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TURNING LEARNING RIGHT SIDE UP

PUTTING EDUCATION BACK ON TRACK

RUSSELL L. ACKOFF • DANIEL GREENBERG

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Learning and Teaching

Education is an admirable thing, but it is well to remember from time to time that nothing that is worth learning can be taught.

—Oscar Wilde

Confusing Learning with Teaching

Traditional education focuses on teaching, not learning. It incorrectly assumes that for every ounce of teaching there is an ounce of learning by those who are taught. However, most of what we learn before, during, and after attending schools is learned without it being taught to us. A child learns such fundamental things as how to walk, talk, eat, dress, and so on without being taught these things. Adults learn most of what they use at work or at leisure while at work or leisure. Most of what is taught in classroom settings is forgotten, and much or what is remembered is irrelevant.

In most schools, memorization is mistaken for learning. Most of what is remembered is remembered only for a short time, but then is quickly forgotten. (How many remember how to find a square root or ever have a need to?) Furthermore, even young children are aware of the fact that most of what is expected of them in school can better be done by computers, recording machines, cameras, and so on. They are treated as poor surrogates for such machines and instruments. Why should children—or adults, for that matter—be asked to do something computers and

related equipment can do much better than they can? Why doesn't education focus on what humans can do better than the machines and instruments they create?

When those who have taught others are asked who in the classes learned most, virtually all of them say, "The teacher." It is apparent to those who have taught that teaching is a better way to learn than being taught. Teaching enables the teacher to discover what one thinks about the subject being taught. Schools are upside down: Students should be teaching and faculty learning.[4]

After lecturing to undergraduates at a major university, I was accosted by a student who had attended the lecture. After some complimentary remarks, he asked, "How long ago did you teach your first class?"

I responded, "In September of 1941."

"Wow!" The student said. "You mean to say you have been teaching for more than 60 years?"

"Yes."

"When did you last teach a course in a subject that existed when you were a student?"

This difficult question required some thought. After a pause, I said, "September of 1951."

"Wow! You mean to say that everything you have taught in more than 50 years was not taught *to* you; you had to learn on your own?"

"Right."

"You must be a pretty good learner."

I modestly agreed.

The student then said, "What a shame you're not that good a teacher."

The student had it right; what most faculty members are good at, if anything, is learning rather than teaching. Recall that in the one-room schoolhouse, students taught students. The teacher served as a guide and a resource but not as one who force-fed content into students' minds.

There are many different ways of learning; teaching is only one of them. We learn a great deal on our own, in independent study or play. We learn a great deal interacting with others informally—sharing what we are

learning with others and vice versa. We learn a great deal by doing, through trial and error. Long before there were schools as we know them, there was apprenticeship—learning how to do something by trying it under the guidance of one who knows how. For example, one can learn more architecture by having to design and build one's own house than by taking any number of courses on the subject. When physicians are asked whether they learned more in classes or during their internship, without exception they answer, "Internship."

In the educational process, students should be offered a wide variety of ways to learn, among which they could choose or with which they could experiment. They do not have to learn different things the same way. They should learn at a very early stage of "schooling" that learning how to learn is largely their responsibility—with the help they seek but that is not imposed on them.

The objective of education is learning, not teaching.

There are two ways that teaching is a powerful tool of learning. Let's abandon for the moment the loaded word "teaching," which is unfortunately all too closely linked to the notion of "talking at" or "lecturing," and use instead the rather awkward phrase, "explaining something to someone else who wants to find out about it." One aspect of explaining something is getting yourself up to snuff on whatever it is that you are trying to explain. I can't very well explain to you how Newton accounted for planetary motion if I haven't boned up on my Newtonian mechanics first. This is a problem we all face all the time, when we are expected to explain something. (Wife asks, "How do we get to Valley Forge from home?" And husband, who does not want to admit he has no idea at all, excuses himself to go to the bathroom; he quickly Googles MapQuest to find out.) This is one sense in which the one who explains learns the most, because the person to whom the explanation is made can afford to forget the explanation promptly in most cases; but the explainers will find it sticking in their minds a lot longer, because they struggled to gain an understanding in the first place in a form clear enough to explain.

The second aspect of explaining something that leaves the explainer more enriched, and with a much deeper understanding of the subject, is

this: To satisfy the person being addressed, to the point where that person can nod his head and say, "Ah, yes, now I understand!" explainers must not only get the matter to fit comfortably into their own worldview (that is, into their own personal frame of reference for understanding the world around them), but they also have to figure out how to link their frame of reference to the worldview of the person receiving the explanation so that the explanation can make sense to that person, too. This involves an intense effort on the part of the explainer to get into the other person's mind, so to speak, and that exercise is at the heart of learning in general. For, by practicing repeatedly how to create links between my mind and another's, I am reaching the very core of the art of learning from the ambient culture. Without that skill, I can only learn from direct experience; with that skill, I can learn from the experience of the whole world. Thus, whenever I struggle to explain something to someone else, and succeed in doing so, I am advancing my ability to learn from others, too.

This aspect of learning through explanation has been overlooked by most commentators. And that is a shame, because both aspects of learning are what makes the age mixing that takes place in the world at large such a valuable educational tool. Younger kids are always seeking answers from older kids—sometimes just slightly older kids (the 7 year old tapping the presumed life wisdom of the so-much-more-experienced 9 year old), often much older kids. The older kids love it, and their abilities are exercised mightily in these interactions. They have to figure out what it is that they understand about the question being raised, and they have to figure out how to make their understanding comprehensible to the younger kids. The same process occurs over and over again in the world at large; this is why it is so important to keep communities multi-aged, and why it is so destructive to learning, and to the development of culture in general, to segregate certain ages (children, old people) from others.

What went on in the one-room schoolhouse is much like what I have been talking about. In fact, I am not sure that the adult teacher in the one-room schoolhouse was always viewed as the best authority on any given subject! Long ago, I had an experience that illustrates that point perfectly. When our oldest son was 8 years old, he hung around (and virtually worshiped) a very brilliant 13 year old named Ernie, who loved science. Our son was curious about everything in the world. One day he asked me to explain some physical phenomenon that lay within the realm of what we have come to call "physics"; being a former professor of

physics, I was considered a reasonable person to ask. So, I gave him an answer—the "right" answer, the one he would have found in books. He was greatly annoyed. "That's not right!" he shouted, and when I expressed surprise at his response and asked him why he would say so, his answer was immediate: "Ernie said so and so, which is totally different, and Ernie knows." It was an enlightening and delightful experience for me. It was clear that his faith in Ernie had been developed over a long time, from long experience with Ernie's unfailing ability to build a bridge between their minds—perhaps more successfully, at least in certain areas, than I had been.

One might wonder how on earth learning came to be seen primarily a result of teaching. Until quite recently, the world's great teachers were understood to be people who had something fresh to say about something to people who were interested in hearing their message. Moses, Socrates, Aristotle, Jesus—these were people who had original insights, and people came from far and wide to find out what those insights were. One can see most clearly in Plato's dialogues that people did not come to Socrates to "learn philosophy," but rather to hear Socrates' version of philosophy (and his wicked and witty attacks on other people's versions), just as they went to other philosophers to hear (and learn) their versions. In other words, teaching was understood as public exposure of an individual's perspective, which anyone could take or leave, depending on whether they cared about it.

No one in his right mind thought that the only way you could become a philosopher was by taking a course from one of those guys. On the contrary, you were expected to come up with your own original worldview if you aspired to the title of philosopher. This was true of any and every aspect of knowledge; you figured out how to learn it, and you exposed yourself to people who were willing to make their understanding public if you thought it could be a worthwhile part of your endeavor. That is the basis for the formation of universities in the Middle Ages—places where thinkers were willing to spend their time making their thoughts public. The only ones who got to stay were the ones whom other people ("students") found relevant enough to their own personal quests to make listening to them worthwhile.

By the way, this attitude toward teaching has not disappeared. When quantum theory was being developed in the second quarter of the twentieth century, aspiring atomic physicists traveled to the various places

where different theorists were developing their thoughts, often in radically different directions. Students traveled to Bohr's institute to find out how he viewed quantum theory, then to Heisenberg, to Einstein, to Schrodinger, to Dirac, and so on. What was true of physics was equally true of art, architecture…you name it. It is still true today. One does not go to Pei to learn "architecture"; one goes to learn how he does it—that is, to see him "teach" by telling and showing you his approach. Schools should enable people to go where they want to go, not where others want them to.

The trouble began when mass education was introduced. It was necessary

- To decide what skills and knowledge everyone has to have to be a productive citizen of a developed country in the industrial age
- To make sure the way this information is defined and standardized, to fit into the standardization required by the industrial culture
- To develop the means of describing and communicating the standardized information (textbooks, curricula)
- To train people to comprehend the standardized material and master the means of transmitting it (teacher training, pedagogy)
- To create places where the trainees (children) and the trainers (unfortunately called "teachers," which gives them a status they do not deserve) can meet—so-called "schools" (again a term stolen from a much different milieu, endowing these new institutions with a dignity they also do not deserve)
- And, to provide the coercive backing necessary to carry out this major cultural and social upheaval

In keeping with all historic attempts to revolutionize the social order, the elite leaders who formulated the strategy, and those who implemented it, perverted the language, using terms that had attracted a great deal of respect in new ways that turned their meanings upside down, but helped make the new order palatable to a public that didn't quite catch on. Every word—*teacher, student, school, discipline,* and so on—took on meanings diametrically opposed to what they had originally meant.

minority children coming out of primary school were functionally illiterate. The board of education's special unit on literacy had been called in but had no effect. The community's leader then sought help from a professor at a local university who had no experience with literacy problems. The leader explained that because experts could not help with the problem, maybe an outsider could.

Having worked in that neighborhood on other problems, the professor knew the young people were not dumb; to the contrary, they were incredibly street smart. Therefore, he suspected the reading deficiency was due to lack of motivation, not intelligence. Aided by graduate students, he conducted a door-to-door survey of households in the community to find out how many contained a book. More than 65 percent didn't. Furthermore, he discovered that most of the children entering school had rarely, if ever, been read to by a parent or another adult (or even seen someone read).

The culture in which they had grown up was orally oriented, not literary. Rap was an invention of that culture.

With funds obtained from the Sears Foundation, the professor purchased a set of Charlie Chaplin's silent films and had them shown during every school day in the primary school's auditorium. Students were permitted to sit in on the films at will. In a very short time, the desire for literacy permeated the school, and learning began. The students desperately wanted to read the titles in the films.

We are motivated to learn when we see those we admire and respect, even love (for example, parents), engaged in an activity that brings them great satisfaction. We try to emulate them. Faculty can serve as role models—it is in that sense that they are the most effective motivators. But then they have to be seen learning, not only teaching. Today, this is much more likely to be seen at a university where faculty are engaged in research, and students can participate in it with them. But, why does this have to be reserved for higher education? Anyone who has no desire to learn should have no involvement in the learning of others.

There can be little doubt that self-initiated learning that arises from the internal motivation of the learner is the most efficient and best retained type of learning, least likely to arouse resistance or encounter seemingly

insurmountable blocks. The question of whence motivation arises is, however, a much more controversial and critical one.

The common view, one that underpins almost all educational enterprises that have arisen over the past 150 years, is that motivation must be instilled from without, by a pedagogically sophisticated educator. This view is understandable when education is considered a way to enforce a particular social agenda on children. From the realization that such coercion inevitably arouses antagonism came the need to convince children that society's agenda is actually their own agenda, too; only then would children in school be able to learn effectively. The primary activity of schooling became pedagogy, instilling in children motivation to do what the school authorities wanted them to do (or, in plainer terms, seducing children to think they love spinach by looking for ways to cook it that would make it seem delicious to them).

The reason this has been such a dismal failure, especially as the information age unfolds, is that seduction is ultimately a poor tool for a long-term relationship—in this case, between a person and an area of study. A poignant story illustrates the point. As a young professor of physics, I worked hard to develop a set of inspirational lectures, all carefully crafted to motivate the undergraduates in my introductory course to learn a subject that was widely considered to be too hard and too dull for most students. One day, a senior walked into the office and asked to speak with me. "You have ruined my life," the senior said, with more sadness than anger. "How?" I asked. "When I was a freshman, I took your course. You made physics so interesting that I decided to major in it. It wasn't until my senior year that I realized that I am actually not really interested in the subject, and that my talents and goals lie elsewhere. Because of you, my entire college career was wasted."

In fact, pedagogical seduction that works is the exception rather than the rule. Most of the time, it just fails from the get-go.

Whence, then, does internal motivation come from, if not from someone on the outside looking for ways to instill it? The fact is that our present state of knowledge does not allow us to answer this crucial question. The source of our internally driven life goals and passions remains a mystery. Some would trace it to genetics, some to parental or family influence, some to peers, some to exposure to role models, some to random life experiences, some to supernatural inspiration. Whatever its source, its existence is undeniable and often visible from earliest childhood.

Consider the following true anecdote. One day we took our 2-year-old son for an outing to a local city zoo. We were planning something guaranteed to give him pleasure; after all, what child doesn't enjoy a zoo? He liked looking at pictures of animals in books, and he knew we were on our way to see live animals. No sooner had we alighted from the bus than he noticed the cobblestone sidewalk in front of the zoo entrance and promptly sat down to study its patterns. For well over an hour, he was wholly engrossed in looking intensely at cobblestones. We never got into the zoo.

Where did this passion for patterns come from? Certainly not from anything he had heretofore encountered, as far as we knew. It was a new delight, offered to him purely by chance, and one that resonated with something deep within him. As a young man, he became a passionate art photographer, focusing in particular on the myriad patterns that the world around him offered. How did this determined internal motivation arise?

Most people have similar, possibly less-eccentric, stories in their lives. The key role of an educational system devoted to enabling children to develop their interests is to provide a setting in which the various internal motivations each child possesses can flourish into active pursuits. It is not the role of adults to attempt to replace the motivations already present in children with others that the adults wish the children had.

What, then, are we to make of the instance cited previously, where the clever introduction of Chaplin silent movies motivated children to learn? A closer look at the story yields a different take on the situation. The adult agenda was to find a way to motivate children to learn to read. The reason the adults pursued this agenda was twofold: First, all the attempts made in the primary school classrooms had so far failed to instill literacy in the children; and, second, the adults were of the firm conviction that every person had to know how to read to function minimally in today's world, and that something had to be done actively to make sure children will be able to read.

Why all the attempts made in the classrooms failed should be clear from what I have already said. But what of the second point? Underlying it is the tacit assumption that, left on their own, children will not discover that this crucial element of modern adult life exists. It is somehow a "mystery" that adults know but that is hidden from children.

Suppose, however, that these same children who were exposed to the Chaplin films in movie sessions (that were, to say the least, welcome reprieves from the unspeakable boredom of classroom work) were allowed to encounter the world around them freely during the day, instead of being forced to sit in classes. If, indeed, some level of reading is critical to functioning in the world, what are the odds that children would not find this out on their own? Don't they figure out and ultimately master myriad other critical features of adult life (such as speech, social skills, using a phone or computer, driving, and so forth)? After all, reading is a simple matter of decoding a few symbols that represent spoken language. Why assume it is beyond their abilities to do on their own initiative, when they discover a need for reading on their own and are internally motivated to do so? When so motivated, they require access to printed and written material.[5]

In fact, many schools exist that have done away with reading instruction altogether; those schools allow children to come to that skill when they seek it on their own. It should surprise no one to find out that eventually all the children become readers sooner or later—some at the age of 4, some at the age of 12!—and that so-called "reading disorders" are extremely rare in such schools.

Computers and Education

Educators tout the value of computers and the Internet in their schools, primarily because they have heard that these are the tools of the future, and they want to appear modern and up-to-date. So, they bring the hardware into the schools—and then they use it in lieu of, and just like, the standard hard-copy textbooks and workbooks of old. They impose stringent limits on students' free access to these electronic paraphernalia and prescribe in detail how, where, when, and for what purpose students are to use them.

The fact is, however, that through the cyberworld, people of all ages can now link themselves directly to the most up-to-date sources of information on virtually any topic they choose to pursue. In other words, a person who wants to find out about something now has the ability to seek out world-class expertise, to access it at will, and to follow it up to whatever level of excellence desired. *There is no way that the vast majority of*

teachers, whatever their training, can ever hope to match in their classrooms what students can receive at will from sources of their own choosing. In addition, it is a simple matter for any person to link up with others having the same interests, anywhere in the world, and to engage in mutually enriching conversations and interactions that further enhance the understanding of all the participants.

No less significant is the almost infinite diversity of activities and interests accessible to all children—a diversity that stands in stark contrast to the narrowly limited field of view presented by the handful of subjects selected by anonymous pedagogues as the proper focus for all students. *By comparison to the wealth of variety available on the Internet, on CDs, on DVDs, and on a host of other storage media, the world of traditional education seems hopelessly sterile, arcane, and irrelevant.* No person who has surfed the web can ever turn back to the dry pages of a textbook, or the dry elements of a class assignment, without realizing how exciting the former is, and how drab the latter.

Even more significant is the total age irrelevance of cyberspace. Logging on does not entail disclosing your age. (Nor, for that matter, does it disclose your gender, religion, race, ethnic origin, or any other factor that has, for so long, played a major role in determining a person's relationship with those around them.) Everyone in cyberspace is a *person,* and what she or he says is, perforce, treated in the same manner as the communication of any other person.

But how can people learn to engage this new electronic universe? Don't they have to be taught the relevant techniques?

Once again, we encounter the importance of providing an environment in which accessibility, not instruction, is the chief factor. Nothing illustrates this better than an amazing experiment carried out several years ago in India by Sugata Mitra, a physicist by training, who headed the Research and Development department of the Indian Institute of Technology in Delhi. It all began when he started thinking about the following common phenomenon, all too well known to most of us past the age of 30. In his own words: "Any parent who had given his child a computer would invariably remark to me about it. I could hardly ever find an exception. Within a very short period of time, the parent would be claiming that the child was a genius with a computer. When I poked a little further, I invariably found that the child was doing things with the computer that the parent didn't understand."

What People Learn 

The content of human minds—and therefore what can be learned—falls into five classes: *data, information, knowledge, understanding,* and *wisdom*. They are not equally valuable, however, as reflected in the following aphorisms:

- An ounce of information is worth a pound of data.
- An ounce of knowledge is worth a pound of information.
- An ounce of understanding is worth a pound of knowledge.
- An ounce of wisdom is worth a pound of understanding.

Using this tongue-in-cheek metric, an ounce of wisdom is worth 65,536 ounces of data and 4,096 ounces of information. Despite this, the educational system allocates most of its time to the transmission of information, a bit to knowledge, virtually nothing to understanding, and absolutely nothing to wisdom.

Data consist of symbols that represent the properties of objects and events. For example, the address of a building uses numeric and alphabetic symbols to represent the building's location.

Information consists of data that has been processed to make it useful. Therefore, data is to information as iron ore is to iron. Nothing useful can be made out of iron ore until it has been converted into iron. Information is contained in *descriptions:* answers to questions that begin with such words as *who, where, when,* and *how many.*

Knowledge consists of answers to *how-to* questions; it is contained in *instructions*. To say New York is 92 miles to the north and slightly east of Philadelphia is to provide information. To say one can get from one to the other easily by car using the Pennsylvania and New Jersey turnpikes is to instruct, to provide knowledge—*how to* get from one place to the other.

Understanding is contained in *explanations,* answers to *why* questions. If the one providing instructions of how to go from Philadelphia to New York asks the recipient, "Why do you want to go there?" that person is asking for an explanation, and is seeking understanding of the request. Explanations consist of the *reasons* for behavior or properties.