

Using the 5E Learning Cycle of Science Education to Teach Information Skills

By Eric Snajdr

S

tructure is an important component to any lesson. For example, librarians with instructional responsibilities have likely heard time and time again of the importance of having a clear introduction, body, and conclusion to every lesson they teach. Structure on a finer scale can be helpful as well. In this case, the author borrows a framework from science education in order to provide structure around teaching a single concept in depth.

Librarians providing instruction to undergraduates in the sciences have several important decisions to make when planning instructional sessions. One key decision is choosing what content to teach. This decision is closely tied to the learning objectives for the session, which in turn may be effected by multiple variables. Examples of these variables include specific information skills that are essential for student success in the course, the level of, and prior, library experience of the students, specific information skills required for a research assignment, particular requests of the lead instructor, and how many times the librarian will visit the particular class.

Information literacy standards and competencies can provide a blueprint for librarians as they navigate their way through planning learning objectives and instructional content. Standards and competencies outline specific skills and understandings that an information literate student should acquire and various standards have been created for varying levels of focus. For example, there are general standards for students in higher education (ACRL, 2000), more specific standards for students in science/technology fields (ACRL, 2006), and even more specific standards for students in specific disciplines within the sciences (SLA, 2011). Examples of these at varying levels of specificity are listed

below.

General level of focus

Information Literacy Competency Standards for Higher Education, Association of College and Research Libraries (ACRL, 2000)

Science specific

Information Literacy Standards for Science and Engineering/Technology, Science and Technology Section of the Association of College and Research Libraries (ACRL, 2006)

Discipline specific

Information Competencies for Chemistry Undergraduates: the elements of Information Literacy, Special Libraries Association, Chemistry Division, and American Chemical Society, Division of Chemical Information. (SLA, 2011)

Any one of these levels of focus can be useful for librarians depending on the specific students they are teaching. However, when one looks in detail at any of the examples listed above, it becomes clear that students in the sciences have a sizeable set of information skills to learn during their undergraduate years. As a result, librarians might become tempted to load a single class session with a huge variety of topics. This has led some to consider if librarians, at times, are trying to teach too much content during a single instructional session (Chambers, 2008). A trade-off comes into play as librarians carefully consider what is more important, teaching a multitude of concepts at the expense of overloading the students, or, focusing in on teaching fewer concepts in depth. If a librarian has a specific concept or topic that they want the students to learn in detail, they might consider borrowing a particular instructional strategy from science education. The constructivist learning cycle model, or 5

E Learning Cycle, used in science education provides a framework for teaching a topic in depth.

Constructivist learning places the student at the forefront of the learning experience and "learning occurs when [students] make personal interpretations of ideas and experiences" (Biehler and Snowman, 1993). Constructivism, which has its origins in the work of Jean Piaget (Piaget and Inhelder, 1969), does not view students as empty vessels to be filled with knowledge by the instructor. Instead this framework acknowledges that students enter into educational experiences with prior knowledge and life experiences related to the material. The instructor acts more as a guide, identifying the prior knowledge of students, correcting misconceptions and linking new information to what students already know.

The effectiveness of the 5 E Learning Cycle model, which is based on the idea of "concept change", has been supported by research and has gained widespread use in science education (Bybee et al., 2006). The model is made up of the following steps or phases: engage, explore, explain, elaborate, evaluate. Descriptions of each phase are outlined below.

Engage

- instructor focuses student attention
- instructor stimulates student interest
- instructor might relate to the students why the topic is important (perhaps how the topic relates to students lives and/or to their success in the course)
- can involve a problem to solve or a discrepancy bringing out the natural curiosity in students

Explore

- students are given the opportunity to freely investigate the topic
- students actively investigate material
- students use prior knowledge
- instructor determines what students already know about the topic
- instructor identifies students' misconceptions

Explain

- instructor formalizes the concepts
- official definitions are given and discussed

Elaborate

- students extend their understanding
- students apply concepts in new ways

Evaluate

- instructor gathers evidence in order to identify what students have learned
- although it is the final of the five

phases, it is important to note that the evaluation may be done throughout the lesson

Example - Evaluating information (Web sites)

An example of the 5E learning cycle in action can be demonstrated through a lesson on evaluating information. Take, for example, a class of first year science students learning to evaluate Web sites containing science information. This hypothetical lesson incorporates Standard Three of the ACRL Information Literacy Standards for Science and Engineering/Technology, "The information literate student critically evaluates the procured information and its sources..." (ACRL, 2006). Performance Indicators specifically addressed in this hypothetical lesson are, "The information literate student: selects information by articulating and applying criteria for evaluating both the information and its sources" (ACRL, 2006). With the following outcome, the student "examines and compares information from various sources in order to evaluate reliability, validity, accuracy, authority, timeliness, and point of view or bias" (ACRL, 2006).

This hypothetical lesson provides an excellent example of how students enter into an educational setting with prior knowledge and misconceptions. Most students have a variety of experience in finding information on the Web, and many students likely think they are quite good at finding quality information. Many librarians would likely argue that most students have misconceptions in this area as well as an incomplete idea of how to evaluate information in general. With the 5E method, students will have a chance to link their prior knowledge to new material, as well as clear up misconceptions along the way.

Engage

During the 'Engage' phase of this hypothetical lesson, the librarian sets the scene thus prompting the students to think about how the topic is important. The librarian might ask students, "In your own lives, how many times in a given week do you consult the Web for information?" This brings the relevance of this topic to the students' attention, tying it in with the importance of it to their everyday lives. The librarian can then ask the students to take a minute to think over the following question. "How can one determine the quality of information on a given Web site?"

Explore

In the 'Explore' phase of this sample lesson, the librarian uses an active learning technique called "Think-pair-share." This is technique can be used in a variety of ways. In this case, students have already been thinking on their own about the question/problem posed above. They then pair with a class member and the two students consult with each other and write a list of different pieces of evidence they may garner from a Web site to determine the quality of information on the site. The librarian might prompt the students to "Think about what you know about Web pages..." or "Here is a sample Web page on the screen..." or ask, "What can provide evidence about the quality of information on the Web page?" The librarian can then ask each pair to report back to the entire group an item on each of their lists (this is the "share" portion of Think-pair-share).

Explain

In this phase, the librarian introduces formal terminology (e.g., from the standards for science "reliability, validity, accuracy, authority, timeliness, and point of view or bias") (ACRL, 2006). The librarian then defines and provides examples of each of the terms, also pointing out how some of the student responses from the think-pair-share activity fall under the evaluation criteria. The librarian can distribute handouts with the evaluation criteria listed (broken down into further detail) or an annotated checklist of the criteria. Then, the librarian asks each student to use the detailed criteria or checklist in order to evaluate two Web sites on a science topic of their choice.

Elaborate

In this phase, the students apply the above criteria to new situations. The librarian can lead a discussion based on the following question, "How might these criteria relate to evaluating other forms of scientific literature (for example, books, science news articles, peer reviewed research articles, technical reports)?" The librarian might have the students write a short essay on how they would apply the criteria that they just used to evaluate Web sites to evaluating one of these other formats of scientific information.

Evaluate

This is an ongoing process and can take place throughout the lesson. For example, the librarian can informally gather evidence of student understanding while observing them as they work in small groups during the "think pair share" activity. The librarian can also gather informal evidence during class discussions via student responses. A more formal evaluation can be obtained by

grading the products of student work (e.g. Web evaluation checklist, essay) and specific feedback can then be provided to each student.

Conclusion

The 5E learning cycle has strengths and weaknesses. One weakness is that this method is likely to be more time consuming than many alternative teaching methods. This method takes a good deal of planning on the librarians' part and will likely take more class time than other, more traditional, methods of instruction (e.g. lecture). Another potential weakness is that there is not as much teacher control during some phases of the instructional model. For example, portions of the instruction session involve student participation with open-ended student responses.

The free form character of the 5E learning cycle can be a strength as well. The many student-generated responses allow the librarian to identify prior knowledge the students have with the topic. In addition, the 5E learning cycle allows the librarian to lead students in correcting their misconceptions and to build on the prior knowledge the students bring with them to the learning experience. The students play an active role in interacting with using and applying new knowledge. Finally, a major strength of this instructional model is that it allows students to actively investigate and learn about a specific topic in depth.

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