GENERAL EDUCATION IN THE FACE OF
UNCERTAINTY: THE LIBERATING EFFECT

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General education in American colleges and universities has a long
chronicle, but a short formal ancestry. Even though the sense of
the idea and many applications can be traced through the waves of
enlightenment and eclipse that form the classical tradition of liberal
education, it is only in the twentieth century that consciously con-
structed programs of general education finally appear. The move-
ment toward such curricular expressions was part epistemological,
part intellectual, and part pedagogical, but it began (without a label)
largely as a rearguard defense of the classics. A simple effort to
insure the structure and content of the old courses of study against
the "barbarism" of the natural and social sciences gave way to pro-
grams that tried to capture the most durable concepts of the higher
learning. The liberating effect of learning on individuals was one of
these concepts. It turned out, however, that "liberation," along
with other traditional concepts, had to be reinterpreted age by age.

Perhaps it is not so strange that the wars of this century have
raised out of human chaos the sharpest questions about how man-
kind's knowledge could bring a measure of fundamental under-
standing. The context and aftermath of the First World War has-
tened the birth of the famous general education course on Western
Civilization at Columbia University. The Harvard "Redbook" of
1945, by its reconciliation of older heritage and newer science, ad-
dressed in full scope the issues raised by totalitarianism and World
War II. At Massachusetts Institute of Technology a distinctive and
often overlooked approach to general education, the humanities se-
quence, came forward as a product of the atomic age and the Korean
War. Finally, in the resurgent discussions of general education dur-
ing the 1970s one can discern overtones of the moral challenges of
the Vietnam War. The many rationales for formal programs of gen-
eral education are summarized by Levine and Thomas: sustaining
the continuity of Western civilization, sometimes broadened to in-
clude all civilization; building a foundation for active, informed
citizenship; insuring the elements of common discourse and mutual


6. President’s Commission, p. 72.


9. This is not the place for an extended comment, but many aspects of general education (not only foreign language study) are damaged by the tendency to prescribe the same requirements for all students, without reference to their personal interests or major programs, sometimes even without a rationale for the prescription. This tendency may be one of the reasons for the typical unpopularity of general education requirements. For example, Frederick Rudolph, after completing his study of the “History of the Undergraduate Course of Study since 1636,” commented, “General education would never die. Perhaps, also it could never be made popular”—in *Curriculum: A History of the American Undergraduate Course of Study since 1936* (San Francisco: Jossey-Bass, 1977), p. 260.


understanding; and, lately, meeting the paradoxes of technology, environment, and inhumanity.\textsuperscript{4}

However, neither the ideas nor the forms of the programs developed under the banner of general education display any consensus. Not only is there no one pure "general education" program, but there is also an absence of a commanding concept, a preeminent design, a coherent group of values, or a specific body of knowledge. Frustration among those who seek to develop general education often arises from the search for a single best model and the failure to recognize that each program is an independent construction.

The work of Herbert Simon, \textit{The Sciences of the Artificial}, implies that programs such as general education may be seen as "artifacts," each being an artificial system designed to fulfill a purpose.\textsuperscript{5} In Simon's words:

Fulfillment of purpose or adaptation to a goal involves a relation among three terms: the purpose or goal, the character of the artifact, and the environment in which the artifact performs. . . . An artifact can be thought of as a meeting point (an "interface" in today's terms) between an "inner" environment, the substance and organization of the artifact itself, and an "outer" environment, the surroundings in which it operates. If the inner environment is appropriate to the outer environment, or vice versa, the artifact will serve its intended purpose.\textsuperscript{6}

The significant distinction here is between artificial systems and the natural systems of the sciences, which aim at the systematic understanding and prediction of phenomena that already exist in nature. By focusing on the teleology of artificial systems, as Churchman noted, one is led to a consideration of design.\textsuperscript{7} Again, Simon's phrases are appropriate:

The artificial world is centered precisely on this interface between the inner and outer environments; it is concerned with attaining goals by adapting the former to the latter. . . . Engineers are not the only professional designers. Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artifacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state. Design, so construed, is the core of all professional training; it is the principal mark that distinguishes the professions from the sciences.\textsuperscript{8}
This conceptualization makes clear that the curricular revisions which seem unending to faculty members and the differences that appear among general education programs are not symptoms of confusion, but rather evidence of vitality. The task is to design an educational artifact, not a perfect natural system. The artificial system can never be perfect, only "satisficing" in Simon's term, and is always open to reexamination.

The line of reexamination developed in this paper begins with the premise that general education springs from that knowledge which is of generic significance, whether in the humanities, the natural sciences, or the behavioral sciences. The degree of general significance is partly a function of conditions in the environment. A contemporary case is made for the notion that the phenomenon of uncertainty has become part of our external environment. In creating the artifact of general education, it will be argued, uncertainty and the knowledge we have about coping with it should be included.

Even though analysts of general education state that no particular body of knowledge assures the liberalizing effect, the changing nature of knowledge is a prime mover in program change. Specialized aspects of knowledge are often lifted into prominence by external events, and whatever their technical importance has been, their significance now becomes general. As Flay has observed, it is the "general" part of general education that carries the greatest meaning: those elements of knowledge that have the greatest significance for the "genus," that is to say generic topics, form the basis for the design of general education.

The idea of generalizable knowledge as an origin of program development has not been entirely overlooked. Bell, Phinix, and Hook have attempted to build categorical or operational frameworks for establishing generalizable knowledge and the related skills. However, they still depend heavily on the literary tradition and take only a limited account of generalizable knowledge in other fields. The recent fascination with "computer literacy" and "numeracy" in general education barely acknowledges the scope of generalizable concepts available from the sciences. A good example of how special knowledge becomes generalized is found in general systems theory, which began in biology but quickly spread to other disciplines and even to applied fields such as management.

If general education is composed of that knowledge which has general significance in the contemporary setting, then the question arises as to who makes that determination. Often curricular changes come about through external factors, such as new licensing requirements or new kinds of job openings. Sometimes they emanate from
changes within the clienteles of higher education. Remedial courses are an example. In the case of general education, however, the initiative lies with the faculty. As knowledge specialists, they are best prepared to determine what segments of study are ready to be generalized. Such choices and decisions are easier to avoid than to face; thus we observe that changes in the curriculum are very slow, as was recorded by Blackburn and his colleagues in their comparative analyses of course distributions over the span of a decade.\textsuperscript{12}

It is argued in this paper that the concept of uncertainty has special validity for general education programs. However, other potent concepts also press for recognition. Three will serve as examples. (1) Technology, which has gained a distinct place in the industrialized Western nations, is of general importance. A program in the mode, if not the title, of general education was introduced at Penn State in the late sixties under the rubric of “Science, Technology, and Society.” Syracuse University, having established a “liberal arts core” program that required “clusters” of courses selected from the humanities, social sciences, and natural sciences and mathematics, recently introduced a technology sector from which another cluster must be drawn.\textsuperscript{13} (2) In the social sciences, the concept of a “pluralistic society” is replacing the “melting pot” idea. Waters and others have pointed out the general importance of our special knowledge about ethnicity, since in a pluralistic milieu we are all ethnics of one kind or another.\textsuperscript{14} (3) Others have advocated courses on “how to think,” a naive title for basic logic. Levine reports Geertz’s analysis of the disciplines, which produces the conclusion that “an important change in the way we think about the way we think” is underway. It is from such reassessments of the structure of learning that we identify new generalizable elements of knowledge and select those which merit inclusion in the artifact called general education. Just as the external environment helps to define those subjects that are ready for general education, so events within the academic community help to define how they can be treated.

The Cultural Context

The concept of “uncertainty” is today at the nexus of concerns in many sectors of society. Several specialized bodies of knowledge in fields as widely separated as physics and management have contributed to the conclusion that high levels of uncertainty will be especially powerful during the next twenty-five years. The whole quasi-discipline of futuristics rests on the premise of exceptional uncertainty leading into a precarious future.
In its full form, the notion of uncertainty is not the same as simple change, but neither is it abject mystery. Many aspects of change are rather well understood in advance. We know, for example, the inexorable path of aging, its direction, its effects, and the approximate rate at which it occurs. Although the certainty of that knowledge does not eliminate uncertainty about how to deal with the phenomenon, it surely reduces the scope of the variables. But if the direction and rate of change are not known, and if the very question of whether it will occur stands open, then the uncertainty is of a very different kind. Such gross distinctions about the kinds of uncertainty, change, and chance are well established in practical thinking and theory.

There is the recent distinction which occurs in game theory between the concepts of "uncertainty" and "risk." The risky situation is taken to be one about which the inquiring system can make probability statements which are based on directly observable events. An uncertain situation, on the other hand, arises, say, in a two-person game where the actions of one player depend on his own developed strategies and these strategies cannot be predicted from the relative frequency of past plays, since they are based in part on the one player's concept of how the other players will conduct the game. It is said to be impossible for one player to obtain evidence about the "inner states . . . of the other player." 16

John Newhouse's recent analysis of a highly volatile industry, aircraft construction, reports a practical recognition of the two kinds of uncertainty.

The excitement in this business lies in the sweep of the uncertainties. Matters as basic as the cost of the product—the airplane—and its break-even point are obscure because so much else is uncertain or unclear. The fragility of the airline industry does, of course, create uncertainties about the size and the reliability of the market for a new airplane or a new variant of an existing airplane. Then, there is a wide range of unknowns, for which an arbitrarily fixed amount of money must be set aside in the development budget. Some of these are so-called known unknowns; others are thought of as unknown unknowns and are called "unk-unks." The assumption is that normal improvements in an airplane program or an engine program will create problems of a familiar kind that add to the costs; these are the known unknowns. The term "unk-unks" is used to cover less
predictable contingencies; the assumption is that any new airplane or engine intended to advance the state of the art will harbor surprises in the form of problems that are wholly unforeseen, and perhaps even novel, and these must be taken account of in the budget.\textsuperscript{17}

The presence of "unk-unks" in other sectors of society has the effect of confounding the established line of theory: the artifact no longer provides a "satisficing" purpose. Looking at long-term trends in economics, for example, Thurow questioned the adequacy of the \textit{Homo economicus} who, with his insatiable innate wants, forms the basis of production and consumption theory.\textsuperscript{18} The current uncertainty in the economic system signals the inadequacy of the dominant theory and demands a more careful look at its sources.

What the economics profession and our society have failed to face is the problem of how wants are generated. Given modern sociology and psychology, the postulate of innate wants is simply untenable. \ldots There is a fundamental long-run problem facing our economy and our profession. Neither has come to grips with the problem of how a society deliberately and consciously generates the wants that the economic system is to satisfy.\textsuperscript{19}

Whether Thurow's economic interpretation is appropriate must be decided in another forum; the point here is that uncertainty challenges theory as well as practice.

A manifest inability to either explain or resolve uncertainty also produces personal discomfort. Bertrand Russell maintained that fear of the unknown is at the root of cruelty, prejudice, and "ferocity toward those who are not regarded as members of the herd."\textsuperscript{20} When that discomfort is translated into social terms it affects the basic institutions. As Schon puts it, in the current era "no established institution in our society perceives itself as adequate to the challenges that face it."\textsuperscript{21} Schon frames his discussion of uncertainty around the growing inadequacy of a believing in some "stable state" as a normal or ideal condition. Given the plethora of contemporary information, he notes,

There is not an "information gap." There is an information overload, too many signals, more than can be accounted for; and there is as yet no theory in terms of which new information can be sought or new experiments undertaken. "Uncertainty" is a way of talking about the situation in which no plausible theory has emerged.\textsuperscript{22}
Schon also addresses the contention that change has always been with us, and always at accelerating rates. Today several special consequences of change heighten the uncertainty. The rate of diffusion is rapid—a central point in Toffler’s popular book *Future Shock*. The changes are more “pervasive”—a technical modification reaches more widely into many aspects of life. Changes are also more “implosive”—they drive together all people connected in any way with the phenomenon. Schon’s main thesis is that, since we are committed to the image of some stable state, our systems and energies go into defending this image against change, into a “dynamic conservatism.”

If we turn to organizational theory about business firms, we will note a similar concentration on the problems of uncertainty. Here those of the environment are presented.

A second focus of analysis has emphasized the organization’s ability to control or change its environment. In addition to adapting its own structures to the environment, several theorists . . . have noted that organizations may act on their environments in order to reduce uncertainty. It has been shown, for example, that organizations may make their environments less uncertain by engaging in long-term contracts with other organizations . . . by absorbing elements of the environment into the organization . . . by seeking external support for the organization within the environment . . . by forming temporary coalitions or joint ventures with other organizations . . . or by undertaking an interorganizational merger. . . .

The future of higher education itself offers an excellent example of how and why uncertainty has come to prominence in contemporary life. To begin with, that confluence of upward trends in population, economic growth, technology, and high-level manpower that reaches back a hundred and fifty years or more is no longer visible. We are at the “end of trends” as a basis for planning. Some factors that made up the trends have passed a “tip over” point and will probably never reappear; the high birth rates characteristic of youthful populations, the rural-urban mix, and the dominance of agriculture or manufacturing over service occupations in the laborforce may well be things of the past.

After examining the shape of the future, the Carnegie Council concludes, in *Three Thousand Futures*, that educational institutions themselves must cope with the future. The inference is clearly that “uncertainty” is not manageable through the systems of higher education that have been constructed over the past two decades. The
insubstantial words like "leadership," "flexibility," and "quality," which appear among the study's recommendations, do not in themselves constitute a useful response.

The Case for Statistical Thinking and Statistics

Because of the unusual number of uncertainties in the times ahead, it is all the more critical that university students, both undergraduate and graduate, acquire enough intellectual insight to feel at ease with uncertainty and to cope with it intelligently. What source can we draw upon to help students, the academic programs in which they study, and the organizations they will eventually inhabit, with this task? Right now the body of specialized knowledge that can best be generalized to address many aspects of uncertainty in a variety of situations is statistics. However, even the richness of formal statistics cannot comprehend the full scope of uncertainty, so we propose that a course in general education be designed around the uncertainty phenomenon, not around a claim to preconceived solutions. Let us examine in more detail each of these points: the aspects of statistics that can be generalized, a phenomenonological approach to course design, and, finally, the obstacles that can be seen on the path to change.

It is the theoretical framework and the conceptual base of statistics that offer the most substance to a systematic study of uncertainty. There are other reasons for bringing components of statistics into general education. In this journal, Weaver recently argued persuasively that descriptive statistics can cultivate "habits of systematic thinking and creative concepts of knowledge." We now make still another case, that the very ideas, the concepts around which both inferential and descriptive statistics are developed, can inform the approaches students make to a major phenomenon of society and their personal lives, uncertainty.

The value of statistical thinking is evident at the very threshold of the topic. By encouraging the student to distinguish a lack of particular information from utter ignorance, and to formulate problems in their most fundamental dimensions, an orderly beginning is set. The treatment of bias in all its forms produces caution and precision toward all observations and a constant awareness of questions of validity. Probability theory has emerged as a powerful heuristic tool in modern life, with the qualities of a "way of knowing" in the sense that Phenix has used the term. Randomness and chance as general concepts help us to find order in disorder, regularity in irregularity, pattern in fluctuation, and causes behind apparent chaos. A
contribution is made not only to understanding, but to the skills of evaluation and prediction as well.

In similar ways, the approaches to synthesis that are characteristic of the discipline of statistics take on general applicability. Uncertainty manifests itself in multidimensional forms; conceptual synthesis treats questions of extent, variability, strength, and typicality or representativeness. The synthesis of information gives rigor to the process of comparison and analysis.

If the gathering and ordering of information in appropriate amounts and forms is one side of logical treatment, then the other is extrapolation. Here again the canons of statistics address the crucial questions of the validity, sensitivity, and robustness of measures. Considerations of transitivity among systems, between models and reality, and among properties are brought to the surface. Finally, the refined approach to inferential extrapolation makes clear the power and limits of various inferential methods. By suggesting orderly ways of linking and testing relationships among inferences, a system of proof appropriate to the problem is developed.

These conceptual components of statistics, along with others, are in harmony with knowledge as we have come to perceive it in the twentieth century. Boldrini states:

Indeed, the opinion was once firmly held that scientific truth was something essential and predetermined, a hidden principle of the physical world and a difficult objective for studious minds to achieve stage by stage, through conjecture and experiment. That opinion has now been shown to be mistaken. By scientific truth is still meant, of course, a certainty, but a subjective one, transitory, a special relation between man and the world, adapting itself to the progress of knowledge, and to changes of interpretation and of human requirements. . . .

In science, as opposed to art, it is methodic rigor rather than imagination which predominates. In the widest sense, all the sciences rely for rigor on the discipline of method, that is, on statistics. . . . Anyone who says "science" also says "statistics," and vice versa—knowing that statistics can no more be avoided than can logic, by which man thinks, or language, by which he expresses himself. . . .

Naturally, in the relative truths of a science historically conditioned and essentially changeable, in which the possible predominates over the necessary, the probable over the determined, the transitory over the definitive and, in a certain sense
also, creativity over objectivity, it would be vain to regret the
disappearance of those universal positive foundations which
past thinkers had so laboriously built up on the basis of logic,
mathematics, and experiment. But, it is precisely in this lack of
certainty that the transcendent Truth re-emerges as free choice
... and refers us back to the words "Ego sum Veritas."\textsuperscript{29}

By taking account of the many faces of uncertainty—those men-
tioned here, and others—and combining them with the body of for-
mal knowledge generated by several strains of statistics, we can
design a general education course that will rely upon issues palpable
to the students and within the range of their experience. Such a
course will accustom them to the prospect of a lifetime of uncer-
tainty ahead. It will develop their skills in problem perception and
formulation, scientific thinking, mathematical precision and ele-
gance, probabilistic thinking and statistical reasoning, and so forth.
Most of all, it will make them see uncertainty as an opportunity for
creative discovery, for value judgment, and for integrative think-
ing.\textsuperscript{30}

Even though the concepts of formal statistics help to address the
nature of uncertainty, they do not circumscribe all solutions. The
focus of the course in general education must be uncertainty itself.
William Kruskal, in recent correspondence with the senior author,
observed that "uncertainty encompasses a far broader set of ques-
tions and issues than those of probability and statistics as we ordi-
narily construe those disciplines. Indeed, I worry when I see at-
ttempts to apply probabilistic ideas prematurely (sometimes
imperialistically) to domains not ready for them."\textsuperscript{31}

As a study under the aegis of general education, the course design
should be phenomenological, with less emphasis on the overall use-
fulness of statistical literacy, and more effort to establish "uncer-
tainty" as the focus of study. Because uncertainty confronts us in so
many forms, the source of teaching materials is very rich indeed.
Collections of short illustrative reports from "real life," which are
available in the form of apocryphal stories and secular parables,
abound in folklore and humor to address particular points. Problems
of observation, bias, and inference, for example, are captured in the
old fable of the blind men and the elephant. The contemporary press
is filled with illustrations of our efforts to deal with the uncertainty
of international affairs (e.g., the "missile gap") or domestic issues
(e.g., smoking and health). Under ideal circumstances one might
hope to address the uncertainty in the lives of students through cre-
tative advising and a consideration of campus issues.\textsuperscript{32} The ultimate
place for the ideas of general education is, after all, in the life of each student.

The obstacles to converting a good idea into an accepted course, however, are formidable. While proponents might see the virtues of this topical approach, responsible faculty members know that introducing something new into the curriculum almost always means dropping something else out: the limits of time and resources now make curricular change a zero-sum game. Often the earlier claims to legitimacy made for those subjects already in place remain strong.

A placement problem of a different sort would appear as soon as the idea were fully developed and accepted by a faculty group. At what point in the path of student development should the subject be introduced? Perry, Heath, Sanford, and others have demonstrated that students usually begin the college years with a need for structured, authoritarian positions that promise certainty. Later they move toward an examined relativity and a sense of commitment, but that process takes several years. There are three positions in a university program where a course on uncertainty would hold special benefits. One is the freshman year, where the process of maturation might be accelerated. The second is the beginning of the junior year, when many personal and academic decisions are made. The third is at the threshold of graduate study. A general treatment of uncertainty, offered as a freshman course, could be followed by more detailed treatment within the framework of the disciplines.

Summary

This paper has argued that a contemporary approach to general education should include the concept of uncertainty, since we are preparing students for a world in which uncertainty, in different manifestations, will be a recurrent and major fact. Although there is no single best model for accomplishing any curricular goal, we believe that a general education course on uncertainty could well use statistical thinking as its central form of knowledge. Including such a course in a general education plan would not be easy or simple, but in one way or another we owe it to our students to liberate them from their ignorance about uncertainty—or their discomfort with it.

Notes


32. Patil, "Coping."