From Dr. HsingChi Wang, Research Assistant Professor, Center For Craniofacial Molecular Biology and Senior Researcher, TIMSS Study, Michigan State responding to:

Reading: The Most Important Science Process Skill
Dr. Stan Metzenberg, CSU Northridge
Special to The Antenna
The full text of Dr. Metzenberg's article is available at
http://youth.net/ysc/educnews/readscie.htm
or at the bottom of this discussion

10/29/99 10:06 am

Dr. Metzenberg:

Hello. I read a post of yours regarding scientists' reading. I'm curious; what's your evidence to support your argument? I have been working with scientists for over two years, and I was a physics major in college. Over these years, I have never heard my colleagues and other fellow graduate students claim that the majority of their time was spent on reading. Most of the promising future scientists (graduate students in science department of higher education) were found (by the historians in the History of Science Department of the University of Washington) to have spent their time on problem solving (lab work). Because of the urgent publication needs in the scientific community, research analysis in the laboratory is their life!! Graduate students in science departments were found not to use their library cards to borrow books as frequently as compared to social scientists...reading books is at the bottom of their pressing research needs (participating in conferences is perceived as a primary source to receive information from their peers.) In addition, in Richard Feynman's autobiography, he also addressed how little time he would spend on reading things. There are capable scientists who have already secured position in academia, who will spend lots of time on reading, yet...that's a relatively small proportion! This is not to suppress the importance of reading, I guess scientists have their own approach to absorb information, it's just that I would be very interested in what supports your argument!

Response From Dr. Metzenberg

Dear Dr. Wang:

Thanks for your note.

My evidence? I'm an eyewitness.

I am a scientist, am married to a scientist, and grew up with a scientist father. I know the field and the habits of people who succeed or fail. Graduate students bear a tremendous burden of absorbing content from reading and from attending seminars (i.e. direct instruction), and any grad student who is unaware of what others are doing and have done in the field will not survive long in school. While grad students (and post-docs) spend a great deal of time at the bench, as you point out, the fraction of their knowledge that is learned "by hands-on discovery" is very small compared to the fraction that is learned by reading or attending seminars. The benchwork that they do is often highly specialized, and they must rely on explicit instruction to absorb the bulk of their field. By the way, you cannot compare the rate at which scientists and social scientists check out books - scientists read journals, which they are generally not allowed to check out, and they may have their own subscriptions to important journals. The science book sections in university libraries are usually small and out of date for this reason. If you have read Feynman's lectures, and have noted the pace with which students at Caltech were expected to absorb physics, I think you will agree that Feynman was not a constructivist. Feynman took pleasure in explaining things well, and in demonstrating fundamental principles of physics, but he did not suffer fools gladly and expected his students to know a tremendous amount when they walked into his classroom. Pasadena public schools use FOSS and STC kits as their sole curriculum in elementary and middle schools, and have done so since about 1992. Do you know

how many Pasadena district students were accepted to Caltech this fall? Only one! With a strict textbook-free program in the early years, Pasadena students have little to no chance of attending a prestigious school in their own backyard. They're washed up before they even have an opportunity, and these poor kids are often the children of Caltech professors. If Feynman were alive, he would have led the scientific community's opposition to the Benchmarks and NSES. People who knew him have told me this.

Response From Dr. Wang

Dear Stan:

You are a scientist, we don't do "eyewitness" in scientific field, we collect data, analyze data then try to interpret what the findings mean. Yes. It is crucial for scientists to use the scientific knowledge they have gained from journal articles and past training (instruction) (Notice that not every scientific training in higher education now is direct instruction...things have been changed! Innovative instructional approaches have been reported at Harvard, Berkeley, and elsewhere in European institutes.) All your observations about graduate students are precisely as described (as to being torn by assignments from various lectures) they read because they were assigned...but interviewing them you would find how much they appreciate those reading assignments. Moreover, it really does not match what you had said in your post, from my interpretation of what you described, you equate the working scientists to "reading" scientists.

Scientists need to be at their benches, in the field to conduct their research. Whenever they have intellectual blocks, they try to collect/absorb "knowledge" through interacting with other scientists (maybe find clues from journal articles, attend conferences, dialogue with peers,

or simply go to their mentors to seek guidance.) Sitting down to read is such a luxury to them. Yes, intellectual people LOVE reading, yet, when you have a deadline to meet to publish those years of hard research before others do so, you've got to seek the fastest path to gain your knowledge.

This is why sometimes we need to think about our science instruction and using a different approach to keep up with this fast growing information society. We have come to face a very different competitive scientific community, even with the advancement of technology, we cherish reading when we have the chance, and yet, reading is only one of the building blocks to build background knowledge...

New ways to approach information are emerging everyday. Reading is still a wonderful thing, yet, remember that we are trained scientists who have a passion for what we are doing. In K-12 science classrooms the kids (in Pasadena school district, for example) were born in a very different time compared to us. They question authority (we usually followed what teachers said, not them, they do not do that anymore). They want a reason for doing any task! Life is full of choices for them today, they even prioritize school subjects based on what they need (or what they think they need)! Science teachers in K-12 today have to help these students build up their "passion" for science...if things are not interesting enough, and fail to engaged their interest in the first place, you've lost them and probably for good. Wouldn't you want to help more youngsters to cultivate the "passion" that you have for scientific discoveries; understanding scientific research, and have the momentum to carry on "reading" more scientific books; wanting to stay with PBS's wonderful science programs instead of switching to dumb TV soap operas; to continue to appreciate the natural phenomenon after they are done with schooling?

If you have visited SEED classrooms, you would have known why things were not working well in those schools. It is not that the kits-based science instruction failed to attract or engaged students in the affective domain of science learning. It is the science teachers who they've attracted in Pasadena and have very little science background/subject knowledge (as the same everywhere in this country, elementary science teachers simply have a deficit in science). When they need to go further to have serious scientific learning after the kits-activity, they become panicked and most frequently they skip this step!! Yet, how could one blame them...it's the teacher colleges that have failed them, it's the policy makers who have disappointed them. We as a nation have not come to an agreement of what should be the standards or core knowledge in science classrooms, therefore, we failed at the front end of pre-college science education. Those who enter science departments are only a small portion, and they rarely become science teachers. We have failed to promote scientific literacy early on in middle schools, and in college the potential science teachers may never have any science beyond the fuzzy "general science study."

Kits-based instruction has its outstanding effects but needs lots of capable teachers to make it meaningful! If they have substantial subject knowledge, and if they have sufficient training they would be comfortable in conducting serious post-lab discussions with students (like scientists do after their lab work).

In summary (gosh, I am talkative this morning, must be the coffee!), just hope to communicate this notion of being "polarized" in educational policy, we as a nation have tried to reform science education for nearly 50 years, every time an innovative approach was carried out successfully on a small scale, there was never any follow-through because it was "miscarried" through political undercutting! In scientific research, once a finding has been reported, other

scientists would go for it after the findings went through peer review. You may argue that educational research sometimes fails to be rigorous enough as compared to scientific research...yet, sometimes the approach to research in social science just cannot be judged based on scientific standards in natural science. Kits-based curriculum, inquiry or project-based learning, problem-based learning have their research findings to support powerful effects in learning science; the same as reading the history of science (i.e., Harvard Project Physics). These approaches have shown powerful effects, we should not erase them simply because they were not carried out properly. Our nation has enough disagreement already, we need to be open-minded especially those of us at the front end of political venues. Using a less rigorous scientific design to retest what other scientists found in their experiments and then to claim the other scientists were wrong is not acceptable in the scientific field, then why it should be the case in social science?

It's been a wonderful discussion! Thank you!

best for now,

HsingChi

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The Most Important Science Process Skill Dr. Stan Metzenberg, CSU Northridge
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It has become fashionable in science education to mold K-12 students around an idee fixe [obsession] of a modern scientist; formulating hypotheses, observing measuring, and discovering through hands-on investigations. What has been left unsaid is that real scientists don't actually spend very much of their day "observing" and "measuring." They read! Reading for understanding of content is the core process skill of science, and there is no substitute for practice at an early age. Consider the changing emphasis that California has placed on reading skills in the past 20 years. In the 1978 California Science Framework, the issue of reading in science instruction was discussed in depth in an appendix, and the promotion of specific science vocabulary was a key point. In the 1990 California Science Framework, which mercifully is being rewritten this year, the importance of science vocabulary was discounted and analyses of the type included in the 1978 framework were denounced. Many of the popular hands-on kits in current use provide no reading materials for students at all, and this is the fulfillment of the constructivists' dream. For everyone else it is a nightmare. A student who has not developed the skill of learning through reading has no professional future in science. Without a foundation in scientific vocabulary and with minimal knowledge of scientific fact, their words bear an accent of ignorance that is impossible to conceal and nearly impossible to remediate. While young people should be encouraged to enter science, they must also be given the education that will permit them to succeed. Hands-on investigative activities ought to be sprinkled into a science program like a "spice"; they cannot substitute for a "main dish". The best "hands-on" program would be one in which students can get their "hands on" an informative textbook!

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The California Content Standards are available at: http:.//www.k12standards.org.