, 9, 10, 11, 12, 13).
- Be able to research and produce, within a group, a written report and oral presentation in a professional format, using literature resources, lectures, and various databases. (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13).

Assignment objectives mapped to each question

Assignment Objectives mapped to relevant questions from the 13 item questionnaire:

- Be able to find a structure of a protein and indicate important interaction sites on the protein and the type of interactions with a ligand/drug. (1, 2).
- Be able to write a description of the disease/disorder/condition and what causes it. This should include, but is not limited to, symptoms, diagnosis, how the disease/disorder/condition is acquired. Describe the organs, tissues, cells, and organelles in the cell that are affected. Can the disease/disorder/condition be prevented? (3, 4, 5, 6).
- Be able to identify drugs in development for this disease and describe them, including mechanism of action, chemical structures and name, physical chemical properties, route of administration, ADMET, indication, dose, contraindications, clinically relevant interactions. (3, 7, 8, 9, 10, 11, 12).
- Be able to provide a description (including schematics, diagrams and graphs) of a modified and/or targeted drug delivery strategy. (1, 9, 10, 11, 12, 13)

Survey

Optional survey included as a separate assignment, following the post-test.

1. Did you use any of the skills, techniques, or databases discussed in the videos to complete your group project?
 - a. Yes
 - b. No
2. This video content was previously presented during a course lecture in PHRD 552, Pharmaceuticals III. Did you prefer the videos or would you have preferred a single in-person lecture covering content from all four videos?
 - a. Videos
 - b. Lecture
 - c. No preference
3. Did these videos enhance your learning, make it easier to complete the group project, or otherwise affect your performance in this course? Please briefly explain (open-ended question with 50,000-character limit).