Critical Thinking Skills and Information Literacy: Tools Future Geoscientists Must Possess

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As an educator in the geosciences, it has been increasingly evident that students need to possess certain skills in order to be successful future geoscientists. Among many of these skills is the ability to think critically and be well-informed as to which sources of information are credible and reasonable during the process of research.

Critical thinking consists of cognitive processes of discernment, analysis and evaluation. It includes, among other processes, reflecting upon a tangible (or intangible) item in order to form a solid judgment that reconciles scientific evidence. A certain amount of "common sense" is necessary in order for this to work effectively. However, "common" sense is no longer as "common" as it used to be. In fact, one might even regard "common" sense as relatively *"uncommon"*.

Within the framework of a "healthy" scientific skepticism, the process of critical thinking involves acquiring information and evaluating it to reach a well-justified conclusion. The vast majority of critical thinking skills includes such things as; assessment of beliefs and identification of preconceived notions, prejudice, misconceptions, artificial bias, media propaganda, distortion or exaggeration of the truth, or misinformation, etc. Recent advancements in cognitive research indicate many educators are tending towards an emphasis on teaching their students critical thinking skills, intellectual standards, and cultivating intellectual traits (such as intellectual humility, intellectual empathy, intellectual integrity, and fair-mindedness) rather than on rote memorization of scientific facts. Hamby (2007) regards critical thinking as involving two aspects:

1. *a set of cognitive skills, intellectual standards, and traits of mind;* and
2. *the disposition or intellectual commitment to use those structures to improve thinking and guide behavior*.

Critical thinking does not include simply the acquisition and retention of information or the possession of a skill-set, which one does not use regularly; nor does critical thinking merely exercise skills without acceptance of the results (Facione, 2007). Gabennesch (2007) warns of the danger, however, of overuse of the term such that it may eventually become meaningless. Gabennesch (2007) suggests:

One of our major responsibilities as skeptics is to maintain a continuous exploration of fundamental questions involving critical thinking, including:

1. What are the essential components of critical thinking?
2. Are those who claim to be promoting critical thinking doing justice to the concept or corrupting it?
3. What is the value of critical thinking, and how do the benefits justify the undeniable costs of studying, teaching, and practicing it?

Thomas Gilovich (1991) has argued that scientists, by virtue of their "way of looking at the world, the habits of mind that they promote," are in the best position to educate others about the importance of "question[ing] our assumptions and challeng[ing] what we think we know." Perhaps our future geoscientists will follow in this pathway.

Several conceptions and interpretations *of information literacy* have become prevalent over the past decade. For example, one interpretation defines information literacy in terms of a set of learned competencies that an informed citizen of an information society ought to possess to participate intelligently, critically, and actively in that society (from Shapiro and Hughes, 1996). The American Library Association's (ALA) Presidential Committee on Information Literacy, Final Report states that, *"To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information"* (ALA, 1989).

Jeremy Shapiro & Shelley Hughes (1996) define information literacy as *"A new liberal art that extends from knowing how to use computers and access information to critical reflection on the nature of information itself its technical infrastructure and its social, cultural, and philosophical context and impact."* Strong words to live by in this technologically advanced age where geoscientists must not only be technically capable, but information savvy as well.

Some key processes and terms associated with informational literacy skills include: selection, analysis, synthesis, evaluation, and critical review. Indeed, critical thinking and a healthy skepticism are necessary components of information literacy and a progressive and functional critical thinking skillset.

As the world becomes both larger and smaller at the same time, in a time where "globalization" makes the headlines on a daily basis, and in an era when spatial problems are visualized in new ways, our future geoscientists need to understand how to ask the important questions and how to think in a critical manner, as they never have before. They can't simply take one's word for viewpoints on issues anymore by depending on the once-reputable news sources. No, students of today, as our future geoscientists and problem-solvers of tomorrow, must entertain the notion of new ways of thinking and researching and seeing issues from completely new perspectives. The world will demand more from our future geoscientists than ever before and they must be up to the challenge.

As I write this opinion piece, I am astounded that words such as “critical thinking” and “information literacy” have developed so rapidly into our lexicon of educational terminology. While Gabennesch (2007) cautions the overuse of such terms, I suggest that we have only seen the dawn of these essential tools for learning, and problem solving. Some final words of advise to the future geoscientist: learn to think critically, be skeptical in a healthy sense, and become familiar with reputable sources of information. There is no substitute for experience in this arena, but hard work and perseverance go a long way in reaching your goal.

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