You Can Always Look It Up — Or Can You?

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Fifty-eight years ago when I was in ninth grade, I attended a progressive school in New Orleans called Metairie Park Country Day School. If you saw the movie "Auntie Mame" with its Park Avenue version of my progressive experience, you will know that progressive theories in the 1940s were mainly confined to private schools; they hadn't seeped very far into the public-school domain. At Metairie Park, my entire 9th-grade curriculum consisted of two "integrated," "multidisciplinary" projects, as they would now be called. They were: participating in the school production of Gilbert and Sullivan's "The Mikado," (I can still sing many of the solos and choruses by heart), and building a complicated scientific instrument called a "phonodyke. "I was excused from ordinary classes. It was great fun. Fortunately for my education, I spent just one year at that school. My earlier years had been very fruitful ones spent in a regular public school in Memphis, Tennessee, the Lennox school, where we studied Shakespeare in fourth grade.

The progressive theory that students should gain knowledge through a limited number of projects instead of by taking courses in separate subjects is based on the following reasoning. If you learn a bunch of facts in separate, academic courses you will passively acquire a lot of inert, fragmented knowledge. You will be the victim of something called "rote learning. "But if you engage in integrated, hands-on projects you will achieve integrated, real-world knowledge. By this more natural approach you will automatically absorb the relevant facts you need.

To pursue a few projects in depth is thought to have the further advantage of helping students gain appropriate skills of inquiry and discovery in the various subject matters. One will learn how to think scientifically, mathematically, historically and so on. One will learn, it is claimed, all-purpose, transferable skills such as questioning, analyzing, synthesizing, interpreting, evaluating, analogizing, and, of course, problem-solving — important skills indeed, and well educated people possess them. But the consensus view in psychology is that they are gained mainly through broad knowledge of a domain. Intellectual skills tend to be domain-specific. The all-too-frequent antithesis between skills and knowledge is facile and deplorable. In any case, with these abstract skills in hand, the theory goes, one is prepared for a lifetime of learning. Any specific facts that you didn't gain you can look up later in a reference book or, nowadays, on the Internet. Broad, factual knowledge, it is said, is mostly pointless because the facts will be "out of date" within five years. Last January, an education professor was quoted as saying that "detailed information need no longer be taught because it can easily be garnered from the computer and the Internet."[1] "You can always look it up" has always been a watchword of the progressive approach. Certainly, preparation for a lifetime of learning is one of the most important purposes of schooling. In a changing world we cannot learn in school everything that we need to know in life. This has always been true and is undoubtedly even more true today. But the important question is, how do we best prepare our students for lifelong learning? Is the in-depth study of a few topics, practice with a variety of "thinking skills," and access to the Internet the best formula? Cognitive psychology suggests it is not.

There is a consensus in cognitive psychology that it takes knowledge to gain knowledge. Those who repudiate a fact-filled curriculum on the grounds that kids can always look things up miss the paradox that de-emphasizing factual knowledge actually disables children from looking things up effectively. To stress process at the expense of factual knowledge actually hinders children from learning to learn. Yes, the internet has placed a wealth of information at our fingertips. But to be able to use that information — to absorb it, to add to our knowledge — we must already possess a storehouse of knowledge. That is the paradox disclosed by cognitive research.

Take for example some research conducted by Professor George A. Miller and his colleagues, who studied what happens when children actually do look things up. George Miller is one of the great pathbreaking figures in cognitive psychology. In 1987, he and Patricia Gildea published a report on children's learning that included some experiments in their use of a dictionary to learn word meanings.[2]

The normal child's aversion to doing this, Miller found, was amply justified. In the time it took children to find the dictionary word and construe its meanings they usually forgot the original problem context and never found their way back. They mainly experienced frustration. That difficulty was exacerbated by the inherent uncertainties and ambiguities of word definitions. As a consequence, children consistently produced sentences like:

"Mrs. Morrow stimulated the soup." (That is, she stirred it up.)

"Our family erodes a lot." (That is, they eat out.)

"Me and my family correlate, because without them I wouldn't be here."

"I was meticulous about falling off the cliff."

"I relegated my pen pal's letter to her house."

Of course, Professor Miller is in favor of dictionaries and encyclopedias in appropriate contexts where they can be used effectively by children and adults. But those contexts turn out to be somewhat rare occasions when which nuances of meaning can be confidently understood. Reference works including the internet are immensely valuable in those constrained circumstances. But Miller has shown very well why, outside those circumstances, adults use reference resources so infrequently. His observations are well supported by other areas of cognitive psychology.

For instance, there is a domain of cognitive science called "expert-novice studies." Two of its leading figures are Herbert A. Simon, the Nobel prize winner, and Jill Larkin, who has co-authored articles on this subject with Simon. Their studies provide an insight into the paradox that you can successfully look something up only if you already know quite a lot about the subject. In these studies, an expert is characteristically a specialist who knows a lot about a field — say a chess master or a physicist, whereas a novice knows very little. Since the expert already knows a great deal, you might suppose that she would learn very little when she looked something up. By contrast, you might think that the novice, who has so much to learn, ought to gain a still greater quantity of new information from consulting a dictionary or encyclopedia or the internet. But, on the contrary, it's the expert who learns more that is new, and learns it much faster than the novice. It's extremely hard for a novice to learn very much in a reasonable time by looking things up. [3]

Simon and others point out that one reason the novice has this difficulty is that the human mind is able to assimilate only three or four new items before further elements evaporate from memory. The expert had already assimilated most of the elements being looked up, and therefore needed to pay attention only to one or two novel features which could easily be integrated into his prior knowledge. In a famous experiment by de Groot, a chess expert could learn a complex new chess position after just a few seconds exposure, whereas novices could remember very little. That was because the novices had to remember ALL the unfamiliar positions (which the human mind simply can't do) whereas the experts had to notice only a few salient departures from a wealth of positions they already knew. [4]

The analogy between the chess experiment and looking things up is quite apt. Imagine an expert and a novice looking up the entry "planets" on the internet and finding the following:

planet — any of the non-luminous bodies that revolve around the sun. The term planet is sometimes used to include the asteroids, but excludes the other members of the solar system, comets and meteoroids. By extension, any similar body discovered revolving around another star would be called a planet.

A well-informed person would learn a good deal from this entry if, for example, he was uncertain about whether asteroids, comets, and meteoroids should be called planets. A novice, even one who "thinks scientifically" would learn less. Since he wouldn't know what planets are, he probably wouldn't know what asteroids, comets, and meteoroids are. Even the simple phrase "revolving around another star" would be mystifying, since he probably wouldn't know that the sun is a star. Equally puzzling would be the phrase "other members of the solar system," since the term "solar system" already requires knowing what a planet is. An imaginative novice would no doubt make some fortunate guesses after a rather long time. But, looking things up turns out to have an element of Catch 22; you already need to know something about the subject to look it up effectively.

There's a third area of research that is relevant to looking things up, and it's especially interesting to those who are concerned with helping schools narrow the achievement gap between social classes and ethnic/racial groups. It is recent work on vocabulary. The biggest academic gap between groups in the early years — a gap which grows ever bigger — is the vocabulary gap. It's hard for a child or adult to look things up if vocabulary limitations keep them from making basic sense out of the words in the reference book or on the internet.

Betty Hart and Todd Risley, in their important book *Meaningful Differences*, have shown that enormous vocabulary differences develop between children before they they reach kindergarten. In the absence of compensatory schooling, this initial disadvantage will grow, because the low-vocabulary child will learn less than the high-vocabulary child when exposed to the same lessons.[5]

To reduce this difference requires better parenting, better preschooling, and more systematic teaching of school subjects in the early grades. Vocabulary is a reflection of knowledge. Only when children learn subjects in a cumulative way can they build up their vocabularies rapidly, and remedy their deficiencies. Specialists in vocabulary estimate that in order to understand something that is read or heard or looked up, the percentage of already-known words necessary for comprehension is around 95%.That's a rough, if simplified, principle to keep in mind. To make it worthwhile to look something up, you already need to know 95% of the words. [6]

To end this report from the research literature, I'll mention two more research programs that it will be useful to know about when you hear slogans about looking things up. Thomas Landauer is a brilliant psychologist at the University of Colorado who, with his colleagues, has made a lot of progress in devising a workable computer model of how children's minds manage to learn the meanings of as many words as they do. Many aspects of the model reflect what we know children in fact do, and it is the only successful model of the astonishing rate at which children learn the meanings of words.

Landauer's work is complicated and highly mathematical, but its essence is this. We learn and refine word meanings that we have experienced in the past even when we are not experiencing those words in the present. The mind unconsciously assigns a word that it encounters to a domain of related words, and on each occurrence of the word, the mind not only refines the meaning of the word being encountered but also the meanings of other, previously-experienced words that belong near its domain. [7]

The mind is constantly modulating and readjusting all those neighboring words, even when we're not paying attention to the process. That's the key insight about the rapid rate at which we learn words over time. Although the average rate is amazing, the process is gradual and cumulative as we experience thousands of words a day. The words that I am paying attention to refine and calibrate the meanings of previously-experienced words that I'm NOT attending to.

This means that dismissive talk about "mere facts" is hugely oversimplified. Facts, like words, are rarely inert or isolated. A child's (or adult's) mind is in a constant flurry of subterranean integration and hypothesis-making. And a person's success-rate in making sense of words and facts increases with a person's knowledge.

This fascinating work of Landauer's brings into relief a critical characteristic of human learning — its gradual and cumulative nature. We extend and refine our knowledge and our vocabulary slowly over time — but only to the extent that we have the opportunity to do so. We cannot extend our knowledge if we are not being exposed to new knowledge. Most of the unusual words which educated people know are words that are rarely heard in ordinary conversation. They are picked up in reading. We should encourage children to read in a wide diversity of topics in order to build up their treasury of knowledge and words. We should take great care in the books we make available, assign, and recommend. The ongoing, cumulative process of building knowledge and vocabulary cannot be replaced by brief incursions into the dictionary or the internet.

An advantaged 17-year-old high school graduate usually knows about 80,000 words. That means, from age one, 80,000 words have been learned in 5,840 days, which averages out to about 13 new words a day. Of course that's the average rate for an advantaged child after 16 years, not the actual rate at which new word-meanings are acquired at the end of each day. The child as listener, reader, and speaker is experiencing thousands of words every day, and is gradually enlarging and mapping a huge continent of word/meaning associations. [8]

To the extent that other forms of learning follow this same slow pattern of accretion, these results argue in favor of a broad, curriculum in the early grades, and one which would also, of course, encourage children to probe deeply into subjects that interest them. A broad curriculum builds vocabulary. The critical academic difference between advantaged and disadvantaged children is a difference in vocabulary size. Imparting broad knowledge to all children, starting in preschool, is the best way to enable all children to acquire a broad vocabulary, and, more generally, achieve equality of educational opportunity. This evidence for a broad-gauged curriculum in the earliest grades is strengthened by the finding that students cannot learn or probe deeply into material that is largely new to them. Studies show that the most effective learning environment is one that guides a student through manageable, incremental advances in knowledge. Other studies show that the most effective learning materials are those which offer the student a relatively small proportion of new content.[9]

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The progressive idea of pursuing a few projects in depth is not an implausible theory. The breadth-versus-depth problem in education is perennial and real. So is the problem of the integration of knowledge. Any teacher of science who fails to offer concrete experiences that manifest the feel and heft of things is missing a big opportunity for helping students gain conceptual insight. Any teacher of early math who doesn't challenge students with real-world problems that require a translation back and forth between the physical world and the abstract relations of math is leaving out an essential element of good math teaching.

But teachers prove every day that lively teaching techniques which motivate students and enhance their active participation in learning are entirely consistent with imparting broad knowledge effectively to young children. The best teaching methods do not have to be coupled with an anti-fact or anti-academic mentality.

Lively teaching is quite consistent with making sure that a broad yet selective array of topics is taught and learned in each subject, so that students will not be ignorant at graduation of key topics like photosynthesis.

Unfortunately, this moderate position on combining lively teaching techniques with broad knowledge is considered a cop-out by progressivists who caricature the teaching of facts as "rote learning," and "inert" knowledge. Teachers at Core Knowledge schools, where there is an emphasis on broad factual knowledge, as well as on lively teaching, have uniformly observed that their students haven't become rote-learning robots after all. On the contrary, factual knowledge has made them more engaged and curious than they were before. On museum visits teachers notice the difference between kids who formerly ran around randomly pushing buttons, and saying "gross" when they saw invertebrates, and children who become deeply absorbed in the museum experience because they have learned what vertebrates and invertebrates are.

Breadth, as it turns out, is not the enemy of depth. According to independent evaluations of Core Knowledge schools conducted by Johns Hopkins researchers, Core Knowledge students use the library and look things up more than control students, because they have gained selectively broad knowledge in history, and science, and literature. Knowing about the Nile river makes them want to learn more about the Nile, and their breadth of knowledge enables them successfully to look things up. Since they already know something about the Nile and Egypt, they are able to contextualize what they find out when they do look it up.

This brings me to the last example of research on looking things up. One of the most important principles of psychology is that knowledge builds on knowledge. The more you know, the more readily you can learn something new, because you have a lot more analogies and points of contact for connecting the new knowledge with what you already know.

Another way of stating this is simply to say that the more you know, the smarter you are. Our students become more intelligent when they know more. So does everybody. Researchers have been telling us this fact about human intelligence for many years. Intelligence increases with knowledge. General knowledge is the best single tool in a person's intellectual armory.

It's often asserted that a student's home environment and socioeconomic status are the dominant factors in determining school achievement. But it turns out that an even more important factor is a student's breadth of general knowledge. The correlation between academic achievement and socioeconomic status (.42) is only about half the correlation between academic achievement and general knowledge (.81). "MERE facts" indeed! General knowledge proves to be more important for learning than parents, peers, and neighborhood combined (though of course those factors influence one's breadth of knowledge).[10]

So I'll close with a little anecdote. A few days ago, a student asked me to fill out a recommendation form for admission to my university's school of education, where disparagement of "mere facts" may still be heard. Nonetheless, the very first item on the admissions form asked for an estimate of the candidate's breadth of knowledge. This is standard practice on admission forms, because studies have shown that general knowledge is the single most reliable index to a person's ability to perform a variety of tasks. I wouldn't have noticed this glaring inconsistency if I hadn't been writing this piece, and clearly the contradiction hasn't struck anyone in the education school. To avoid contradiction, our ed schools will need to change their anti-fact slogans or they will need to change their admisssion forms. It's clear from the consensus of scientific opinion that it's the anti-fact slogans that ought to be changed.

In sum, anti-fact slogans and the polar oppositions between breadth and depth are misleading. Readiness to learn means already knowing a lot of what you are trying to learn. Learning to learn is not an abstract skill. It entails already having the preparatory knowledge that enables further learning to occur. Possession of this enabling knowledge is the most reliably accurate meaning that can be attached to the term "learning to learn."

Hence the current discussion of the "Digital Divide" — the inequalities in access to computer technology — does not go deep enough. To give all children a chance to take advantage of the new technology means not only seeing to it that they have access to the technology but also ensuring that they possess the knowledge necessary for them to make effective use of it. Our responsibility as educators is to define the knowledge our students need and — through a lively variety of pedagogical techniques — to help them master it. If we don't, the Internet will only exacerbate the "Matthew effect. "Those who know a lot will be able to learn a lot more. Those who know little will add little, and will will face instead a frustrating confusion of information that they will be unable to sort, evaluate, or absorb. We must not let that happen. We must start early, in pre-school, to build the fund of knowledge that provides the only real chance for bridging the digital divide at its more profound level.

If we teachers convey general knowledge to our students in a coherent and effective way, and encourage them to read widely, we will give them the tools they need for lifelong learning. We will truly enable them to look things up.

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1. Quoted in the Greensboro, North Carolina "News and Record," January 2, 2000, by Charles Davenport, in a review of "The Conspiracy of Ignorance," by Martin Gross.

2. G. A. Miller and P. Gildea, "How Children Learn Words," "Scientific American," September, 1987, pp. 94-99.

3. J. Larkin, H. A. Simon, et al, "Expert and Novice Performance in Solving Physics Problems," Science," 208, (1980), 1335-42.

4. W. G. Chase and H. AS. Simon, "Perception in Chess," Cognitive Psychology, 4, (1973), 55-81.

5. Betty Hart and Todd Risley, "Meaningful Differences," Baltimore, 1995.

6. B. Laufer, "The Lexical Plight," in J. Coady and T. Huckin, eds., "Second Language Vocabulary Acquisition," Cambridge, England, 1997.

7. A useful summary can be found in: T. Landauer and S. Dumais, "How Come You Know So Much?From Practical Problems to New Memory Theory," in D. Hermann et al., eds., "Basic and Applied Memory Research," Vol. 1, Mahwah, NJ, 1996.

8. Computations from several sources converge on 80,000 words, and Miller (1987) estimates twice that rate for high-vocabulary children.

9. Wolfe, M., B. Schreiner, M. E., Rehder, B.,Laham,D., Foltz, P. W., Kintsch, W. & Landauer, T. K (1998). Learning from text:Matching readers and texts by Latent Semantic Analysis. Discourse Processes, 25, 2&3, 309-336.See also B. Rosenshine and R. Stevens, "Teaching Functions," in M. Wittrock, ed., "Handbook of Research on Teaching," New York, 1986.

10. D. Lubinski and L. G. Humphreys, "Incorporating General Intelligence into Epidemiology and the Social Sciences," in "Intelligence," vol. 24 (1997) pp.159-202.