Original Paper

Search Engines and Critical Thinking, Evaluation and Investigation

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Abstract

Increasingly, teachers are assigning work involving internet searches and students are increasingly employing the Internet to procure at least preliminary information. However, the vast majority of teachers fail to teach critical analysis of material posted on the Web. This paper will explore this issue and examine the need for instruction in critical thinking regarding sources on the Internet.

Keywords

search engines, higher order thinking skills, critical thinking skills

1. Introduction

The use of the Internet as a source of information and data has virtually exploded over the past few decades. Students are often assigned homework and are encouraged to "surf the net" or use "Google" to locate primary or secondary sources or to simply find materials relevant to a particular topic. However, not all students are wise, prudent and judicious, about where they locate information and are not always cautious and critical about the first bit of information that they may encounter on Google or whatever particular search engine that they may employed.

This paper will explore issues relevant to determining the legitimacy of sources found on the Internet. Students need to think critically by evaluating sources, looking at multiple sides of an issue and, lastly, determining the accuracy or possible bias of a document or posting on the Internet.

Increasingly, just about anyone can "post" on the Internet. Individual websites can compare and

contrast people based on someone's posting or associate two people (e.g., Adolf Hitler and Hillary Clinton) or two points of philosophy (existentialism or humanism). Although evaluation skills are thought to be embedded into the curriculum, we are not sure if critical evaluation skills are used or employed effectively in assignments. Often teachers lament the fact that they covered critical thinking skills.

However, pupils may not employ these skills in their rush to complete an assignment. Students often do not differentiate between fact, opinion, theory, and rumor. Often, digital academic vocabulary is not taught—for example-URL-stands for "Uniform Resource Locator" and DOI. Means "Digital Object Identifier" not "downloaded onto the Internet". Teachers should be adamant that certain basics of validating websites are learned in depth. Students need to clearly understand what is an opinion, perspective, and what is a documentable, discernable fact.

"Facts" are usually backed up by a consensus of experts. For example, we know the exact date of the Treaty of Versailles ending the First World War. However, we can debate the causes of World War II from various perspectives. Some historians blame the economy, others the punitive nature of the Treaty of Versailles. Still others expound on the brutality of Adolf Hitler and his attempt to exterminate the Jews. Students need to carefully draw inferences about the information that they gather, and teachers should demand multiple sources of information as well as multiple authors. Although it may be difficult for elementary students to understand the political leanings of various groups (Republican vs Democrat and Liberal vs. Conservative) teachers should make preliminary efforts to communicate without bias, at least—some of the general tenets of each political party. There are shared beliefs, attitudes and philosophies that groups of people maintain and it is difficult to ferret out the main beliefs, as times do change and leadership fluctuates. There are also basic feelings about certain people that can affect one's objectivity. The people of Poland have different feelings about Nazi Germany, and the Jews are certainly entitled to hold certain feelings about a long dead Nazi leader.

There have been heroic attempts to bring a sense of truth to the Internet regarding the accuracy and specificity of what is posted. For example, SNOPES.com is one such site that attempts to identify rumor and innuendo from factual knowledge. David Mikkelson founded Snopes. Mikkelson (a research and writer) funneled his passion for investigating urban myths and legends into a website that is highly regarded as the "go to" site on the Internet for debunking urban legends, myths, rumors, and false and misleading information. Snopes (www.snopes.com) has an up-to-date top 25 urban legends list, a fact check section and a search engine to investigate past and present rumors on the Internet. In addition, the site has a link were readers can submit urban legends and rumors to be researched. Snopes is not politically affiliated and has a small research staff that investigates and write articles fact checking misleading and false Information found on the Internet.

Over the past few years, there has been a movement away from the Western canon as a "bunch of facts" to comprehension strategies and Common Core. Students need to be taught that events that shaped decisions have historical surroundings and precedents. For example, the assassination of Dr. Martin

Luther King occurred at a specific time in history. Perhaps, if it had occurred 5 years earlier, there is no way of telling how the sands of time could have been altered. If anyone can post and published on the Internet, then, we need a minimal set of standards or filters.

2. The Process of Searching the Web

In the past, high school and college students would trek to the stacks of the library in a hearty, robust effort to procure the needed necessary information for an assignment or term paper. Today, the data is a mouse click away, and the legitimacy of the procured information is somewhat questionable. The information "out there" runs the gamut from reams and reams of information to the preposterously sublime (Your Co-Worker Could be a Space Alien—Here's How You Can Tell). Students need to be able to differentiate between humor, sarcasm, irony, foolishness and blatant boldfaced nonsense.

The Internet has "Wikipedia" that allow individuals to make their own contributions to various topics (e.g., comparing the political philosophies of Hitler to Hillary Clinton). Wikipedia has no direct instruction as to how to use it, and how to prudently, judiciously examine its contents. However, the Internet does provide some data, as we say, straight from the horse's mouth, so to speak, as interviews are posted. However, people can "mis-speak" and once posted, comments are rarely changed.

Concepts about web literacy should be taught by teachers and clearly understood by the students. For example, a commentary is different than a hypothesis, which remains unproven, and a theory is different than a scientific law.

In this day and age of ranting and raving and getting on one's soap-box, the Internet has increasingly become a medium for venting anger, angst and frustration. To assist, in analyzing a web site or validating informationa critical thinking website can be found at: http://www.4criticalthinking.com/This site provides critical thinking elements and concerns.

3. Professional Learning Communities

In many schools, teachers gather to discuss lesson plans and how best to teach a topic and share concerns. Often, the PLC (Professional Learning Community) support teachers who are endeavoring to teach not just information, facts and knowledge, but also techniques to examine critically, the source of knowledge. In the past, scholars and learners were very much reliant on an editor or a publisher to ascertain the veridicality of statements or inferential assumptions (e.g., the causes of the Civil War). This is particularly important in an age with an emphasis on standardized tests—and their often misused results.

Very few principals have the statistical acumen to know about "ceiling effects" and/or homogeneity and heterogeneity. These professional learning communities in effect should hone the skills of teachers and attempt to fine tune both the higher order thinking skills of students as well as critical thinking skills vis-a-vis the Internet.

4. Alternative Sources

In every field of endeavor, there are main sources of information and then there are tangential, perhaps less read or more obscure sources. Today, "success" is based on the number of "hits" that a site accumulates. Little if any critical evaluation of a site is found. Often, the critical evaluation is of the layout or color of the main page. This is why teachers should request multiple sources of information from students and require students to discuss the competencies of the source. All too often, gibberish and hucksterism are linked via a tilde (~) to some university site. Students do not know that a tilde designates a personal webpage.

There are webmasters to assist but it may or may not be part of their job description to monitor the accuracy of postings. Indeed, a common complaint among some faculty, trying to locate a colleague at another university is that an email may still be posted, with someone's picture on it that has left years ago for another university or college.

5. Critical Thinking in These Times of "Fake News"

In the current zeitgeist, there is much discussion about what some refer to as "fake news". It may be that individuals believe that the news that is posted on the Internet is slanted or biased or tends toward one area or another. Some see the current news stories as quite negative, while neglecting the positive aspects that are transpiring in the world. In other instances, information is taken out of context and one or two sentences are "lifted" from a speech which may be positive on the whole, but when taken "out of context" present a different premise. For additional information on this topic, readers should peruse, critically the following web site. https://www.psychologytoday.com/blog/the-main-ingredient/201801/survival-guide-the-era-fake-news Students need to be taught how to ask questions, and teachers need to continually reinforce that behavior in classroom discussions. Questions could include "Where is the proof?"; "Where is the data?"

"Where is the evidence?" "What is the motivation of the author?" and even in so called "research studies". Individuals need to be aware of a research study that has a small sample size and often are a non-representative sample size. Certain research studies are conducted by organizations that have a particular perspective in mind. For example, drug companies may want to encourage the use of their medications and thus fund their own research to prove that their particular drug is effective in the treatment of cancer or some other illness or malady.

6. Some Basics—Opinions Versus Facts vs Theories vs Evidence

In the K-12 classroom, students need to be taught the difference between an opinion (which they are allowed to have) and a fact (Donald Trump is the current President) versus a theory (the theory of relativity or a theory of human behavior as opposed to evidence. There is sometimes a blurring of fact and opinion and often information is interpreted and "spun" by politicians. Context becomes even more

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important. A joke or something told in a sarcastic manner can be misinterpreted or misconstrued. Knowing the context of a situation is of paramount importance as well as the specific circumstances surrounding an event. Evidence, of course, varies—there is legal evidence versus scientific evidence (which is still subject to interpretation and the scientific method). In my opinion, much more has to be done in terms of teaching students higher order thinking and critical thinking skills in order to evaluate information on the Internet. Students also should be warned about extreme language on the Internet. While certain things are quite problematic, students should be concerned about words such as "gargantuan" and of course "huge" (which is a quite relative term). The amount of snow in Alaska is different than the amount of snow in Hawaii (if ever there is snow in Hawaii).

7. Pictures, Charts and Graphs and the Like

Students on the Internet need to be aware of blogs and other postings that seem to inundate the reader with a vast amount of colorful pictures, charts, graphs and people with smiling faces. Some individuals are fooled by showy presentations and they begin to believe that these presentations must be telling the truth, when nothing could be further from the truth. In fact, Don Mc Millan often presents on the misuse of Power Points and how many Power Points actually bore the attendees and obfuscate the issues being presented. Some politicians also "lie with statistics" and there is a great book by Huff (1982) that describes the misrepresentation of data, and ways in which pictures can be changed or manipulated.

8. Some Major Problems

Many people, including students, are so busy that instead of doing library research, they quickly go to Google, or Yahoo, or some other search engine, type in a few words or questions or descriptors and then base their conclusions or their assignments or term papers on what they have gotten from that search engine. Their thinking is often based on their first assumptions or presumptions about what they view on the Internet, not understanding that what they have read is perhaps an official position of some organization.

Students are not taught the meaning of words such as propaganda, or indoctrination, and are not exposed to these concepts during their high school or even college careers. It is important to understand the meaning of certain words as they can have a relatively profound impact on one's thinking. In these turbulent times—the words "racist, sexist" and various other terms have been bandied about somewhat carelessly (in my opinion) when in fact there is no empirical proof that any person is, in fact a racist.

They could conceivable be a dentist, since those words all end in "ist" or a proctologist (which also ends in "ist". Diane Ravitch (2014, 2004) has cogently written about the use and misuse of language, not necessarilyas it pertains to the Internet—but to education in general.

9. An Embarrassment of Riches

The Internet has made information and knowledge readily available at our fingertips. It enables us to speedily search for knowledge and research that in the past could only be located on microfiche or in esoteric journals. However, with this rapidity of accessing Wikipedia and other sources comes pitfalls in that students, in general, are not really trained to sift through the mountains of data and publications to discern what is truly relevant or appropriate. These students need focusing skills, and the ability to discern what is truly good scientific evidence and knowledge, and what has been posted by some ordinary high school graduate or even college graduate.

Anyone who has visited the British museum, or the Trinity College Library in Dublin, Ireland, or even the Smithsonian can recognize the very vast amount of information that is available to individual scholars. Attempting to procure the exact, specific, precise information that one needs or wants however, is less easy to procure. Competent librarians are often the best source of information and have the skills to go directly to an author, book, journal or source of a certain needed information or data. They will often caution students to be careful of using Wikipedia and other "pulp" or similar sources.

Even today, one does not have to journey to a local book store or library. There is a book by Croft, Metzler, and Strohman (2010) on "Search engines: Information Retrieval in Practice" and this book can be downloaded and it is currently being revised. Revisions are often necessary, as things change in technology rapidly. I am personally no longer using 5-inch floppy disks, and have transitioned to 3 inch and now Memory Sticks.

10. Thinking Critically about Search Engines

High school students, middle school pupils and obviously college students need to be wise, prudent and judicious about what search engine they utilize. They may do a general search with Yahoo or Google, or may use some esoteric site such as http://www.wumpus-search.org/ It is unclear, at least to the first author how students are introduced to typical search engine, and how specific disciplines teach students in their content realm, which search engines or meta search engines to use for engineering, math, science, theatre and music or drama. Some sites popup more rapidly than others, some may be more eye catching or appealing. Users need to have to have a critical eye for the usefulness of each particular search engine. There may be other search engines that are more appropriate or reasonable for certain topics or themes such as http://www.dogpile.com/

11. Tips for Validating a Website

Students today are growing up in a culture where information is literally at their fingertips. While past generations relied on libraries, today's culture relies on the Internet. When the second author asked 8th grade students how do they know if something is true on the Internet, they have responded: "Why would someone lie about that?" In teaching web literacy to educators and K-12 students there are several helpful hints that can assist students and teachers in critically thinking about the information

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they come across on the Internet.

12. How to Read a Website

Learning how to read a website address can give clues as to who owns a site and the type of information found there. Helping students and teachers learn how to read a web address begins by breaking down the address. For example, www.enmu.edu stands for: World Wide Web, Eastern New Mexico University, and Education. The "edu" part of the web address is called an extension. Extensions can help us understand the additional information about web addresses. Common extensions include:

.net (Network)

.com (commercial)

.org (organization)

.gov (government)

.mil (military)

http://goes.gsfc.nasa.gov/text/web_country_codes.html provides at list of extensions by countries around the world.

13. Searching for Websites

Searching for information on a search engine like Google or Yahoo can be an overwhelming task. For example, typing in a topic or phrase in a Google search engine can retrieve millions of results. One approach to limit this number is the put your topic or phrase into quotation marks. This will allow the search engine to search for that specific topic or phrase. If quotation marks are not used the search engine will look for all words independently and together. For example

1) Go to Google and type in Web Literacy;

2) The results will be in the millions;

3) Now, type in "Web Literacy" in quotes.

While the number will still be relatively large, the number of results will be drastically reduced.

14. Is a Webpage Current?

It is important to know how to check when I webpage was last updated and or created. Often websites have not been updated in several years making their information invalid. One approach to finding out when a website was last updated:

1) Go to a webpage;

2) Delete the current address in the address bar and type JavaScript: alert (document last Modified);

3) A time stamp will appears telling you when the webpage was last updated;

4) This approach does not work in a Chrome Browser.

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15. Who Owns a Website?

An important aspect to understanding web literacy is understanding who owns a website or webpage. People and organizations can present bias points of view.

1) Go to www.whois.net

2) Paste the address of a website you would like to know more about (who owns the site) into the search bar. The will tell you who owns a website and what organization it is a part of, if any.

3) For example: paste in: martinlutherking.org

4) Now, look at the current information on who owns the website.

5) In the list you will find the name Stormfront. Stormfront is a white supremacist group posting information on Martin Luther King.

16. Who Is Linked to a Particular Website?

Often, it is important to know what other organizations or link to a website. Knowing who is link to a site can give clues to the intent of a site. To check who is connected to a website, go to Google and type: Link: and the web address. For example,

1) Go to google and type Link: enmu.edu

2) This will provide you a list of websites linked to Eastern New Mexico University's webpages.

What is the History of a given website?

The following website will allow you to view a website's past:

1) Go to web.archive.org (Internet Archive-Way back Machine),

2) In the search bar, paste the address of a website,

3) If the site has a history, click on a year and specific date and view what the webpage looked like in the past.

Beware of Online Filter Bubbles (2011) TedTalk.

https://www.ted.com/talks/eli_pariser_beware_online_filter_bubbles

Beware of Online Filter Bubbles is an informative TedTalk by Eli Pariser discussing online search engines such as Google and Yahoo. He talks about the dangers and problems of Yahoo and Google editing and customizing peoples' search results. He points out that two people can have two completely different results based on where they are searching from (geographical locations), what type of computer is being used and past search results (history of searching).

Sample websites that can be used for learning on how to validate web pages are:

http://www.genochoice.com/

Geno Choice is a website that allows one to create and design disease free children through DNA sequencing. https://www.allaboutexplorers.com/

All About Explorers is a website created by teachers to teach students about web literacy. While the site appears to be a good source of information about explorers, it is really a site to teach students how to validate information. https://zapatopi.net/treeoctopus/

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The Northwest Tree Octopus is a site that is trying to save the Tree Octopus from Extinction. It provides pictures, videos and current information on the Northwest Tree Octopus. https://www.improbable.com/ig/winners/

The Improbable Research website provides a research-based looking website that presents awards to improbable research studies. http://www.dhmo.org/truth/Dihydrogen-Monoxide.html

The Dihyrogen Monocide website is dedicated to spreading the news about the danger of H2O (water).

17. Some Rudimentary Critical Thinking Basics

As in many educational endeavors, one is taught the "Who, What, When, Where and Why" of things and in terms of critical thinking, this realm is no different. Thinking critically about information on the web, a preliminary question is obviously, "Who Wrote This?" and what are their qualifications? When something is written by a well-known figure such as Bill Gates, there is a certain aura effect. In other instances, students, and in fact, everyone needs to know the source, as many things on the web are often written or attributed to, some organization. While there may be a Center for the Study of Space Aliens Living in the U.S. out there somewhere, the typical reader has no way of knowing if this is a legitimate organization or a blog run out of someone's basement.

Often readers attribute to serious sounding organizations much that should not be applied. For example, a reader may believe that a certain organization may be housed in Washington, D.C. and is staffed by 10.

Ph.D.'s and an army of typists and secretaries. The truth again may be that one person, in their spare time is going to the public library to research French Literature. A second question is "Whe". Unless one clearly knows when something was posted, unless one knows when a pdf was given a DOI number, unless one can get the specifics on some document, it should be viewed with caution, bearing in mind that things have changed since the 1960's. Third question is "Why?" Why is this being published? For informational purposes, for educational purposes, for historical documentation, to influence others, or for perhaps indoctrination purposes or propaganda purposes. Students need to be aware of the fact that this may occur on the web and is insidious and predatory. Fourth question is "What" What is the message either implicit or complicit that is being conveyed. In this age of political correctness, there are often subtle hidden messages or even blatant obnoxious messages. In some instances the message is simple—"Send us money" "or Buy this product from us" or "Get something free, and don't read the fine print and we will charge your credit card a large amount of money in 2 weeks". Fifth question is "Where". This becomes complex as some individuals from a certain college or university post something under the auspices of a college or university—but what is published (for example, astrological readings) is not condoned by the college or university that it apparently comes from. Self-identified "experts" in a certain topic are just that—they are "self-identified". Some organizations are also self-identified as "the leading voice" in the field.

Sometimes the real experts and the most effective, efficient organizations do not need to self-proclaim

their expertise. True scholars net work with others and they know the reputable organizations and the leading researchers in their field. Students, individuals and even teachers need to look at all information with a critical analytical eye. Schools often attempt to teach students about Internet safety. Topics can include being aware of online predators, cyber bullying and individuals that attempt to extort money. Often, librarians will monitor internet use and provide feedback and caution students about Wikipedia, and refer them to an appropriate sources of knowledge and information. Web literacy and validating information in the Internet is an on-going challenge and dilemma which requires critical thinking skills and the development of a sound web literacy curriculum for teachers. Students need to be very carefully taught to take time to critically evaluate all information gleaned from the internet and to think long and hard about the validity, and truthfulness and quality of the information procured from the World Wide Web.

18. Summary and Conclusions

There is truth, there is trash, and there is trivia posted all over the ubiquitous Internet. All students-elementary to middle school to university need to be able to discern what is appropriate and valid information, and what is drivel.

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