

The success of these evaluation procedures in stimulating “have-not” students to improve performances has significance for the meaningful science and technology education for these students because of being different by virtue of a vastly different environment and lifestyle from that of the other major population groups.

No matter what is put in print to ensure that a given science and technology education program will be executed in such a way as to de-emphasize memorization and emphasize understanding in the context of real problems, if science educators do not sympathize with this approach or understand it, the outcome

may not be positive. The most important contribution of science educators must always be their ability to make interpretations, make innovations, invent their own study units, and make them close by adapting to opportunities in their classroom and living environment. They must be inventive in demonstrating examples for an idea from the resources at hand in specific situations.

Let us think, organize, and strive together as professionals so that our “have-not” (less advantaged) students can discover for themselves the value of logical inquiry, tested intuition, and the general process of innovation for themselves and their community.

For those who seek detailed information, please request same from:

Dr. R. M. Kalra

Department of Educational Measurement and Evaluation

National Institute of Education

S-82 Greater Kailash-II

New Delhi 110048

Skills in Education: A Philosopher's View

Skill and knowledge intertwine. The choice between them for education is traditionally based on concern for social stability plus the view that knowledge is superior to skill. This must change to let education accord with the need to replace knowledge with the skill of literacy and stability with the skill of democratic control.

Skills Versus Knowledge

Learning and knowledge belong to different subjects—philosophy, psychology, education, and sociology. These differ greatly from each other. In philosophy the theory of knowledge (epistemology) and of method (methodology) concern foundations—what can be known and how? This is of no relevance to education, or to psychology, or least of all to sociology. In psychology the concern is with individual ability and performance; in education it is their acquisition; in sociology it is their institutions.

Some philosophers shift their concern from knowledge to recognized skill and proficiency. Interest in this stems from concern with the problem of knowledge: knowledge claims are more questionable than skill claims. Obviously, knowledge involves skills. Even literacy is generally considered a skill rather than a knowledge, and it is vital for the acquisition of knowledge. Obviously, skill involves knowledge, it is goal-directed, and its application assumes some knowledge of ends and means.

The paradigm is language: its acquisition is the mastery of a skill plus the possession of some knowledge.

This suggests to view knowledge as a skill, the skill of answering correctly some questions. It is a reduction of all knowledge to skill. It is an error: mathematics is rightly viewed by mathematicians as knowledge and by engineers as a skill.

Despite the popularity of the view of knowledge as skill, the study of skill is still neglected. Psychological and educational studies describe specific skills and techniques of their transmission and acquisition. General studies on knowledge and learning abound, but studies on skills in general are scarce. The reason seems obvious: skills as such are mere facilities. There can be specific knowledge about them, about mastery over them, and about their acquisition. More cannot and need not be said. So philosophers suppose that there is nothing to say about skills in general; to acquire and cultivate and exercise them is specific. This is irrationalism. Do not think, do! Act! Live!

This version of irrationalism is Hegel's. It was endorsed not only by his followers. Gilbert Ryle is known for his distinction between knowing that and knowing how. Michael Polanyi spoke of skills as of personal knowledge or as tacit knowledge, to stress that the skilled are able to transmit their skills in workshops but not to explain how. Polanyi is im-

Joseph Agassi

Dr. Agassi is Emeritus Professor in the Department of Philosophy at Tel-Aviv University, Israel and at York University, Toronto, Canada.

portant, and his influence is tremendous, since he has influenced Thomas S. Kuhn, whose term “paradigm” is synonymous with Polanyi’s “personal knowledge” or “tacit knowledge,” which is not knowledge in the sense of the ability to articulate but a skill that cannot be characterized.

According to Polanyi, the practice of the acquisition and transmission of a skill profoundly differs from theorizing about it. A theory may be false, but a practice is a fact. This is his reply to the skeptic critique of rationality. Hence, theory is secondary to practice. It is partial and therefore defective. But practice is a part of reality. Practice precedes theory and may be used to validate it—never the other way around.

Objection: A new practice is often suggested by a theory. Polanyi said, no, the personal knowledge of experts decides how seriously a theory should be taken. Patent testing, too, he said, rests on the tester’s personal knowledge.

This is irrationalism: Eating precedes knowledge of nutrition; therefore, faith precedes knowledge. (Polanyi was religious.) Obviously, eating does come first; yet the theory of nutrition does help improve diets. Polanyi questions this. He contends that the choice of a theory as a practical guide is itself a practice decided by skillful decision makers.

Here is a basic impasse: Knowledge and skills always go hand in hand; it is hard to decide which of the two is the basis for the other. Viewed critically, they are corrective of each other and they can help improve each other. This cooperation is masked by the prejudices that beset learning due to the institution view of a division of labor between the inferior skilled and the venerable learned.

Knowledge and Skills as Adjustments

The scientific revolution was heralded by Sir Francis Bacon. His approval of technology is a major component of the ethos of the Age of Reason that fathered the industrial revolution. He was no pragmatist; he valued theory both intellectually and practically. The basis of the classical theory of learning of the Age of Reason is the idea of Bacon’s in the modification of John Locke: All learning is one—babes-in-arms, infants and adults, common people, travelers and researchers, Christians, Jews and pagans, they all use the same method, the inductive method of learning from experience by association.

Learning is thus polarized to the acquisition of the extant knowledge and of the new. Their mixture in infancy and in research refutes this; it holds only for instruction, since pupils’

innovations are proscribed. We adjust by imitation and invention jointly. How we adjust is unexplored. Success of efforts to adjust is not assured. Adjustments are hard to compare, except longitudinally. We are trained to be inflexible, on the presumption that it contributes to social stability.

Stability was universally admired. In the Age of Reason, this was tacitly taken as self-understood. The first to speak against stability was Karl Popper, who suggested in 1945 that it should be replaced by democratic control. This is no longer a live issue; stability in the modern world is unrealizable. (Those who speak in its favor confuse the desire for it with the wish for some regularity and for the reliability of expectations for peace and for high quality of life.)

The change from the demand for stability to one for some regularity permits adults to remain as flexible as children. Can adaptability be kept and developed past puberty? Classical rationalists answered it positively. The only obstacle to it, they said, is the prejudices acquired by instruction. This led visionaries to oppose schooling. They were in error. Schooling is a necessary evil though instruction can be eliminated almost totally; being replaced by training. Training to be critically minded is basic, since it reduces prejudice. Schools should offer training in learning.

Adjustment is complex and difficult. The adjusting child learns to behave like others. This leads to disaster. The child then learns to discriminate: adults and children differ, as do male and female, relatives and strangers, rich and poor, the strong and the weak. Discrimination is hard to learn. What makes people different? Without a good answer, discrimination is learned as adjustment: one must adjust. One of the most reactionary social thinkers ever, Erik Erikson, viewed those whose skill at social discrimination is impaired as mentally incompetent. Yet in traditional societies his theory obtains and is endorsed. Normal conduct includes skills regarding social discrimination, and these are impossible without familiarity with established rules and compliance with them. Only a century ago in the civilized world defiant women were certified as mad.

A child moving to new surroundings meets the demand for the acquisition of new knowledge and skills. There is no basic difference between adjusting the second time and the first. There is no basic difference between the acquisition of a second language and a first, except that social pressure may put the bilingual at a disadvantage, and then it may serve the bigot researcher to support irredentism despite all evidence to the contrary. As long as

one freely encounters two or more languages at an early age, one meets with no problem. But there is a problem in moving as adults to new surroundings. The reaction to this experience is mixed; it is often disgust combined with fascination, rooted in the demand for a barrier between us and them, erected in the name of social stability.

The barrier between us and them is justified by some theory that depicts us as superior, contrary to the doctrine that was called "the brotherhood of men" and that is better referred to as the siblinghood of humanity. The ancient Greeks realized that we are to them as they are to us—more or less. This led to the distinction between truth by nature, which is demonstrable, and truth by convention, which is arbitrary. The doctrine of the siblinghood of humanity is true by nature and is thus superior to the doctrine of superiority, since only truth by nature binds. This was identified as demonstrable truths. Somehow, no one ever asked: How is the doctrine of the siblinghood of humanity demonstrated? Since it was (rightly) taken for granted that all doctrines of superiority are truths by convention, the doctrine of the siblinghood of humanity was (wrongly) never questioned.

And so, the very idea that knowledge is not confined to national boundaries was taken as identical with the idea that the siblinghood of humanity is of truth by nature: hence, the distinction between German and British philosophy is bogus.

The Doctrine of Prejudice

Knowledge is universal. This is explained as due to a similarity of all intellects: "all men are created equal" (intellectually, not physically). Few examples of universally endorsed practices were known, but quite a few natural truths were. So, of theory and practice, not surprisingly the former was deemed basic. When art is viewed as employing a universal language, it was meant as praise. When skills and techniques are recognized as universal, such as scientific technology and the skills associated with it, they are praised above other skills.

In the Age of Reason, science was expected to bring peace and prosperity to the world; enlightenment was then deemed highly valuable both intellectually and practically. But this great progress can be attained only at a cost: one must give up whatever opinion one has; all bias must be renounced. This is Bacon's doctrine of prejudice. He suggested that research will not reveal the truth as long as researchers adhere to preconceived notions. Conjectures are evil, he said, since they color

perceptions and distort images of reality.

This idea is nowadays regrettably often overlooked, though ideas inherited from the Age of Reason make no sense without it. The preoccupation these days with rational degrees of belief is rooted in the conviction that entertaining a belief not based on facts is dangerous. Also, Bacon's doctrine is at the root of Marx's view of class-prejudice, of Freud's view of neuroses as prejudices hard to eradicate, and of Wittgenstein's view that clarity is important and is risked by the ambiguity of language. By this idea people refuse to admit error; error is then eliminated only through the demise of its perpetrator. It is repeatedly rediscovered by psychologists. Recently it was ascribed to Gordon Allport and to Leon Festinger.

The doctrine of prejudice was refuted by William Whewell early in the 19th century, as the result of the overthrow of Newton's theory of light (1818). Were it true, then it would never have been given up, since earlier it was unanimously endorsed. Popper went further. He said that one can never be free of all prejudice; those who deem themselves free of prejudice are the greatest offenders, since they find no need to be critical of views they consider true, and so they are prejudiced to the utmost.

Bacon contrasted instruction and study. The one is the transmission of prejudice that blocks the road to study that is learning fresh from the hand of nature. Hence, children are born researchers. In the 20th century, this led to the discovery method in education. Remarkably, this excessively simple-minded idea was taken seriously enough to be repeatedly implemented. It is monumental evidence to the strength of the hold of Bacon's doctrine of prejudice on modern science curriculum planners. The contrary opinion is also popular: national prejudices should be taught, since they contribute to social stability. It should be generally agreed that neither the total adherence to tradition nor its total rejection is a viable option. Rethinking the aim of education and the reform of the educational system is imperative.

Training to Replace Teaching

Rationalists always took this for granted: Education is most significant, and teaching is a poor substitute for learning. Why teach then? Rousseau said that since children are autonomous, we should not teach. Kant said that the aim of education is to train for autonomy. But schools suppress it. What is the best way to promote it? The advocates of the democratic school system or the open school system sug-

gest that democratic schools are the best tools for the education for autonomy.

If education is training, then training for autonomy should include training for skills for the enhancement of autonomy, moral but also economic. The transmission of skills may then replace the traditional transmission of knowledge. The following questions may then be raised: How much knowledge is needed for effective training? What skills are essential for what other skills? How can education be viewed as vocational training? The availability of pocket calculators renders detailed training in arithmetic unnecessary, unless experience shows that mathematical training requires it. Some familiarity with the national ethos is essential for the reasonably competent citizen (though with no need for indoctrination). The ability to make a simple instrument is essential for becoming a physicist just because simple laboratory operations are executed with the aid of high-tech instruments and computer programs.

The split of schools to vocational and scholarly should vanish, as well as their isolation. Educational bureaucracy and its elitism are

growing. Combining learning with industry is becoming very attractive, especially in Sweden, where job improvement, job rotation, and semi-autonomous teams are increasingly common, showing how to close the gap between the academy and industry. Study, work, and play are different activities, yet their separation is unnecessary and harmful.

Reform should transform teachers into coaches. This will remove indoctrination. The end of training in general and of every specific program should be stated and debated. The reduction of indoctrination will invite the inquiry into the possibility of prolonging adaptability quite generally. Perhaps this is just a dream, but it is too exciting not to examine it empirically.

Overcoming discrimination will eliminate barriers to adjustment. The supreme source of discrimination is schooling. This will change as schooling ceases to instruct knowledge and instead train for skills. Scholarly skills and diverse daily skills and artistic skills will be then integrated. This will go very well together with pluralist participatory democracy.

“It’s Pretty Scary”: The Traumas of Change

Paul Black

Innovation in education is a stressful and often painful process for all involved, and particularly for teachers. The quote in my title came from a teacher involved in one of 23 innovations studied in detail in a recent Organization for Economic Co-operation and Development (OECD) study of the processes of change in science, mathematics, and technology education across 13 of its member countries. I believe that a general distillation of lessons drawn from the results (Black & Atkin, 1996) contains many lessons of importance for school technology.

It is clear that, for countries all over the world, technology is “the new kid on the block” in the school curriculum. This new kid is exciting, but difficult. The JISTEC 1996 underlined this view: the numbers, over 800 delegates from 80 countries, were evidence of growth in interest, while the diversity of the presentations, and of the conceptions of school technology underlying them, was evidence of the excitement and of the difficulties. Given that, in many countries, school technology is either new or recently re-born, it follows that its future in schools depends upon the implementation of innovation and change, and so we have to look hard at the prospects for

success of innovative change. Here the omens are not encouraging: the pantheon of curriculum revolutions is crowded with the gods who failed.

One motivation for international study is that countries naturally look at the ideas and practices in other countries to see whether they can improve their own systems. There are many dangers in attempting such transfer, and the OECD work signaled the need for a more complex understanding of innovations, one which tries to understand how their growth depends on the environment of their country’s particular culture. However, six common themes emerged across the OECD cases as key issues. I shall discuss these in turn before drawing some general conclusions.

THE IMPETUS FOR CHANGE

Some countries are driven by “demons”—standards are falling, other countries stand higher in the league tables of the Third International Mathematics and Science Study (TIMSS), international competitiveness is threatened. Some press for students to be better prepared for work in employment, with well-developed general skills so that they can be flexible, learning for today’s task but well able to learn afresh as technology transforms tomorrow’s task.

Paul Black is Emeritus Professor in the School of Education at King’s College in London, United Kingdom.