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Title

The Flipped Classroom: Student-Driven Library Research Sessions for Nutrition Education

Authors

Virginia Pannabecker, University Libraries, Virginia Tech, Blacksburg, VA, USA

Cristina S. Barroso, Department of Public Health, University of Tennessee, Knoxville, TN, USA

Jessica Lehmann, School of Nutrition & Health Promotion, Arizona

Shortened Title for running head

Student-driven flipped library research sessions

Abstract

This article reports on the use of a flipped classroom technique to teach library research skills to upper-level undergraduate nutrition students. A public university Health Sciences librarian and two Nutrition faculty members, collaborated to implement a flipped classroom model utilizing online videos and brief assignments packaged in a course-specific library guide for pre-class preparation. Implementation, materials examples, and an evaluation of the method are included. This method provided pre-class learning and increased in-class, hands-on practice in library research for students in an active learning environment. Students found and applied evidence from scientific research studies to course assignments.

Keywords

Flipped Classroom

Active Learning

Nutrition Education

Undergraduates

Faculty Librarian Collaboration

Library Research

Introduction

College students enter degree programs and specific courses with varying levels of skill in conducting library research (Head, 2013a; Head, 2013b). Many course assignments require significant library research for successful completion, and these requirements reflect skills needed for success in health sciences careers (Accreditation Council for Education in Nutrition and Dietetics [ACEND] of the Academy of Nutrition and Dietetics, 2013; American Association of Colleges of Nursing, 2008; Commission on Accreditation in Physical Therapy Education, 2014). Faculty and librarians often collaborate to provide students with course-specific library research skills sessions and suggested resources. However, when presented so that students simply listen to or observe such content, students may not be able to successfully apply skills themselves when they begin to conduct research for their course assignments; employing active learning methods increases student comprehension and achievement (Freeman et al, 2014; Miller, McNear, & Metz, 2013).

The flipped classroom, or inverted lecture technique, which has become popular in K-12 education as a way to increase active learning during class sessions, is also growing in popularity in undergraduate and graduate college education (Arnold-Garza, 2014; Datig & Ruswick, 2013; Demski, 2013; Honeycutt & Garrett, 2013; Honeycutt & Glova, 2013; McLaughlin, et al., 2014; Missildine, Fountain, Summers, & Gosselin, 2013; Tune, Sturek, Basile, 2013). In this technique, often attributed to Bergmann and Sams (2012), instructors provide online video lectures, reading materials, and/or assignments that the students complete prior to attending an in-class session, allowing each student to cover content at their own pace. During the in-class session, after a question-and-answer check-in, students begin work on a long-term related course assignment, or complete an assessment assignment prepared for the session. The students often work in groups to benefit from peer learning.

This method allows students to have prior demonstration and explanation of content or skills and an opportunity to apply their new skills and knowledge in a risk-free, experimentation-friendly environment where instructors can provide further support when questions arise (Arnold-Garza, 2014; Bergmann & Sams, 2012; Demski, 2013; McLaughlin, et al., 2014; Missildine et al., 2013; Tune, et al., 2013). Questions surface with the whole class present and solutions can be presented by peers or through facilitation by the instructor. In this way, all students benefit from everyone's learning. This technique increases retention of knowledge and skills (Arnold-Garza, 2014; Missildine et al., 2013; Bergmann & Sams, 2012; Tune, et al., 2013), promotes opportunities for higher-level skills learning, and stimulates further interaction between peers, and between students and instructors (Arnold-Garza, 2014; Datig & Ruswick, 2013; Demski, 2013; McLaughlin, et al., 2014; Bergmann & Sams, 2012; Tune, et al., 2013).

The study reported in this article adds to the literature documenting the effectiveness of the flipped classroom technique in higher education, with a specific example applied to library research skills for upper-level nutrition education. A Nutrition professor and a Health Sciences librarian collaborated on content and instruction for course-specific library research methods for three semesters of Nutrition 450 (NTR 450) – Nutrition in the Life Cycle I, an upper-level undergraduate course. During the third semester, Spring 2014, a faculty-librarian team, including the Nutrition professor, a second Nutrition professor, and the librarian, planned and implemented a flipped class session to teach library research skills to students in two sections of NTR 450, Nutrition in the Life Cycle I.

Background & Approach

Being able to find, understand, interpret, and apply evidence-based nutrition research is a necessary skill set to be successful in the health science workforce (ACEND, 2013). Therefore, several of the course activities and assignments in NTR 450 were designed to develop this skill set. During all three semesters of teaching this course, the assignment instructions and scoring rubrics specifically included a requirement to cite at least five peer-reviewed research articles to substantiate the thesis of papers and presentations. The content and materials presented were similar throughout all three semesters, with course activities and assignments changing based on student feedback and course evaluations. Activities and assignments for the second and third semesters remained consistent. To support students' ability to complete research-based assignments, the librarian provided a guest lecture for the class each semester.

Fall 2012

In the Fall 2012 semester, the librarian's lecture focused on informing students about the library, its resources, how to search for peer-reviewed research articles, and minimal information on citation styles. The library research skills lecture was not included in the course syllabus or schedule. Even though the librarian demonstrated literature searches using various databases, this lecture was not interactive and did not require advance preparation by the students. The students who attended were given the opportunity to ask questions, but very few did. The professor included a brief in-class group assignment to support the librarian's lecture. Twenty teams of five students each completed a worksheet on topics presented in the lecture. Credit was earned for completion, but not accuracy. The in-class group work consisted of a 5-item exercise: 1) What was the librarian's name? 2) Describe the three library accounts, 3) What is PubMed? 4) How can you obtain full-text articles, and 5) How can you save references for future use?

During Fall 2012, although the course assignments were originally designed to elicit critical thought and to demonstrate student understanding of the scientific evidence, student performance on the various course activities and assignments that required the use of peer-reviewed research articles was weak. Many students cited non-scientific resources, did not cite peer-reviewed research articles, or scholarly works, and if they did, many did not cite their references properly. The professor and librarian determined that the in-class library research lecture and group work exercise were not effective in reinforcing the information provided.

Fall 2013

After the first offering of the course, the professor and librarian met to discuss how to better address the needs of the students. The librarian suggested that in addition to covering the same topics presented in the first offering she would create and make available a web-based library course guide, linked via Blackboard prior to her guest lecture. The library guide described in detail various library resources, including nutrition-specific tools, how-to videos, and contact information for the librarian and her colleagues. The librarian's name and contact information was also included in the course syllabus and schedule. The syllabus described the rationale for the course assignments and offered advice on how to be successful in the course, including attendance of the librarian's presentation. The schedule also recommended that students bring a laptop or tablet to class for the librarian's presentation. The second guest lecture was interactive and much more student involvement occurred. The students that attended the guest lecture were more engaged, tried library resources during the demonstration, and several asked questions. Furthermore, student performance on the various course assignments that required the use of scholarly work was improved: most of the students now used scientific research studies from peer-reviewed journals to support their theses and properly cited the works. A minimal number of students used or cited non-scientific resources.

Implementation of Flipped Classroom Method

Spring 2014

Flipped Library Research Session – Preparation & Pre-Class Assignment

Based on the success of the Fall 2013 course, the professor and the librarian decided to build on the same format for the Spring 2014 semester by implementing a flipped library research skills class session for even greater interactivity and skills application. Another Nutrition faculty member taught an evening section of NTR 450 for the Spring 2014 semester and joined in implementing the same syllabus, assignments, and assessments. The strategy for implementing a flipped class session included: (1) expanding the web-based library course guide to include a step-by-step pre-class library resources assignment (Appendix 1), (2) requiring students to complete the how-to videos and practice prior to the librarian's presentation, with an option to provide feedback on the pre-session activity - all contained in the library course guide, (3) planning an in-class activity that would provide an opportunity for students to use the skills and knowledge gained from the pre-class assignment, and (4) assessing student knowledge of the various library resources and their ability to apply library research skills with a pre-quiz (following completion of the library course guide pre-class assignment) and post-quiz (following the in-class activity session). Students' completion of the pre-class assignment and pre-quiz were intended to allow the faculty-librarian team to tailor the in-class session to the needs of the students. As in the previous semester, the syllabus and schedule included the librarian's name and contact information, rationale for the course assignments, offered advice (e.g., attendance of the librarian's presentation), and required students to bring a laptop or tablet to class for the librarian's presentation. Additionally, the faculty-librarian team decided to motivate students to complete the pre-class assignment by allocating course points to both the pre- and post-

quizzes. Students could earn five points for completing the pre-quiz regardless of the number of correct responses while they could earn up to five points on the post-quiz (based on the number of correct responses). The questions for the pre- and post-quizzes were the same and covered how to conduct literature searches and how to use specific university library resources. Not all of the students completed the pre-quiz, but the majority did, and most students correctly answered the pre-quiz questions.

Flipped Library Research Session – In-Class Activity

The in-class library research sessions took place early in the Spring 2014 semester, during the fourth week of classes. To optimize student involvement and engagement, and to provide a relevant activity to practice and apply library research skills learned during the pre-class assignment activity, the faculty-librarian team connected the in-class library session to an upcoming group research project that required students to analyze a controversial nutrition issue, take a position on the issue, and support their position with evidence from scientific research literature (Appendix 2).

The professors each began their respective class session with a brief introduction discussing research article types, specifically what is a “research study,” what are its typical components, and how can students identify this type of source. This introduction was followed by a Q&A session. Next, in each library class session, the librarian introduced herself and talked with the students about the library research pre-class assignment. During this time, the pre-class assignment learning objectives were reinforced through discussion and students had the opportunity to ask about aspects of library research that they still found confusing.

In each session, the professor and librarian then reviewed the controversial nutrition issue

assignment with the class. The students had already been assigned to groups for the project, and had selected their topics. The groups were in different stages of their research process, but none had completely finished the assignment. The students were asked to separate into their project groups for the remainder of the class. A 1-page reading log handout (Appendix 3) was distributed to each student group for completion by each group as a whole.

The in-class activity objective required each group to conduct a search on their topic in PubMed and/or CINAHL research databases, identify research studies that addressed their topic, and choose one research study that best represented a high level of scientific evidence (based on its methodology and relevance to their topic) and that they would likely use in their assignment. They read and discussed the article as a group while completing the reading-log handout that included areas to report on the methodology, description of study participants, sample size, and a citation for the article in APA citation style.

Given that the project groups in each class section were at different stages of the research process, this in-class activity provided an opportunity for the students to apply the library research skills that they had learned and for the librarian and instructors to assist in ways that were responsive to each student group. For example, one group had trouble identifying how their nutrition issue was being discussed in scientific literature. In this case, the librarian pointed out “Topic Overview” resources on their library course guide, including the Nutrition Evidence Library where the group found evidence summaries that provided several scholarly sources related to their topic to consider, and ideas for keywords for searching in research databases. Another group understood their topic and the position they were considering, but their topic posed two major difficulties in identifying relevant, high-level research studies. They were researching the possible effects on an infant from a mother’s intake of soy during the pregnancy. They were having difficulty identifying research study articles that were not either

about giving infants soymilk or about studying the effects of soy intake during pregnancy based on animal research. In this case, the librarian had the opportunity to work directly with this group for 15-20 minutes to arrive (collectively) at a search strategy using a combination of keywords with Boolean operators (AND, OR) and filters (human subjects only) to obtain a result set of research study articles consisting of more than five references relevant to their topic. Another group that had taken a position on their topic but had not yet conducted a literature search, changed their position on their issue entirely due to evidence in scientific research literature that they found during the session. Other issues that were addressed with facilitation from the instructor or librarian included citation formatting, topic refinement, and advanced use of research databases (e.g., PubMed and CINAHL).

Assessment Methodology

A twofold approach assessed the effectiveness of the flipped library research session: (1) optional student feedback regarding the how-to videos and practice exercises included in the web-based library course guide pre-class assignment (Table 1) and (2) assessment of student knowledge of the various library resources and their ability to apply library research skills via a pre-quiz and post-quiz administered via the course site (Blackboard CMS) for course points (Table 2).

Approval to publish the results of this teaching experience was sought and obtained from the Arizona State University Institutional Review Board with the protocol being considered exempt pursuant to Federal Regulations 45CFR46 (1) Educational settings. All data were de-identified.

Library Course Guide Pre-Class Assignment Feedback

The library course guide introduced and provided a single location for the pre-class reading, videos, and exercises. The library course guide feedback option asked about student perceptions of how useful the pre-class assignment information and activities would be for their course.

Table 1. Library Guide Optional Feedback Items

Comments or suggestions on this assignment? Use the Feedback box below (the email address is optional – feel free to leave that blank for anonymous comments). Thanks!

What did think of this assignment?

Was this information helpful?

Yes No I don't know

How useful was this page? (1 = Not Useful, 5 = Very Useful)

1 2 3 4 5

Additional comments

Your email

Pre- and Post- Library Research Skills Quizzes

The students took the pre-quiz after completing the library course guide pre-class assignment. The purpose of the pre-quiz was to gauge understanding so that we could tailor the library research session to address the most needed concepts. It was not graded for accuracy, just completion. The students took the post-quiz (same questions as the pre-quiz) after the in-person library research session, and this quiz was graded for accuracy. Both the pre- and post-library quizzes were required course activities (Table 2).

Table 2. Pre-Quiz and Post-Quiz Items and Corresponding Correct Answers.

No.	Item
1	What [University Libraries] service can connect you to a librarian for research assistance anytime, 24/7? a) [University Libraries] online library b) [University Libraries'] Ask a Librarian service [correct answer] c) AskALibrarian.com d) [University Libraries] Interlibrary Loan & Document Delivery service
2	What account must you have set up to use the [University Libraries'] Interlibrary Loan & Document Delivery service? a) Library Account b) RefWorks Account c) [University Interlibrary] Loan Account d) ILLIAD Account [correct answer]
3	If you request a scanned PDF of an article via the [University Libraries] Interlibrary Loan service, you will usually receive it within... a) 24 hours [correct answer] b) 2 days c) 1 week d) 48 hours
4	Let's say you're wanting to find current research on whether or not vegetarians are at risk for vitamin D deficiency. When searching in a research database, like PubMed, it's a good idea to break down your topic into major concepts (keywords) to type into the search box. Which of the following would be the best choice of starting keywords that are relevant to the topic and reflect the main concepts? a) People on a vegetarian diet at risk for vitamin D deficiency b) Are vegetarian children at risk for vitamin D deficiency? c) Vegetarian diet AND vitamin D [correct answer] d) Which vitamins do vegetarians need in supplements to stay healthy?
5	Go to PubMed research database via the [University Libraries] home page. Type in: pregnancy AND vegetarian diet . On the left side of the results page, click on '5 years' to see only articles published during the last 5 years. How many results do you have after adding the '5 years' limit? a) 100-150 b) 200+ c) 50-90 d) 20-40 [correct answer]

Descriptive statistics are reported as frequencies, percentages, means, and standard deviations (SD) and were performed using the statistical software package SPSS Version 20.0. For each

student a mean score was calculated (the sum of the number of correct responses) for both the pre-quiz and post-quiz. A paired t-test was performed to assess whether the pre-quiz mean scores were statistically different from the post-quiz mean scores (a paired t-test compares two sets of measurements from the same sample). The null hypothesis is that there is no difference between the means for the pre- and post-quizzes. We predicted that the post-quiz mean is greater than the pre-quiz mean. A two-sided significance level of 0.05 indicated statistical significance.

Results

The flipped pre-class assignment and library research in-class activity objective was to provide NTR 450 (Nutrition in the Life Cycle I) students with the knowledge and skills needed to search scholarly scientific literature and to review and choose relevant research studies to use as evidence in supporting a thesis (e.g., a position on a controversial nutrition issue).

Participants

A total of 178 students were in the two sections of NTR 450, with 97 (morning class section) and 81 (evening class section) students in each respective section. The majority were seniors (62.4%) followed by juniors (25.3%) with the remainder being post-baccalaureate, sophomores, or graduate students (12.3%). Most students were female (80.9%) with 19.1% male. Students enrolled were primarily Nutrition or Health related majors, with Nutrition-Dietetics being the largest represented major with 56 students (31.5%). Healthy Lifestyles and Human Nutrition were equally represented with 36 students from each (20.2%), followed by Exercise and Wellness students at 18 (10.1%) and other Nutrition specialties at 15 (8.4%). The remaining students were from a variety of other degree programs (9.6%).

Library Course Guide Pre-Class Assignment Feedback

A small number of students (18) provided optional feedback via the library course guide after completing the pre-class assignment. Out of these, 15 ranked the library course guide's usefulness as 4 or 5 (range 1-5 with 5 being the highest). Sixteen answered "yes" to "Was this information helpful?" Open comment responses showed that students considered the short online video tutorials on library services and database searching to be "fast and easy." Another student noted that the pre-class assignment information renewed confidence in using the library website and resources. Participants who chose a ranking of "1" or "No" (not helpful) did not include comments.

Pre- and Post-Quizzes

The percentages and number of correct responses for both the pre- and post-quizzes are shown in Table 3. More students provided correct answers for the post-quiz than for the pre-quiz.

Table 3. Frequency and Percentage of Correct Responses on Pre-Quiz and Post-Quiz Items

	Combined Session (N=125)		Morning Session (n=70)		Evening Session (n=55)	
	Pre-Quiz % (n)	Post-Quiz % (n)	Pre-Quiz % (n)	Post-Quiz % (n)	Pre-Quiz % (n)	Post-Quiz % (n)
Item 1	74.4 (83)	88.0 (110)	78.6 (55)	94.3 (66)	69.1 (38)	80.0 (44)
Item 2	55.2 (69)	92.0 (115)	52.9 (37)	91.4 (64)	58.2 (32)	92.7 (51)
Item 3	72.8 (91)	92.0 (115)	67.1 (47)	97.1 (68)	80.0 (44)	85.5 (47)
Item 4	96.0 (120)	98.4 (123)	95.7 (67)	97.1 (68)	96.4 (53)	100 (55)
Item 5	75.2 (94)	91.2 (114)	78.6 (55)	94.3 (66)	70.9 (39)	87.3 (48)

Of the 178 students enrolled in the two sections of NTR 450, only 125 completed both the pre- and post-quizzes. Results for the paired t-test (Table 4) show that there was a significant difference in the scores for the pre-quiz (M=3.74, SD=1.0) and post-quiz (M=4.58, SD=0.7); $t(124)=-9.05$, $p\text{-value} < .001$. The results for the morning and evening class sections separately were as follows. Morning: pre-quiz (M=3.73, SD=0.9), post-quiz (M=4.73, SD=0.6), $t(69)=-8.97$, $p\text{-value} < .001$. Evening: pre-quiz (M=3.75, SD=1.1), post-quiz (M=4.40, SD=0.9), $t(54)=-4.19$, $p\text{-value} < .001$.

Table 4. Paired T-Test and Means of Pre- and Post-Quizzes

	Pre-Quiz Mean (SD)	Post-Quiz Mean (SD)	T (df)	95% CI	p-value
Combined Sessions	3.74 (1.0)	4.58 (0.7)	-9.05 (124)	(-1.0, -0.7)	< .001
Morning Session	3.73 (0.9)	4.73 (0.6)	-8.97 (69)	(-1.2, -0.8)	< .001
Evening Session	3.75 (1.1)	4.40 (0.9)	-4.19 (54)	(-1.0, -0.3)	< .001

SD: standard deviation

df: degrees of freedom

95% CI: 95% confidence interval

Discussion

The library course guide optional feedback questions showed a small sample of positive student perception of the usefulness and relevance of the pre-class library research assignment. The in-class sessions further demonstrated student engagement and ability to use the skills learned in the pre-class assignment towards finding and analyzing topically relevant scientific research studies for their projects. The pre- and post-quiz mean scores demonstrated understanding from the pre-class assignment activities with 70% or more of all students answering 4 of the 5 questions correctly; followed by increased understanding and confidence after the in-person, student activity-focused class session, with 88% or more of all students answering all 5 questions correctly. These results suggest that a flipped classroom session has an effect on student comprehension. Specifically, our results suggest that when students engage in a flipped

library research session, their comprehension of library resources and their ability to use them increases (Figure 1).

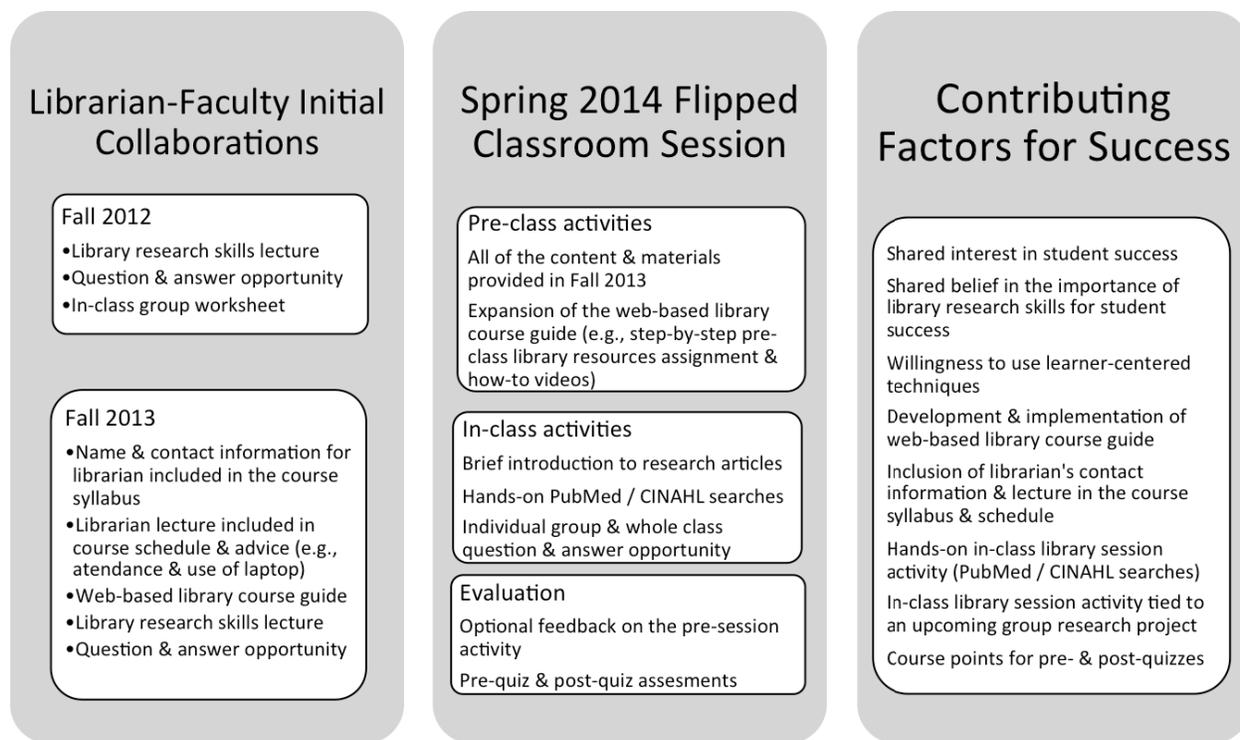


Figure 1. Progression from Guest Lecture to Flipped Classroom Library Session & Format of the Flipped Classroom Library Session

Faculty / librarian collaboration made this implementation of the flipped classroom method for a nutrition library research skills session successful. For the specific implementation, in the pre-class assignment, videos were most well liked, but students also appreciated a text section that described four methods to find and retrieve full text of scholarly articles via the university library's resources and services. The library guide pre-class assignment format allowed for explanatory text, including an opportunity for the librarian to provide a self-introduction and a brief statement regarding how the pre-class assignment would provide skills useful for course assignments, which further reinforced a common base of understanding between the students, librarian, and course instructors (Figure 2). The pre-class library course guide assignment was

NTR 450: Nutrition in the Life Cycle I

Emphasizes nutritional needs and problems during pregnancy, lactation, infancy, and childhood.

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Welcome!

Hi! My name is [Librarian], and I'm one of two Health Sciences Librarians at the [University] Library. You can see my photo on the right side of this page.

This assignment should take you 30 minutes or less. Completing this assignment and your library quiz in your NTR 450 Blackboard course site will prepare you for our hands-on library research session on January 27th.

Follow the steps below to complete your assignment, then head to your blackboard course site for NTR 450 and complete the short quiz.

Step 1: Get to know your [University Library]

Step 2: [The Library] doesn't have it? We can get it for you!

Step 3: Set up your ILLIAD Account to use the Interlibrary Loan / Document Delivery service

Step 4: Get to know 2 research databases for Health Sciences research

Step 5: You try it!

Step 6: Last Step!

Comments and Suggestions

Thanks! And, let me know if you have any kind of technical issues or other problems with materials on this page. My contact info is on the right, or here:

[email address]

~ [Librarian]

Figure 2. Top Portion of the Library Course Guide Home Page for the Flipped Classroom Library Session

Step 4: Get to know 2 research databases for Health Sciences research

View the 2 videos below to see examples of keyword searching in 2 major Health Sciences research databases: PubMed and CINAHL.

In each video, Look for:

1. How do you use keywords to search each database?
2. How can you use synonyms to expand your first keyword search?
3. How can you limit your search results using categories like: publication date, gender, or article type?
4. How can you get to full text of an article showing in your search results?

Figure 3. Pre-Assignment, Step 4 Instructions – Excerpt from the Library Course Guide for the Flipped Classroom Library Session

broken into manageable 'steps,' each of which included 'Look for...' points providing students with clear indications of goals for each learning activity (Figure 3). During the in-class session, the fact that the professors had already assigned students to project groups, that most groups had selected their controversial nutrition topic, and that some had already done preliminary research improved their readiness to 'dig in' to more in-depth research during the hands-on session. The professors' introductory discussion on characteristics of research studies and their use as scholarly sources for evidence-based presentations provided a targeted research goal for students while they tried out their library research skills. Having a physical reading log handout for evaluation criteria of 'best research study on your group's topic' allowed students to directly apply their knowledge, skills, and classwork in a way that contributed tangible content for use in their project presentations (thus further motivating them to complete the in-class assignment). Providing only enough handouts for half of the students so that everyone had to share with someone contributed to promoting group searching and discussion. Requiring the students to work in groups and facilitating group work through professor and librarian support for questions and difficulties were essential aspects of the in-person session activity, which resulted in greater peer-to-peer engagement and learning. Instructors noted excellent quality of research used by students for the controversial nutritional issues project and subsequent projects.

For future implementation, the authors assert that collaboration between the professors and the librarian was key in planning and carrying out the flipped class method, and they will continue such collaboration when implementing the method in future classes. The results presented here indicate that the flipped classroom technique provides a method to improve upper-level college student library research skills through interaction, engagement, and peer-to-peer learning. The results support incorporating a pre-class assignment providing targeted content and skills and a follow up in-class group activity with a targeted in-class work goal that results in tangible content towards a course project. Improvements could include: post in-person session feedback from

students on their perception of the effectiveness of skills learned for course assignments and overall success in library research; videos in the pre-class assignment content that are further tailored to the specific course content; methods to improve compliance in taking both the pre- and post-quizzes; and a future controlled study to further measure this method's effectiveness.

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Note

Appendices materials (library guide pre-class assignment text, course assignment & rubric, and reading log handout) are also available via the corresponding author's institutional repository at:

<http://hdl.handle.net/10919/50865>

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