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REDUCING THE INFORMATION LITERACY GAP IN HIGH SCHOOL STUDENTS

An Action Research Study

Heather McPherson
hmcpherson@swlauriersb.qc.ca

Margot Dubé
mdube@swlauriersb.qc.ca

Introduction

A wealth of resources are available on information literacy. Information literacy (IL) is a multifaceted skill that encompasses information seeking, identifying research questions, finding answers to research questions, and then evaluating and using information appropriately (ALA 2001). Much research has been conducted on the low level of IL found amongst high school students. Failure to make connections between IL skills taught in high school and the skills required in post-secondary education is another problem (Varlejs, Stec, and Kwon 2014). Our goal was to teach students critical-thinking skills related to digital and media literacy competencies within the framework of our local curricula. Students must be able to navigate 21st-century technologies as graduates transition from high school to post-secondary institutions and the work force. We perceived the need for a formal approach in the teaching of research skills with an emphasis on technology. The focus of this article is our teaching experience with developing cross-curricular pedagogical materials and, over a two-year period, using those materials to help students develop their research skills.

Over the past eighteen years I (high school science instructor Heather) have encouraged students to participate in school and regional science fairs. Acting as head judge at our regional science fair, I observed that an important component of successful competition is the students' ability to conduct proper research for their projects. While preparing students for local, regional, or national science fairs I found that many students lack the most basic information literacy skills. Clearly, the teaching of information gathering and processing falls short of what is required for students to compete at high-level science fairs. Rather than simply accepting the status quo, I decided that something needed to be done. The time had come for action research and a talk over coffee with the school librarian Margot.

Together, Margot and I decided to apply for a professional development grant from our school board. The purpose of the grant was to develop a standardized approach to teaching research skills that was multidisciplinary and suitable for students in grades seven through twelve. The grant included three days of release time for a team of English, social studies/history, and science teachers: two from junior high and two from senior high. In her capacity as a district-wide resource (school board librarian as well as high school librarian), Margot facilitated all team meetings. During the release time the team worked collaboratively to develop a set of student-friendly tools to improve literacy skills; these tools were level-appropriate and correlated with the curriculum.

Our first step was to establish learning goals. Some were skills that we believed students needed to develop so they could succeed in high school research projects such as prepping for a science fair. Other learning goals were tied to providing students with a set of skills to transition more easily from high school to the rigors of research at post-secondary education institutions.

In our school, the study was initiated with two classes of grade ten science students and two classes of grade eleven science students. In year two, we presented the material to four new groups of grade ten students and to three groups of grade eleven students who had received instruction in IL the previous year. This process provided us with useful information regarding students' acquisition of

IL skills over a two-year period. Similarly, the junior high teachers involved with the project adapted the materials to the level appropriate for their students and incorporated and reinforced these skills within their class research projects over a two-year cycle.

Teaching Methods

We created handouts that focused on research steps and selection of information sources, and a checklist to evaluate a website, as well as an interactive PowerPoint presentation for students. All handouts were general and could, therefore, be used in any subject area when teachers made assignments related to their teaching goals. The handouts and presentation were used with students in grades seven through twelve.

We deconstructed the process of information gathering into four steps: (1) planning, (2) searching, (3) evaluating, and (4) fair use. Descriptions of these steps are described in figure 1. We will explain each step in more detail in the following sections.

Figure 1. Research steps and activities within steps.

RESEARCH STEPS	
PLAN	Analyze the topic
	Find background information
	Select search terms and resources
SEARCH	Use keywords
	Use search engine features
EVALUATE	Assess website quality
	Use a checklist
FAIR USE	List sources
	Use citation builder tools

We (and/or the other teacher participants) presented a slide presentation with supplementary handouts (Appendices A and B) in a seventy-five-minute class. In our school the presentation was given in the school library, which contains a class set of thirty-two computers and an interactive whiteboard. Students viewed the slide presentation and were provided opportunities to try the techniques described in the presentation. Students were required to create a two-sided, three-panel brochure. In grade ten classes each student researched one of three genetic disorders: Tay Sachs disease, cystic fibrosis, or phenylketonuria. Grade eleven students researched a topic of their choosing in the area of pseudoscience. All assignments required that students use a minimum of three sources.

My (Heather's) students arrived in the high school library with this assigned science research project and a one-week deadline. The assignment required students to use a minimum of three sources, including one e-book made available through our digital library collection and one public website.

Step 1: The Planning Process

Students were asked to reflect and answer the following questions related to their assignment:

- What do you already know about the topic?
- How detailed does the information need to be?
- In what field is the research being conducted?
- What kind of sources do you need to consult?
- Do you need to browse the Internet?

After students had a clear idea about their research topics we moved on to finding background information. We advise students to consult general and/or specialized dictionaries, encyclopedias, and Web directories to orient themselves in the context of their topics and to help gather terminology to use when searching the Web. The following are examples of suggested resources to get students started:

> Merriam-Webster's online dictionaries and thesaurus [free] <merriam-webster.com>
>
> Encyclopaedia Britannica's *Britannica School* [subscription database] <www.school.eb.com>
>
> Historica Canada's *Canadian Encyclopedia* [free] <www.thecanadianencyclopedia.com> (one example of a specialized encyclopedia)
>
> Wikimedia Foundation's *Wikipedia* [free] <http://en.wikipedia.org>

We encourage students to look at Wikipedia to familiarize themselves with a topic but warn them not to use Wikipedia as a reliable reference in their final project. In our experience, high school students are generally unaware of the pitfalls of Wikipedia: anyone can be an author, and information can be manipulated despite Wikipedia's move to more-stringent standards. In our school a paid subscription to *Britannica School* is available, and students are strongly encouraged to use this more-reliable source for information they use in their projects.

Web directories are also introduced as a way of easing the problem of browsing the Web and, unintentionally, encountering—and possibly believing—sources that are

not authoritative. Topics in Web directories are organized by subject and are maintained by humans rather than software (Boswell 2014). Students look at sites containing resources organized by categories accessible through menus. Examples include:

> *HowStuffWorks*. [free] <www.howstuffworks.com>
>
> U.S. National Library of Medicine's *MedlinePlus: Trusted Health Information for You*. [free] <www.nlm.nih.gov/medlineplus>

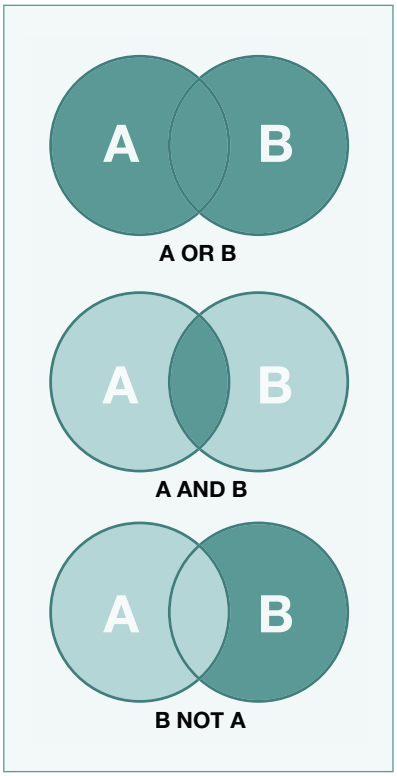
We provide students with a summary of advantages and disadvantages of commonly used information sources (see Appendix A). This summary helps students pinpoint the type of resources that best suit their needs.

Step 2: Search Terms and Search Engines

Following step 1, students learn techniques to search more effectively for information on their assigned topics. The following points are introduced and emphasized with examples:

1. Convert ideas to KEYWORDS
2. Choose unique terms *(e.g., global warming)*
3. State the context, if necessary *(jaguar: cat or car?)*
4. Consider using phrases: *top ten, review, best, how to*
5. Use AND to narrow your search; use OR to broaden your search. Entering AND, OR, NOT in all capital letters is important so search engines don't ignore these "little" words (UK Sourcers 2016).

AND, OR, NOT



We also review the possible range of available search engines. Examples include:

- Google
- Google Scholar
- Sweet Search: A Search Engine for Students
- Ask.com

The following tips for using search engines are reviewed:

- The order in which items appear in the results list is based more on **popularity** than **quality**.
- A search engine is a **tool**; it should never appear as a source in a bibliography.
- There are many specialized search engines. (The majority of students are not aware of Google Scholar, and we, therefore, give concrete examples of the benefits of quality information accessible through Google Scholar.)

Shortcuts that most search engines employ are introduced. We use examples from Google:

- Dictionary, calculator, clock, "I'm Feeling Lucky" button
- Exact phrase: "underground railroad"
- Numbers: **+**2
- Synonyms: **~**investigation
- Conversions: 2 ounces **in** grams
- Specific file type: diabetes **filetype:**ppt
- Exclude adult content: **safesearch:**teen sexuality
- Specific domain: **site:**gov
- Info about a website: **info:**www.howstuffworks.com

Step 3: Evaluation of Sources

High school students generally don't understand that certain websites have more or less legitimacy in terms of bias, quality, or accuracy of information. We explain the CRAAP test (below) developed by the staff of the Meriam Library at California State University, Chico, and we emphasize the importance of assessing the quality of resources found—especially online resources.

> CRAAP TEST:
>
> **C***urrency*: Timeliness of the information
>
> **R***elevance*: Importance of the information for your needs
>
> **A***uthority*: Source of the information
>
> **A***ccuracy*: Reliability, truthfulness, and correctness of the content
>
> **P***urpose*: The reason the information exists (Meriam Library 2010)

Tips for evaluating resources are also provided:

- Look at the URL (Uniform Resource Locator). The Web address indicates a company, institution, or person, and, often, the purpose of the site.
- URL endings are usually an indication of purpose: .org, .edu, .gov, .qc.ca, .gc.ca.
- Check the About Us feature on a website's homepage.
- Use our Website Checklist. (See Appendix B.)

Step 4: Fair Use: Why and How We Cite Sources

Students new to research might have weak notions of plagiarism and the necessity to cite works used in their research. We have all seen neophyte researchers cut and paste part of a website directly into their assignments. (At times neither font size nor color matches the body of the project!) According to Liz Sonneborn plagiarism is: "If you use another person's [words or] ideas, you have to make that clear in your text with citations *and* you have to provide information about where the reader can find those sources with a bibliography" (2011, 11). Plagiarism could also be understood as using "the words or ideas of another person as if they were your own words or ideas" (Merriam-Webster 2015).

We have all seen neophyte researchers cut and paste part of a website directly into their assignments.

Following our lesson, student assignments show a marked reduction of attribution errors. Students are taught:

- To clearly identify the sources used.
- To cite both published and unpublished sources.
- To avoid plagiarism.
- To lead readers to more information on the same or similar subjects.
- When in doubt, cite!

The final lesson segment introduces citing sources in an official format. High school students are required to provide a bibliography as an integral part of research assignments. Prior to this series of lessons, students tended to provide a simple list of book titles or website URLs in their bibliographies, in no particular order. For many students, bibliographies for science fair projects are their first exposure to higher standards of research. During our instruction students are asked to compare the following examples and are then provided tips for bibliographies in general.

BOOK, NO FORMAT:

Cystic Fibrosis by Justin Lee

BOOK, WITH MLA FORMAT:

Lee, Justin. *Everything You Need to Know about Cystic Fibrosis*. New York: Rosen Pub. Group, 2001. Print.

WEBSITE, NO FORMAT:

http://www.thecanadianencyclopedia.ca/en/article/montreal

WEBSITE, WITH MLA FORMAT:

"Montreal." *The Canadian Encyclopedia*. N.p., n.d. Web. 22 Oct. 2014. <http://www.thecanadianencyclopedia.ca/en/article/montreal/>.

Invaluable tips for students learning to create bibliographies:

- Record sources as you are doing your project; do not wait until the end.
- Place your sources in alphabetical order.
- For a website, record the date you used it.
- Try to use sources that provide their own citations:
  - databases and e-books with an auto-cite feature
  - scholarly articles that provide their own citations
- Use the citation format you are told to use. (We teach students MLA format because free citation builders such as EasyBib offer MLA free of charge. Also, *Britannica School's* auto-cite default is MLA.)

Online citation builder tools are explained using free services such as:

EasyBib: The Free Automatic Bibliography and Citation Generator <easybib.com>

Citation Machine <www.citationmachine.net>

Finally, students are directed to further resources when help is required with specific IL questions:

- "How to" videos on YouTube
- Google search support
- School, college, or public librarians—They are there to help!

Action Research Questions

The research questions driving this research are: Would these cross-curricular pedagogical materials we developed help to:

- show students how to find and use print and online tools in research planning?
- develop effective Internet skills: to use advanced search engine

features, to evaluate the credibility of websites, to learn to cite properly and use online citation builders?

- assist students from grades seven through twelve, and facilitate the acquisition of formal research skills necessary for the twenty-first century?

Our goal was to address the information literacy gap that has arisen most significantly as the quantity of online information sources has exploded in recent years.

Study Methodology

At the high school level, students were evaluated on their choice of sources and correct citation formatting. All photos had to be correctly referenced. Rubrics developed by Margot were used to evaluate citations and quality of information. The scientific content was evaluated separately from the information component of the assignment. Following the evaluation of the assignment, informal discussions with students focused on the process.

The cycle was repeated the following year, with a new group of incoming grade ten students and groups of grade eleven students, some of whom had been taught IL the previous year. Science fair projects were also evaluated in both years to determine the efficacy of our interventions.

Prior to participating in the presentations, Heather had noticed that most students had a very haphazard approach to the research project and often did not know how to get started. Prior to this intervention, Margot had noticed students' employing many ineffective strategies such as attempting to use "science fair" as a search term, placing ".com" as an extension to a search topic, or simply typing the whole research question verbatim into the search engine. Margot also noticed that most students considered websites (like Wikipedia) that are frequently displayed at the top of the list of results from a Google search to be reliable sources of information, confusing the popularity of the resource with an indication of quality. In contrast, after the direct instruction on effective strategies and ethical information use, we both saw notable improvements we attribute to the IL instruction. For example:

- After receiving the IL instruction, fewer students added ".com" to their Web searches (example: "electricity.com").
- Students with IL training were more sophisticated in their online searches. Instead of typing an entire research question verbatim into a search engine, students searched on keywords. They were also more likely to evaluate sources instead of simply using the first few sources identified in an online search.
- A marked improvement in the number of students citing images was seen. Prior to the lessons on IL, no students seemed to be aware that using an image without proper citation is plagiarism. This improvement was especially apparent in students' science fair projects.
- The number of students extracting text and using it without adding or altering details was diminished. This change was most notable in the junior high school.

Findings indicated that the information literacy training resulted in substantial improvements in basic literacy skills. Improvements were most profound in students who received the instruction for two consecutive years.

Evaluation of Project

To assess the success of our action research plan, we had informal discussions with students. Comments received included: "I wish we had known this a long time ago," "I never thought about using keywords before," (students following a November presentation); "Thank-you for teaching us Boolean logic and correct citation format" (a recent graduate who was now studying sciences at college). We also evaluated the research projects students did over the period of two years. We evaluated the diversity of resources used by students who received the special instruction, the quality of the resources, and students' ability to cite references correctly.

Findings indicated that the information literacy training resulted in substantial improvements in basic literacy skills. Improvements were most profound in students who received the instruction for two consecutive years. The quality of science fair projects also improved significantly. More projects moved from regional to provincial fairs, and more projects advanced from provincial to national fairs.

Conclusion

High school students need guidance if they are to successfully engage in research projects. The tools described in this article are cross-curricular pedagogical materials

designed to help students develop practical, hands-on skills for planning research, and for searching, evaluating, and using online information. Our goal was to provide high school students with the knowledge to complete high school research projects, to ready graduating students for college-level research, and generally to prepare students to join the 21st-century work force.

This action research project was presented at a school board-sponsored workshop. The audience included teachers, school administrators, and school board (district) personnel. Feedback was very positive. Educators' action research was effective in addressing the problem of high school students' weak information literacy skills and narrowing the IL gap between the skill set of secondary school students and the expectations in college courses. We believe that action research involving teachers from multiple disciplines and from multiple schools working collaboratively is an effective method to initiate change and to overcome barriers in successful implementation of essential pedagogies, including information literacy.

APPENDIX A: SELECTING INFORMATION SOURCES

SOURCE:	BEST FOR:	ADVANTAGES:	DISADVANTAGES:
Encyclopedias (Print /Online)	Background information Quick facts	Easy to use Broad overview Authoritative	Out-dated information
Wikipedia	Background information Quick facts Obscure information	Easy to use Very accessible	May be inaccurate Info may be manipulated by others Bias or slant
Specialized Books	Historical information Quality bibliographies	Age- or level-appropriate Well-organized Comprehensive	Not always current
Newspapers or News Magazines	Current information Local information	Short articles for general use Detailed analyses of events	Possible bias Authors are not necessarily experts on the subject
Popular Magazines	Short articles Photographs and illustrations	Easy to understand	Authors are not necessarily experts on the subject Articles can lack depth Sources not often cited
Scholarly Journals	In-depth information Recent research Bibliographies	Peer-reviewed Specialized audience: other researchers and professionals in field	Terminology and depth of articles may be difficult for novices to understand
Websites	Government information Varied points of view on a topic Statistics Company information Videos	Easy to find Accessible Up to date Information may not be found anywhere else	Difficult to browse Too much information Possible bias Not all websites are available to the general public

Adapted from University Library, University of Illinois at Urbana Champaign. 2016. "Select the Best Information Source." <www.library.illinois.edu/ugl/howdoi/selectingsources.html> (accessed October 6, 2016).

Heather McPherson *is a senior science teacher at Laval Senior Academy in Laval, Quebec, and a PhD student at McGill University. In 2016 she won the McGill University Department of Integrated Studies in Education "Indy" Educator Practitioner-Researcher Award. Her article "Material Science and the Problem of Garbage: Where Does All That Stuff Go?" will be published in the November issue of* The Science Teacher. *With Maggie McDonnell, she wrote "Articulation between High School and CEGEP Science Post-Reform: Understanding the Gap," which will be published in* College Quarterly.

Margot Dubé *is a school librarian. She is based at Laval Senior Academy and has additional administrative responsibilities at the school board level to provide support to other library staff within the district. She is a member of ABQLA (l'Association des bibliothécaires du Québec — Quebec Library Association).*

APPENDIX B: WEBSITE CHECKLIST

Checklist to Evaluate a Website

ANYONE can create a website. YOU must determine if it is worth using.

What is the web address (URL) of the website you are using?

What clues does the web address (URL) provide? Check all that apply:

○ Commercial (.com)	○ Country site (example: .ca for Canada)
○ Personal web site (example: u2.com)	○ Government agency (.gov or .gouv)
○ Academic institution (.edu)	○ Provincial government (example: .qc.ca)
○ Non-profit organization (.org)	○ Network of computers (.net)

Other? Please describe: _____

Who is the author of the website? (Hint: check "About Us")

Is it a well-known organization or institution or person?

Does the website provide any contact information?

What is the purpose of the website? Check all that apply:

○ To inform	○ To express an opinion
○ To teach	○ To present facts
○ To sell	○ For propaganda
○ To entertain	○ For scholarly research

Other? Please state: _____

When was the information on the website last updated?

How does the website appear overall? Check all that apply:

○ Visually attractive	○ "About us" is easy to find
○ Well designed and organized	○ Help is available
○ Easy to read	○ Links to other sites work
○ Easy to navigate	○ Spelling mistakes?

Other? Please state: _____

Would you use this source in your research project? Please explain why or why not:

Laval Senior Academy Library 2015-16

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