Globalization and Education
Pontifical Academy of Sciences, *Extra Series* 28, Vatican City 2006
www.pas.va/content/dam/accademia/pdf/es28/es28-gardner.pdf

THE SYNTHESIZING MIND: MAKING SENSE OF THE DELUGE OF INFORMATION*

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a) From the Beginning: Synthesis

It is surely no accident that the story of human beings began when Adam was enticed to take a first bite of the fruit from the tree at the center of the Garden of Eden – the Tree of Knowledge. 'Knowing Creatures' is as good a description of our species as any. Our knowledge begins with information present at birth, as a result of our species membership and any congenital conditions that may obtain. In the early months of life, knowledge grows out of our actions upon the world and information assimilated through our several sensory organs (Piaget 1983). But as early as the second six months of life, our knowledge is already being augmented by what we learn from others, through what they do, what they show us, and what they tell us. In pre-historical times, the total sum of knowledge may well have been limited; and what was known by one generation was only barely exceeded by the following generation. Even ancient Egypt changed at glacial speed. But once writing had been invented, knowledge began to accumulate at rates that threaten to overwhelm even the most capacious human brains.

Opening our eyes and our minds to knowledge is one thing – making sense of and ordering that knowledge entails a good deal more. The Bible – as well as similar books outside the Judaeo-Christian tradition – represented an early attempt to present and synthesize knowledge about how to live. The Golden Rule and the Ten Commandments are crucial: they represent efforts to distill innumerable examples to their actionable essence. Once societies began to become self-conscious about the knowledge that had accumulated, individuals and groups attempted to set down that knowledge in ways that were systematic and that facilitated assimilation by the

next generation. In the Western tradition, the pre-Socratic philosophers were perhaps the first individuals to try to order current knowledge. Their successors, Socrates, Plato, and – above all – Aristotle, sought to order not only knowledge of how to live but also extant knowledge about the world, as it was understood at that time. Indeed, the books of Aristotle – physics, metaphysics, rhetoric, poetics, politics among many others – represent the areas of knowledge that had been delineated to that time. It is no wonder that Aristotle was known for nearly two millennia as The Philosopher; that students all over the literate world devoured and even memorized his writings; and that, to this day, subsequent efforts to codify what is known are at least loosely patterned upon Aristotle's parsing of knowledge.

The naïve may think that the ordering put forth in the Bible, or in the writings of Aristotle, is self-evident. It is anything but that. To consider vast amounts of knowledge – be it scientific, ethical, historical, or ritualistic – and to determine how best to summarize and present that synthesis represents a heroic intellectual achievement. I don't have to spell out the unfathomable amounts of material that are now present in the world's libraries or on the world wide web; indeed, if Google has its way, before too long, these repositories will be one and the same. But we should recognize the formidable line of synthesizers in the West, from Aristotle, to St. Augustine, to St. Thomas Aquinas (in many ways, Aristotle's successor) to Dante, Leonardo, the Encyclopedists of the 18th century, the Micropedia and Macropedia of the 20th century, the Wikipedia of the 21st century. No doubt non-Western authors could offer their own list. No less an authority than the Nobel Laureate polymath, Murray Gell-Mann, has asserted that in the new millennium, the most valued mind will be the one that can synthesize. Yet, one seaches in vain, in books of education or psychology, for a comprehensive account of synthesizing, and how it can be achieved.

Accordingly, in this chapter, I offer some reflections on what synthesis is, how it can be conceptualized, how it can go wrong, and how this invaluable skill might be inculcated in our students today and in the future.

b) A Definition and Some Examples

The synthesizing mind is capable of assimilating a large amount of information, data, knowledge; evaluating its accuracy and relevance for the task at hand; and putting together that information in a succinct form or format that will be useful for a particular audience – at a minimum, the synthesizer herself; more often, students, peers, or related outsiders.

Effective synthesizers achieve effective synthesis. Until recently, only human beings were capable of such syntheses. Since the advent of computers, it can be said that certain programs – be they medical, aviational, or geological – are capable of synthesis.

In one sense, all of us synthesize regularly. If I have to plan my activities for the day or the week, I need to have some kind of synthesis, if I am not to make missteps. When I am teaching a class, writing an abstract, sending an annual New Year's message, or telling others about my trip to the Vatican, I engage in synthesis. Most of us do not need formal instruction to execute these syntheses, and we can distinguish between those syntheses that inspire, and those that bore or mislead.

The most impressive syntheses are a tremendous premium. In biology, for example, Darwin's theory of natural selection represented a profound synthesis of vast amounts of information that he had gathered about the flora and fauna of the planet of his time and of the distant past. Equally important was the neo-Darwinian thesis of the 20th century, where information about genetics was linked to accounts of natural selection. In psychology, Freud's theory of unconscious motivation joined together into a single, elegant account, disparate data about dreams, slips of the tongue, humor, and neuroses. While many of the individual claims of Freud have been properly disputed, recent neurological and psychological evidence corroborates much of the general picture that he presented a century ago. In economics, Adam Smith put forth the first comprehensive account of how markets work, introducing and integrating key concepts like division of labor, the value contained in production, the laws governing supply and demand; Smith laid the ground work for subsequent, more detailed and formal accounts at the macro- and micro-economical level. No one expects that we or our students will match the achievements of these master-synthesizers. However, we can learn from these examples drawn from intellectual history, and from brief synopses contained in encyclopedias and textbooks, as we attempt to understand their achievements of integration and as we seek to produce more modest syntheses of our own.

c) Modes of Synthesis

For scholars, 'overarching theories' may constitute the gold standard of syntheses. From the past, we think of the writings of Karl Marx or John Maynard Keynes, or Max Weber. In our own era, theorists of comparable scope include the sociobiologist E.O. Wilson, the cosmologist Stephen Hawking, the economists Paul Samuelson and Milton Friedman.

But theories are just one form of synthesis. Let me mention several others:

l. *Narratives*

Perhaps the oldest form of synthesis, the narrative encapsulates persons and events through the creation of a compelling plot line. The Bible has been justifiably labeled 'The Greatest Story Ever Told'. Narratives exist in the non-fictional realm: consider *The Decline and Fall of the Roman Empire*. They exist as well in creative writing – Tolstoy's *War and Peace* offers a panoramic account of the Napoleonic Wars and their aftermath.

2. *Taxonomies*

In this form, information is organized into a coherent, often hierarchical framework, along specifiable axes. The brilliant naturalist, Linnaeus, organized the plants and animals of the planet into a coherent system that has survived, with modifications, until this day. Linnaeus relied on the phenotypical features of living matter; nowadays, gene-based taxonomies are being produced. The Russian chemist Mendeleev succeeded where the alchemists of earlier eras had failed; he was able to produce an ordered Periodic Table of the elements of the earth, based on their detailed atomic structure.

3. *Metaphors, Images and Themes*

A powerful way of synthesizing information stems from the creation of singular figures of speech or images, which capture key operating factors or principles in a memorable manner. The aforementioned master theorists created evocative metaphors: Darwin proposed the branching tree of life; Freud compared the unconscious to that portion of an iceberg that is invisible to the naked eye; Smith introduced the invisible hand that regulates the market. These synthetic achievements can be conceptualized in language or in a visual image. Historian of science Gerald Holton (1988) points out that synthesizers often base their key ideas on underlying themata of which they themselves may not even be aware. For example, both Freud and Darwin saw life as a perennial struggle between opposing forces, while Smith envisioned a harmonious society, based on principles of equitable exchange.

4. *Rules and Aphorisms*

Much of folk wisdom is captured and conveyed by short phrases, designed to be memorable and widely applicable. Across societies nearly everyone learns one or another version of the phrase 'Think before you act' 'Don't try to juggle too many balls at the same time' 'An ounce of prevention is worth a pound of cure'. Important truths in the workplace are also shared among professionals. Lawyers are taught that 'Great cases make bad law'. Scientists are counseled: 'Always replicate an experiment; and the more surprising the result, the greater the imperative to replicate'. Investors learn 'Diversify your portfolio' 'If an earnings report is too good to be true, it probably isn't'; and 'No matter how much you love a stock, if its value drops more than 10%, sell'.

5. *Key Concepts*

Fields of knowledge have key ideas which help an individual to organize a vast amount of material. In my own field of developmental psychology, a key concept is that of the 'end state'; unless you can define a skill or concept in its most developed form(s), it is not possible to study its development. In literary analysis, T.S. Eliot introduced the concept of the 'objective correlative' – the embodiment of an emotion in a particular situation, such that the reader will infer the intended emotion without its being explicitly mentioned. Biologists acknowledge the import of 'model species' – species that have been studied in detail because they are thought to embody general biological principles. That is why so much of genetics research has been based on the fruit fly (*Drosophila*), and why the basic mechanisms of memory have been elucidated in a sea slug (*Aplysia*).

6. *Embodiments in nonverbal symbol systems*

So far my examples have been chosen primarily from daily life and from academic subjects. Syntheses need not be presented in linguistic or scholastic form; indeed some of the most powerful syntheses are embodied in works of art. Consider, for example, Picasso's famous *Guernica*, in which the violent forces of the Spanish Civil War are powerfully conveyed in a single complex mural; or Hogarth's evocative *Rake's Progress*, in which the successive stages of degradation are portrayed. And at this meeting we are within a stone's throw of perhaps the most famous synthesis of the most famous

story in human history – Michelangelo's illustrations on the ceiling of the Sistine Chapel. Syntheses exist as well in other nonliterary arts: Wagner's *Ring Cycle*, Gaudi's unfinished Sagrada Familia Cathedral in Barcelona, Stravinsky's ballet *Le sacre du printemps*, Martha Graham's modernist recreations of Southwest Indian rituals, Charlie Chaplin's *Modern Times* and Ingmar Bergman's *Scenes From a Marriage* come to mind.

d) A Strategy for Synthesizing

I have deliberately chosen syntheses that are well known and are drawn from a wide range of disciplines and art forms. After the fact, and after much exposure, they may appear to have been natural, even inevitable. In truth each represents a huge effort, achieved against the odds after many tries. Only with the appearance of studies like Howard Gruber's examination of Darwin's notebooks (1981) or Rudolf Arnheim's (1962) examination of the dozens of sketches that preceded the completion of *Guernica* can we appreciate the struggles that antedate powerful syntheses. For the novice, a synthesis provides a powerful entry point into a complex terrain; for the expert, a synthesis evokes many fecund trains of association.

It is possible to de-mystify the achievement of a synthesis – at least in part – by providing a retroactive look, by attempting to reconstruct what is entailed in such an achievement. I designate four components:

1. *Goal*

The synthesizer is engaged in some kind of project, either one assigned by others (paint this ceiling, please!) or one assigned to oneself (on my voyage on the Beagle, I am going to survey species scattered around the globe and attempt to make sense of that variety). The goal of the project may – indeed probably is – somewhat vague at the outset. It may be reformulated partially, or even wholly, in the course of work. But one cannot even commence a synthesis unless one has at least a rough 'end-target' in mind.

2. *Starting Point*

Whatever her goals, the synthesizer needs a starting point – in metaphoric terms, a plot of dry land. This point of departure may be earlier syntheses, powerful questions, incomplete or inadequate accounts, a dis-

agreement with a current synthesis. Though the page may be literally blank, it is never blank metaphorically – indeed, earlier instantiations may constitute an obstacle, even as they may be extremely powerful and yet flawed in some fundamental way. Only a fool pays no attention to what has been done before.

3. *Selection of Strategy, Method, Approach*

This choice is probably the key decision made by the aspiring synthesizer. In what form or format will the synthesis appear? What is the epistemic form or frame? (Perkins, 1997) And how will the synthesizer go about moving toward the synthesis? Most commonly, and entirely appropriately, the synthesizer falls back on the tools-of-the-trade of his discipline or profession. These can range from the logical analysis of the philosopher, to the interpretation of texts by the literary critics, the execution of pilot studies by the biologist, the maintenance of notebooks, sketchpads, and diaries by the draughtsman or the novelist. In most cases, recourse to and use of these methods should be second nature, the achievement of years of journeyman practice. But there is no guarantor that the traditional skills of the trade will prove adequate to the task at hand. And so the use of the method must always be tentative, subject to revision or even, on occasion, rejection.

4. *Drafts and feedback*

At a certain point, or perhaps at many points, the synthesizer must take an initial crack at the synthesis: the abstract of the paper, the outline of the lecture or chapter, the modello for the building or statue. This 'first stab' can even be a provisional synthesis in itself. We know from the notebooks of the aforementioned individuals – Picasso, Freud, Darwin, Graham *et al.* – that first drafts attempts are often primitive. At the same time, however, they may contain the nucleus of the final version – the key image, metaphor, theme or concept. The philosopher Charles Sanders Peirce (1955) claimed that these shrewd guesses involved a special mental power that he termed 'abduction'.

Crucial at this point are relevant critiques and feedback. Early in an individual's career, the input of others who are more expert is highly desirable. With time, the synthesizer may well be his or her best critic. The difference between the rough sketch and the final product is crucial, however,

and the distance is rarely traversed in the absence of expert criticism. Ezra Pound's critique and editing of Eliot's *The Waste Land* was so expert that Eliot dedicated the poem to Pound, with the appreciative descriptor 'the superior maker'.

Traditionally, across many fields, mastery and synthesis occurred through a combination of apprenticeship and self-education. Indeed, several of the aforementioned synthesizers employed both modes. Once a field achieves a certain level of complexity and maturity, however, one cannot become an expert without formal training. Education has seldom been examined from the perspective of synthesizing, however. In what follows, I first sketch out the general lines of an educational regimen that I favor, and then revisit that regimen through the lens of synthesizing.

e) A Snapshot of Schooling through the Lens of Synthesizing

During the preschool years, the young child has little trouble synthesizing. Making connections, tying ideas and images together, are her natural mode of cognizing. Only two limitations are manifest. First of all, the child's knowledge base is thin, and much of what she knows is erroneous. After all, we did not evolve as a species to have correct knowledge of the world; we evolved to live long enough to reproduce. Second of all, the child's synthesizing – if I may call it that – is uncritical. Some of the figures and the connections made by young children are beautiful, inspired, worthy of quotation; but many of them are simply quirky, without any lasting merit.

After the first five or six years of life, children's connection-making becomes much less adventurous. In our own work, we have spoken about the emergence of the 'literal stage' (Gardner and Winner,1982). Whether it is playing a game, speaking properly, learning an instrument, or doing sums and 'word problems', the growing child wants to know the exact rules. Free flowing metaphor-making and image construction cease. It is tempting to attribute this decline in integration and synthesis to school. But it is just as likely that formal schooling begins all over the world precisely because youngsters of this age are ready, even eager, to learn the 'right way' to do things.

All over the modern world, a general educational sequence is followed, and with good reason. During the primary years, young students learn the basics. Traditionally, these are reading, writing, and basic arithmetic; nowadays, many places would add the use of the computer. Once the three Rs

have become relatively fluent, students are ready to master the major subject matters or disciplines of their culture. Whereas this mastery once featured religious texts and practices, nowadays the emphasis falls on science, more advanced mathematics, history, foreign languages, and, perhaps, one or more art forms.

I term this phase 'disciplinary mastery'. It is and should be the major burden of middle and secondary school. But the delineator of disciplinary mastery engenders controversy. In many places, such mastery involves the learning of facts and figures. In others, the emphasis falls on carrying out certain practices – writing a coherent essay, carrying out experiments in the laboratory, executing a work of art. Less frequently, students come to master a particular way of thinking: what it means to think like a scientist (relating findings to theory), a historian (acknowledging human agency, avoiding 'presentism'), an artist (organizing materials so they capture a meaning that can be apprehended by diverse audiences) (Gardner 1999).

The ways in which disciplinary mastery is approached determines whether synthesizing is featured or ignored. Students may be presented with one synthesis – that favored by the teacher or the textbook. Students may be given lots of information and asked to make sense of it – thus creating their own syntheses. All too often, the challenge of synthesis is ignored or minimized or assumed to coalesce on its own. Under the latter, unsupported circumstances, the muscle of skilled synthesis is most unlikely to develop.

Nowadays, in the world of practical knowledge, work across the disciplines – which I will tentatively label as cross-disciplinary work – is at a premium. Sometimes, the term is applied to scholastic work that involves more than one discipline, sometimes to professional collaboration in which different experts rub elbows with one another – for example, a medical team involving physicians, nurses, therapists, social workers and the like. To be skilled at either kind of cross-disciplinary work requires the capacity to synthesize knowledge and draw on its flexibly.

In our own work, we find it useful to distinguish among three species of cross-disciplinary synthesizing. Much of this work is best characterized as *multi-disciplinary*. An individual first studies a topic (like the Renaissance) through history, then through science, then through the arts. The teachers and texts make no effort to tie together these disciplinary perspectives; if connections are to be made, they are left to the wit of the student.

Much more challenging is genuine *interdisciplinary work*. In such work, an individual studies a problem or topic through more than a single disci-

pline and seeks to combine – in our term, to synthesize – these perspectives as a means of achieving deeper understanding. The ultimate understanding should be greater than the sum of its parts. For example, appreciation of the achievement of linear (geometric) perspective in the paintings of Renaissance art should be enhanced if the student approaches the issue through the study of artistic history, of geometric principles, of technical instruments. Challenging to achieve, interdisciplinary understanding can be extremely rewarding.

We can distinguish, roughly, among several forms of interdisciplinary thinking. The example of artistic perspective reflects one form, growing out of a realization that a phenomenon is too complex to be elucidated by a single discipline. A second form arises from the need to attack a pressing practical problem. For example, the reduction of poverty cannot be tackled simply by economical analysis. This ambitious goal requires understanding of cultural influences and traditions, individual psychology, political pressures and opportunities. A third form of interdisciplinarity involves a determination of whether a concept or method can be applied across diverse disciplinary contents. For example, once complexity theory had been developed in mathematics, efforts were launched to apply it in a range of fields, from physics and biology to economics and history (Gell-Mann, 1995). Yet another form involves contextualization: the propounding of a scientific theory, like Darwinian evolution or Einsteinian relativity, can be better understood in light of the intellectual and material conditions present in the world at the time of its initial statement.

A mere statement of these varieties of interdisciplinary thinking suggests that their achievement is challenging. Not that many educators are comfortable with more than one discipline. Even those who have achieved comfort may not know the best way to share their expertise with students. For their parts, students are struggling to master the knowledge and procedures of single disciplines; it may be too much to expect that they can synthesize disciplinary strands, even with help.

Yet, the press for interdisciplinary synthesis is unlikely to abate. The question becomes: how can we meet this press, taking into account the limited knowledge and capacities of nearly all students and many teachers? I recommend the fostering of 'multi-perspectivalism', which can be thought of as an intellectually-honest precursor of genuine interdisciplinary work. This jaw-breaking term acknowledges the need for thinking across the disciplines without implying that students have mastered the individual disciplines. In a multi-perspectival milieu, students are

exposed to different approaches to a topic. In that sense, multi-perspectivalism begins with a multi-disciplinary tack. However, multi-perspectival thinking develops as the student is regularly exposed to the various disciplines, and comes to know something of their particular stance. And, crucially, while the student begins as a spectator, he or she is gradually drawn into the enterprise as a participant.

A helpful analogy in conceptualizing 'multi-perspectivalism' is the 'wearing of different hats'. Suppose that in an American history course, the instructor wants students to be able to understand historical events from the perspectives of economics, politics, and sociology. In an exposure to a first example – say, the American revolution – the student learns how the revolution has been interpreted by economists, then by political scientists, then by sociologists. A similar set of perspectives is brought to bear on Jacksonian democracy and on the events leading to the Civil War. After several 'spiral' exposures to the procedure, the student should be able to understand something of these varying perspectives, and to raise points that would be meaningful to the respective disciplinarians. And in the happiest circumstance, by the conclusion of the course of study, the student should be able to listen intelligently to such discussions, to participate actively, and perhaps even to anticipate how each disciplinarian might approach the phenomenon-under-discussion.

Note the difference between 'interdisciplinarity' and 'multi-perspectivalism'. In the former case, the student is expected to have achieved significant mastery of more than one discipline – a daunting assignment. In the latter case, the student picks up enough of the approach so that he or she can follow discussions and eventually participate in them; but there is no requirement that the student have independent mastery of each discipline. We can see the analogy at work in the practical forms of cross-disciplinary work. On an effective medical team, each of the participants has her own expertise. It is not expected that the physical therapist can do the physicians' work, or that the physician can do the social worker's job. Rather each needs to be able to understand the approach of the others sufficiently to enter into useful conversations; and should one of the experts be absent, to anticipate her possible questions, reservations, and contributions.

I do not mean to apply that the only forms of synthesis occur in cross-disciplinary courses, nor that all cross-disciplinary work necessarily entails syntheses. Still, it is true that synthesizing thinking is at a particular premium in learning that involves more than one discipline. It is here that one is likely to find the most powerful metaphors, theories, concepts, images,

and narratives. Those incapable of such thinking will find them at an increasing disadvantage in our knowledge-exploding, knowledge-connecting world.

f) Syntheses Gone Wrong

Not all syntheses are equal, and not all syntheses are accurate. In the case of young children, I have already noted their penchant for making connections, while indicating as well that these connections may stand out more for their charm than for their cogency. Syntheses can go wrong in any number of ways. To mention just a few:

1. *Insufficient Scope*

A synthesis about the Renaissance may focus excessively on the importance of exploration and neglect important intellectual, scientific, artistic, and humanistic advances.

2. *Excessive Scope*

A synthesis in the sciences may be too broad, attempting to bring together the natural sciences and the social sciences, and ending up with a set of questionable principles and misleading conclusions.

3. *Inappropriate Inclusions or Exclusions*

An attempt to explain changes in American society as a result of immigration may group together voluntary and involuntary (slave) immigrants, while failing to note that the original settlers were also immigrants.

4. *Unnecessary Syntheses*

In an effort to explain the nature of combustion, chemists in the 18th century posited the existence of a substance called phlogiston. In an effort to explain the transmission of light and heat, physicists in the 19th century posited the existence of a medium called ether. Acute thinking and experimentation by scientists eventually demonstrated that these entities were illusions, not necessary for explaining the operations of the physical world.

Persons may also be attracted to synthesizing for a variety of reasons. In happier instances, the aspiring synthesizer is curious, has read widely, likes to play with ideas, and realizes that a candidate synthesis may be appealing and yet misguided. Less felicitously, synthesizing may appeal to individuals who do not like to think precisely, who are literally undisciplined, who lack or spurn critical faculties. Correlatively, some good students also resist synthesizing because it cannot be taught and evaluated as precisely as paradigmatic, disciplinary thinking. In addition to monitoring the quality of a synthesis, one does well to focus on the motives and the scrupulousness of the would-be synthesizer.

g) Educational Recommendations

How, then, to encourage better synthesizing? To begin with, it is useful to recognize and make use of means that are primarily implicit or tacit, as well as those that are explicit. On the implicit side, it is valuable for young persons to grow up in milieus in which efforts to synthesize are regularly featured. Whether sitting around the dinner table at home, or listening to a commentator on television, or participating in some kind of informal apprenticeship, young persons benefit from 'live' examples of synthesizing by respected authorities – as well as critiques of those efforts by others who are equally knowledgeable.

Such implicit examples form an important backdrop but rarely are they adequate in themselves. For this reason, I favor explicit efforts in formal schooling to model and train the processes of synthesis. Such efforts can begin in the early years of school, when students acquire information about a topic and are asked to present their learnings in an integrated manner. Oral reports, essays, and projects serve as promising training grounds for judicious synthesizing. Students should be exposed to instructive models of synthesis, be asked to synthesize, and receive useful, pointed feedback on their efforts.

Students can also learn explicitly about synthesis. They can be introduced to distinctions of the sort that have been presented in this paper. For example, they should understand the importance of a goal; an analytic stance; one or more disciplined methods on which to draw; the value of successive drafts with suitable feedback. They should have experience in producing and critiquing various forms of synthesis – theories, narrative, metaphors, images, and the like. And they should also participate in collective efforts to critique

the syntheses made by others – whether the producers of the synthesis-in-question are well known authorities or fellow classmates.

By and large, the amount of synthesis required in college admissions tests has been extremely modest – it may amount to no more than producing the best title for an essay or summarizing its main point in a sentence or two. Far more ambitious efforts are possible. Consider a pilot program being devised by the Rand Corporation that tracks the quality of student learning in college. Students are presented with an assignment – for example, draft a position paper for a mayoralty candidate who has been challenged to lower the crime rates in his city. Students are given a variety of documents, ranging from charts of crime data to newspaper reports on heinous crimes to summaries of research results, and asked to draw on them in preparing the position paper. In an examination for becoming an elementary school teacher in France, the candidates are presented with four papers on the transition from oracy to literacy and asked to prepare a synthesis of arguments and conclusions. In the present milieu, we teach what we test for; to the extent that we have appropriate or powerful tests of synthesizing abilities, we will be stimulated to develop effective instructional methods.

h) Future Prospects

Irrespective of the faddism that may surround concepts like interdisciplinarity, skill at synthesizing is becoming an imperative for the new millennium. Those who can synthesize well will be valued; those who cannot will have to rely on the syntheses of others, and may be consigned to the lower end of the occupational and economic ladders.

Of course, it is possible that, just as much analysis is now computer-driven, much of synthesizing in the future may occur through the use of computers. Indeed, experts ranging from the designers of the World Wide Web to the impresarios of Google, are attempting to develop programs that 'understand content' sufficiently well so that valuable précis and synthesizing can be fashioned. Time will tell how expert these programs are, where they excel, and where they fall short. Still, there will be a need for individuals who can compare the strengths of various syntheses, as well as individuals who can prepare the more ambitious or more original syntheses – ones that will continue to elude even the most talented programmers.

In a paper focussing on synthesis, I have naturally stressed the importance of this needed but relatively unexamined capacity. But education cannot and should not ever be monochromatic. Within a broad study of 'five minds for the future', I have sought to locate the place of synthesis. As I construe it, synthesis occupies a middle ground between disciplined learning, on the one hand, and creative thinking, on the other. In disciplined learning, one masters the ideas and moves of particular crafts and disciplines. As I've stressed, no meaningful synthesis is possible in the absence of at least some disciplinary mastery. On the other side of an epistemological continuum, creative thinking involves an explicit rejection of current understandings, a commitment to raise new questions and produce unexpected yet appropriate answers. Creative thinking involves a foundation of disciplinary knowledge and current syntheses; but one cannot become overly dependent on the current conceptualization if one is seeking to break new ground. Nonetheless, few would question that the most valuable syntheses are often highly creative; and most would agree that even the most bold creation – that of a Picasso, a Martha Graham, an Einstein – involves a good deal of synthesis of what has come before. Indeed, creations in the later years by the most radical innovators often represent a synthesis between long-standing traditions and the recent breakthrough (Gardner 1993).

Two other kinds of minds need to be cultivated in the future. Of great import is a mind that respects other persons, including – and perhaps focusing on – those individuals and groups who seem to be different from oneself. At a more abstract level, we need to cultivate a mind that proceeds in an ethical manner: one that seeks to determine what is right for one's profession, and for one's role as a citizen, even when that course of action runs against one's self interest. At present these noncognitive minds – respectful and ethical – are more important than ever before. It does not suffice to nurture individuals who are disciplined, synthesizing, and creative, if they are not respectful and ethical as well. Perhaps, indeed, how to nurture and integrate these five kinds of minds constitutes a fundamental task for future synthesizers and for synthesizers of the future.

Acknowledgements

For their comments on an earlier draft of this paper, I thank Veronica Boix-Mansilla and Sidney Strauss. The ideas in the chapter are elaborated on in a forthcoming book, tentatively titled *Five Minds for the Future*.

Work described in this paper was supported by the Atlantic Philanthropies and Jeffrey Epstein.

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