# Educational Technotrends

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***Abstract***

Key in education at present is to plan to employ tomorrow's technologies today. Many of these technologies have already been developed and are about ready to be used. Academia should avail itself of the new opportunities, and thus it is worthwhile to review systematically a number of technological innovations. More educational innovations will emerge as core technologies are put to creative use. It is necessary to determine how prior methods can be adapted, and how the old is to be integrated with the new. For our purposes here, technological innovation in education will be considered under the following headings: Which are the Foremost Technologies; Applications; Adaptation; Teacher-Student Interaction; Teaching and Research; Merging Innovation with Tradition.

The reader might find the title of this study curious, even disconcerting. Faddism? Fetish? One would hope not. Key in education at present is to plan to employ tomorrow's technologies today. Many of these technologies have already been developed and are about ready to be used. Academia should avail itself of the new opportunities, and thus it is worthwhile to review systematically a number of technological innovations. My purpose here is two-fold: first, to describe a number of core technological innovations with a significant impact upon education; second, to offer suggestions how these might be effectively employed in teaching.

More educational innovations will emerge as core technologies are put to creative use. It will be increasingly necessary to determine how prior methods can be adapted, and how the old is to be integrated with the new. Even if uses are not completely clear, one should keep in mind that innovations are providing new contours in education. However comfortable or uncomfortable we may be with it, the plodding march of technological innovation in education, as is the case more broadly with technology, is inevitable. Ignoring technological innovation serves no purpose; instead, one must recognize its value and take action. Instead of being

confounded, we should make innovation our ally. As one observer so aptly phrased it, "(T)he choices we face as teachers are simple: we can carry on business as usual and watch education become increasingly obsolete. Or we can embrace the changes, learn as much as we can about them, and assume the role of effective manager" (Klein, 1995, p.152). Expressing the same idea in a more forceful manner, another observer asserts: "We either succumb to the threat of the revolution, or we merge with its promise" (Kussmaul *et al.*, 1996, p. 125-26).

## *Which Are The Foremost Technologies?*

**Multimedia**. Multimedia technologies will continue to alter the way people learn. This is to be welcomed. Why? The short answer is that multimedia technologies will facilitate instructing the way people learn. Alas, too frequently, people are made to learn the way a particular teacher instructs. This has been a perennial dilemma of teaching. Consider the following. Studies indicate that as many as 50% of people on average are "action learners" (*Fast Company,* 1997, p. 106). They learn best by doing. Perhaps another 33% are "people learners," that is, they learn best through conversation and exchanging ideas with others. Only 17% are "information learners": people who read texts, listen to lectures, and learn through the traditional school experience. This places me, for my part, in somewhat precarious position. I am a devout "information learner," and hence in a distinct minority. As a teacher, I represent the intellectually challenged. The ramifications are all too apparent. What the teacher teaches may not be what the student learns (Klein, 1995, p. 154). Multimedia can facilitate in "empowering" students to reflect on other's ideas to supplement instructor input. Multimedia computers, for example, allow people to watch films, to listen to speeches, to scrutinize pictures, all on a computer screen. Many people are already able to enter the "virtual" classroom on their desks; increasing numbers will be able to do this.

Multimedia has three defining attributes for education (Savage and Vogel, 1996, p. 128). First, it offers greatly expanded information access, making large amounts of materials readily available at low cost. Second, as the name connotes, multimedia involves multiple media, with the attendant ability to select the means to convey particular ideas. Third, multimedia affords interaction and interactivity, enabling users to access, handle, examine and selectively present information.

People have a broad assortment of learning styles, aptitudes, interests and motivations. The trick is to "empower" people to learn how to learn. Technology is no panacea, but it should increasingly allow instructors to gear their presentations to audience needs and preferences. Does new technology present an opportunity to involve more students, particularly those lacking in basic skills, in intellectual activity? It probably does. It has the potential, at least. Once instructors have a grasp of technological capabilities, though, imagination must take over.
**Advanced Compact Disks.** Actually a facet of the above, these employ lasers to read large amounts of information stored digitally in a relatively small space. In addition to the standard

music CD, another increasingly popular technology is CD-ROM, which stands for compact disk read-only memory. CD-ROM is rapidly replacing textbooks, reference files, catalogues, and training manuals. Compact disk interactive, or CD-I, is the next step (Burrus, 1993, pp. 42-43). This technology allows the user to interact with the information on a TV screen without employing a computer and keyboard. Compact disk-recordable, CD-R, will merge the benefits of CD's with recording capabilities, and should be widely available with five years.

**Advanced Expert Systems.** With this technology, one will be able to take advantage of great minds through special software. Artificial intelligence software will soon have the capability to glean the expertise of leaders in many fields and offer this to wide audiences at considerable distances. Top legal scholars, for example, will proffer valuable and costly advice to practitioners and law students. Medical professionals can do the same for both healing and teaching purposes. Business schools can acquire otherwise formidably expensive counsel from executives of Fortune 500 companies ( Burrus, 1993, pp. 39-40). The possibilities are extensive.

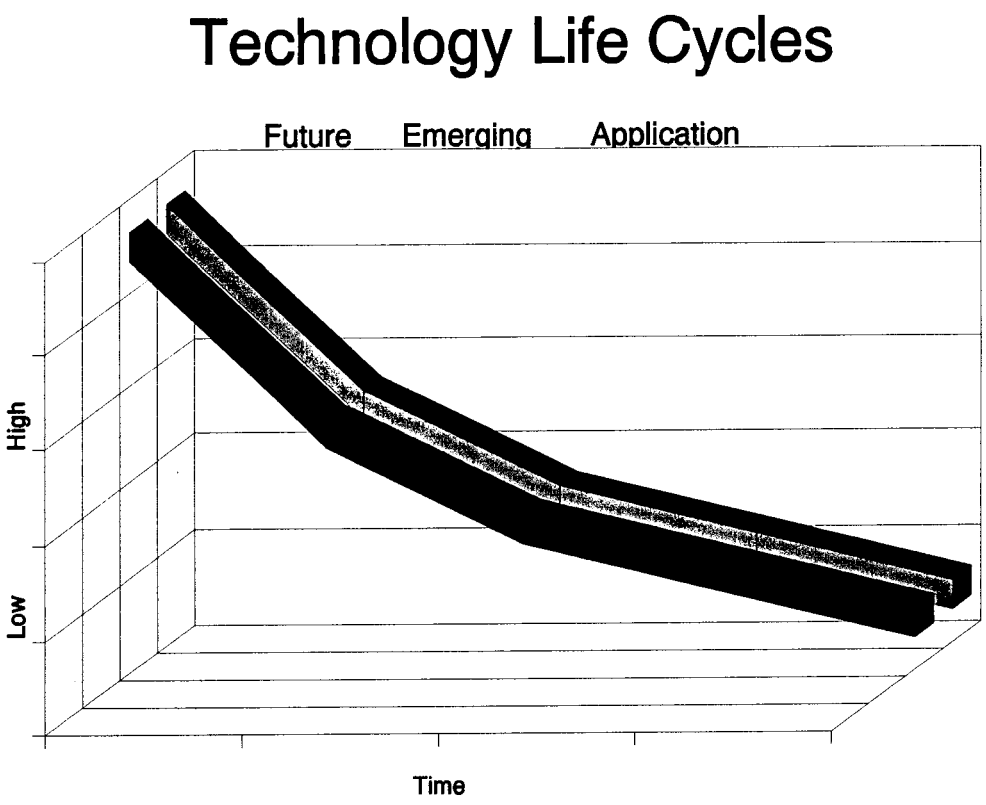
Nearly forty years ago, educational researchers compared the effectiveness of instructing equal-sized groups in face-to-face settings or by telephone (McKeachie, 1986, p. 162). No significant differences surfaced with respect to the effectiveness of method. Related studies have demonstrated that the addition of visuals usually contributes to the learning environment (McKeachie, 1986, p. 162). Over the years, colleges have employed telephone hookups for student discussions with leading scholars and public figures. Modern technologies will significantly improve such capabilities.

Closely related to this technology are telecomputers and personal communications networks (Burrus, 1993, pp. 42-42). The former operates like a combination telephone, fax machine and computer. Among other capabilities, this will allow one to hold academic "office hours" with virtually anyone at any distance. Instructors and students will be able to browse through newspapers on a flat screen, and even to read summaries of professional journals on the road or at home. Telecomputers and personal communications networks will also be able to operate with advanced flat-panel displays--thin, very lightweight television screens providing full-color pictures. Personal computer networks, for their part, will largely liberate one from telephones while traveling. These relatively small and inexpensive units will be designed to receive messages like a pager, but can function as telephones for placing outgoing calls. Presumably, they will be digital and ground-based.

**Desktop video-conferencing.** This technology is similar to a telephone conference call, but with video. Each person uses a personal computer, a small video camera, and a fiber optics system, permitting everyone to see and hear everyone else on computer screens. Several people will be able to work on the information presented on the screen at the same time.

Before we go on, let's consider two questions of technology cost posed in a recent study entitled "Electronic Revolution at the Educational Crossroads" (Klein, 1995, p. 151). The study asks: How much should academic institutions invest in technology, and, closely related, Can we afford it? Without pretending to having definitive responses to such broad questions, I would

cost and risk of future technologies are relatively high, these decline as new technologies become widely available. Klein, for his part, concludes that colleges and universities should "invest a lot and do it soon." Educational decisionmakers might keep the dynamics of the model in mind.




## *Applications*

To grasp the magnitude of technological possibilities, let us next consider some of the specific applications of the educational technotrends specified above. This discussion is not meant to be comprehensive--one could hardly offer that. Instead, it endeavors to convey a sense of technological *potentiality*. A recent study in the quarterly *College Teaching* affords a discussion of the use of e-mail for instructional purposes (Kussmaul *et al.*, 1996, pp. 124-25). Here is an example of how the application of educational technology alters the pattern of instructor-student interaction, much for the better, if utilized properly. As the authors point out, the e-mail is one of several recent innovations allowing students to assume a more active role, facilitating student-instructor interaction, and also permitting students to communicate with each other.

The advantages of the e-mail should be evident by now. E-mail affords users the opportunity to send and respond to messages virtually any time. Instructors might e-mail students certain messages prior to classes, with an eye to providing direction and focus, and encouraging students to ask themselves questions about the subject matter. Students can also pose questions via e-mail; instructors can respond at their convenience. Instructors are accorded more time to consider a question, even to locate sources about the subject area. Not infrequently, one develops new perspectives on a particular question after having given a response. Sometimes, one can simply be distracted and furnish a superficial response; one might have missed certain ramifications; one might simply have been wrong. In the latter case, it is advisable to own up: "I stand corrected." One regrets on occasion the answer one has provided to a particular question, whatever the reason. And everyone simply has bad days. E-mail fosters amplification, revision, and perhaps a more graceful admission of error. E-mail permits instructors to respond selectively to students, to set up electronic bulletin boards for class, and to tender multiple replies to questions, and replies to replies.

Imagination is, once again, crucial. One fairly common suggestion is that class discussions be "seeded" in advance through the e-mail. Student participation can be encouraged and evaluated by e-mail technology. Students, for example, might be required to e-mail a certain number of messages as a facet of class participation. Online "discussions" might be evaluated by instructors. In short, e-mail by itself augments educational conversation in fresh ways (Klein, 1995, p. 155).

E-mail employment, as with many things in human affairs, has advantages and disadvantages. Some regard this method of communication as too impersonal. Some still deem the method intimidating. Regular utilization does presuppose understanding of the technology. Moreover, e-mail messages are written and therefore "on record." Technology-related breakdowns happen and can be a source of major headaches. Some students might simply not have ready access to the necessary technology.

Above all, e-mail instruction can be time-consuming. This reflects a broader problem with any new technology. One must gauge the amount of time that will be involved, and in some cases, determine the cost-effectiveness of such time investment. Over the years, studies have indicated that effectual computerized instruction necessitates new and probably more complex teaching strategies (McKeachie, 1986, pp. 155-56). What such strategies entail has not always been clear. That students need specific training with computers has been a given. Integrating computers into the curriculum requires time and considerable imagination, and it remains axiomatic that technology by itself is not a panacea.

A recent study focuses on the amount of instructor time required to use the e-mail effectively as an instructional tool (Lacina-Gifford and Kher-Durlabhji, 1996, pp. 94-95). Responding to students on the e-mail, checking the news bulletin board and keeping a discussion log sometimes required several hours a day. One simply must take more care in preparing

transmitted materials, exactly because these are "on record." The written word is unforgiving, but can nonetheless be turned to one's advantage. As a written medium, the e-mail necessitates composition, which presupposes a systematic organization of thought. Putting ideas into writing is always beneficial, and we should not hesitate to avail ourselves of the self-discipline benefits that writing affords.

Multimedia will increasingly be replacing or complementing instructional science laboratories. Computers simulate experiments, saving time, expense, effort, and, moreover, often yielding better results. In medicine, special programs known as A.D.A.M. (Animated Dissection of Anatomy for Medicine) enable a revealing of the human body from skin to bone (Savage and Vogel, 1996, pp. 130-31). Students can focus and "zoom in" on anatomical parts, even rotating them and shifting views. Pathologies can be "provided," and students can use the software to acquire additional information about function and malfunction. Even if this medical example is a bit esoteric or far afield, it highlights how educational multimedia can be employed for tutorials, which are clearly among the most intriguing of new technological capabilities (Savage and Vogel, 1996, pp. 130-31). Interactive multimedia will ensure growing sophistication of tutorials, permit continuous substance expansion, and promote student participation. Through video, sound, animation and photography, science laboratories will become "virtual" workshops. In industry, furthermore, numerous training applications present themselves.

## *Adaptation*

In growing measure, learning should involve actions and reactions. As some educators put it, learning should increasingly transcend surface knowledge and understanding (*Fast Company,* 1997, p. 106). For example, interaction with a leading authority in a particular field can supplement the studies this person has produced. Interaction might involve e-mail, video-conferencing, telecomputing or any combination of these. Interaction might occur on an individual basis, or as a group or class project.

Savage and Vogel allude to the applications of new educational technologies as proverbial rungs on a ladder, depicting these as *methodological levels* (Savage and Vogel, 1996, pp. 128-129). The first level the authors identify as *embellishment*, or, more prosaically, the presentation. One can embellish traditional presentations with slide shows or with computer-generated animation. Software programs designed specially for presentation such as *Powerpoint* are relatively user-friendly. Embellishment, as the term suggests, can be an attention-getter, even an interest-stimulator.

Be that as it may, presentation requires technique and a great deal of practice. The following are a few essentials. Perhaps the most crucial question initially to answer is: What do I wish to convey to the student audience? An authority on leadership training asserts that presentations are always more powerful if objectives are manifest (*Fast Company*, 1997, p. 126). Presentations, be they in an academic or non-academic setting, should end in action. In the

setting we are most concerned with here, this action should be, first, learning, and second, but equally important, the incentive to learn more. At this level, one should equip oneself for addressing the following questions. What are my principal objectives and core message? What common experiences and values do I share with this particular audience? Responses to these questions are more consequential than the embellishment itself. One must ensure that the presentation complements the substance, and is not in lieu of it, or even worse, detracts from it.

The second level is the *explanatory* one (Savage and Vogel, 1996, pp. 128-29). Technological innovations in education are instructional instruments; they are *not* ends in themselves. Technology facilitates instruction; it is not a substitute. One must, accordingly, beware of any mechanistic use of technology in teaching. Inclusion of slides or images in the presentation begs questions about what, specifically, these add; why they should be there. Instructors can be and are, in fact, overwhelmed with the amount of images and other trappings sometimes included in a presentation. And if an instructor can be inundated, only fleeting consideration is needed to determine the potential effect multimedia tools might have upon students. General rule: if it smacks of gee-wizzery," think again. Computer-generated slides and graphs can be exciting. Discretion is, however, called for and audience understanding must always be the principal goal.

At the second level, one must develop certain criteria for the utilization of instructional instruments. Explanation is the most essential criterion. Hence, audience attention should move naturally from embellishment in the direction of explication. In some "virtual" laboratories, largely new presentations will be coming available; otherwise, multimedia should complement traditional methods. A 1972 study entitled *The Fourth Revolution* offer two specific criteria for the employment of new technologies in classrooms. These still apply (Carnegie Commission on Higher Education, 1972, p. 2).

* The teaching-learning task to be performed should be essential to the course to which it is applied.

* The task could not be performed as well--if at all--for the students without the technology.

The third level brings us into largely fresh territory: the *exploratory* stage. Here, technology surpasses presentation and is utilized as an information resource (Savage and Vogel, 1996, p. 129). Interactive multimedia comes into its own in this stage. For example, books will increasingly have CD-ROM enclosures that supplement the basic text with several thousands of pages of, for example, primary sources, short films, graphs and charts and high-resolution photographs. "Suggested readings" will be included on the CD-ROM, especially as the capacity of the technology expands. And it will, exponentially. Texts can be readily searched with a mouse; words, ideas and concepts can be identified for expansion. Clicking on certain images in the text yields expanded images; zoom capability can also be employed here. Classical texts

increasingly appear online, facilitating one's ability to search for key words and access commentaries (Kussmaul *et al.*, 1996, p. 125).

## *Teacher-Student Interaction*

Some observers are leery about the potential of technologies to alter adversely patterns of student-instructor interaction. This is a legitimate concern. Attendant challenges aren't new, and many conceivable problems can be resolved though common-sense approaches. For instance, remarkable as it may appear, many college instructors encounter difficulties with student questions. One should distinguish here between merely *responding* to questions and *fielding* them (Hyman, 1982, p. 4). Fielding is a much broader concept, representing the preferable approach. Fielding opens new avenues and invites discussion. Fielding should parry the regrettable, yet all-too-common impression that simple, straightforward answers to complex problems exist.

Why might instructors discourage student questions? Perhaps the salient reason is that instructors feel pressured to maintain control of classroom procedure and content. They are concerned about the need to cover the specified course content. In any course, one operates under time pressures, and it often seems that time is scarce. Many instructors worry, overly so, about being sidetracked by tangents.

One must, especially in this day and age of interactive and multimedia technology, reinforce student questioning. If one does not, the entire purpose of much educational technology is thwarted. Many college students need such reinforcement because of perceptions acquired through years of classroom experience that student questions are not particularly valued. From a pedagogical as well as a human standpoint, this is maddening and saddening. Equally saddening, passive television technology has, over time, not been without its negative effects. People accustomed to sitting in front of the television are those least inclined to interact with video technology.

Students must increasingly learn how to learn; so must teachers, for that matter, in light of the vast growth of information and knowledge in our age. Through interactive technology, teachers have much greater opportunities for contact with experts and leaders in many fields. They have more experiences to draw from; they can see whom to emulate and how. And they must judge for themselves whom not to emulate.

In the interactive process, instructors should do their best to respond directly to student questions; they should convey the impression that questions are worthwhile. They should, as a rule, avoid deflecting questions to other students or to the class in general. Wider experience accruing from interactive technology might offer counsel and admonition. When one encounters others deflecting or avoiding questions, one realizes what is to be shunned. Question and answer sessions represent a key element in the interactive process. Effective instructors know how to field questions by highlighting broader implications, by defining the significance of the subject,

by imparting how certain questions lead to new areas. Instructors should never hesitate to suggest that certain questions are worthy of further exploration. Isn't this, after all, what it means to *learn how to learn?*

The following are appropriate process skills for instructors and students, for moderators and participants (Gall and Gillett, 1980, pp. 98-100). Time-honored, these retain pertinence in a multimedia age.

*Listen to others and keep the discussion focused.*

1. State the issue at the beginning of the discussion.
2. Restate the issue to keep the discussion focused.
3. Summarize statements made by participants.

1. Listen to others' ideas.
2. Acknowledge others' ideas.
3. Question irrelevant remarks.

*Analyze different points of view.*

1. State areas of agreement or disagreement.
2. Ask for temporary agreements to break deadlocks.
3. Ask for clarification.

1. Ask for clarification.
2. Ask for reasons for others' views
3. Provide some of your own views.

## *Teaching and Research*

The notion of separating the functions of teaching and research seems singularly inappropriate, since the mutually beneficial interaction is manifest. I trust I have demonstrated that to some extent here. Technotrends in education should have a significant and positive effect in both areas, and contribute to the critical interaction. In a myriad of areas, knowledge is expanding exponentially, and the tempo of information growth is staggering. Through a variety of media, technology affords useful instruments to manage this vast amount of materials and data. Library catalogues, even some overseas, are increasingly online; journal articles are systematically listed and often summarized; a number of journals already appear online in their entirety. Faculty and students need spend far less time on literature searches, and thus have far more time for understanding and analyzing (Kussmaul *et al.* 1995, pp. 124-25). The research process will be somewhat less time-consuming. Greater amounts of research, in turn, ratchet the information and knowledge spiral upward, though. Technological innovation increases the knowledge base. Such augmentation constitutes a virtuous circle, or so I would argue.

Research and writing entail enormously demanding work, even for professionals. Certainly, no serious professional writers or scholars will speak of the inherent easiness of their pursuits. Writing is an exacting, lonely, and often painful task. The reward stems from the challenge of being out on one's own, of rethinking what has already been examined (Cronin, 1986, p. 1). The writer can work back and forth between experience and ideas, evidence and imagination. As Ernest Hemingway put it:

For a true writer each book should be a new beginning when he tries again for something that has never been done or that others have tried and failed. Then sometimes, with great luck, he will succeed. How simple the writing of literature would be if it were only necessary to write in another way what has been well written. It is because we have had such great writers in the past that a writer is driven far out past where he can go, out to where no one can help him.

This will continue to hold true. One should ask oneself how library and archival data bases can assist those out on their own, can contribute to a rethinking of the explored. Research and writing presuppose grinding self-discipline, but writing projects need not overwhelm. Modern technology facilitates requisite planning and promotes time management. Moreover, college and university faculty should consider how to include students in the computer world they utilize for research support (Klein, 1995, p. 153). William Plater suggests in this vein that, formerly, "teaching has been based on what the teacher knew and valued, but the new tools make it possible and desirable to shift the emphasis to what the students need or want to know--they are no longer limited by *our* knowledge, *our* experience and *our* expertise" (Plater, 1993, p. 14).

If there is a general rule for research, it is this: one should set high standards for one's work, but not so high that it paralyzes the ability to complete the task. Perfectionists, unfortunately, seldom finish writing projects. This is not to advocate that one abide by the "don't get it right, get it written" rule, or suchlike. It is to suggest, though, that recent technologies reduce basic research time; in some cases, lessening the need for research travel. One observer hypothesizes: "In the near future, all the representations that human beings have invented will be instantly accessible anywhere in the world on intimate, notebook-size computers" (Kay, 1991, p. 145). The term "near future" is too optimistic, but the point is nonetheless well-taken. We may yet realize Erasmus's seventeenth century dream of the library with no limits other than the world itself (Klein, 1995, p. 152). Be that as it may, time reduction in the research phase should permit one to focus more upon sophisticated writing. One should welcome the opportunity to overcome some of the frustrations invariably associated with writing.

A non-academic example might be illuminating here. Business executives are wont to use a "66 percent rule" (Cronin, 1986, p. 12). That is, they acknowledge that complete information will not be available, but if they can obtain two-thirds of pertinent information, they feel comfortable making decisions and proceeding. Consider how this applies to academic writing and research. Few scholars are able to procure all available data, information, evidence and interviews about a particular subject area. Researchers who wait for 100 percent will not, in all likelihood, finish their projects. Library data searches will facilitate an imposition of realistic deadlines and schedule cut-off points. One should be able to assess realistically how much information, data and material are available, how much one has accumulated, and whether significant research gaps present themselves. In short, educational technologies used properly diminish research frustrations and alleviate some enduring dilemmas of scholarship.

## *Merging Innovation with Tradition*

In this review of educational technotrends, we have considered how, specifically, technological innovation enhances learning. In any discussion of technological innovation in this area, though, we must neither lose sight of the basics of education, nor discount the role of the teacher. We should endeavor to combine the new and the old, innovation with tradition. Allow me to to offer a brief synthesis of Aristotle's views on education and wisdom (Wheelwright, 1951, pp. 285-87). The aim to encourage readers to heed basics. My point of departure is that Aristotle represents the finest in educational traditions.

That education (paideia) should be regarded as an affair of the entire community is evident. But we must not overlook the question of what this education is, and how it should be practiced. Granted that useful studies should be taught so far as they are really necessary, but this is not to say that all useful studies should be taught. We should impart such useful knowledge as others may learn without becoming "utility-minded" (banausos). Any occupation, art, or study should render the mind more fit for the exercise of virtue. Even among liberal studies, there are some in which people may properly engage up to a certain point but which, if pursued too assiduously, produce undesirable effects. The purpose makes considerable difference: if one learns for its own sake or as a means to virtue, then one is properly pursuing liberal education.

Wisdom (sophia) is a combination of apperceptive intelligence (nous) and scientific understanding (epistêmê); it is fully consummated understanding of the most exalted matters. Sagacity, on the other hand, is concerned with human affairs and more particularly with such matters as admit of deliberation. A sagacious person is one who deliberates well. No one, however, deliberates about what cannot be altered, nor about things that are not a means to an end, i.e., to an end that is not at once good and attainable by action. Hence, a good deliberator may be described in general terms as one who can arrive by calculation (logismos) at the best of human goods attainable by action. Sagacity involves a knowledge of particular facts, which can be acquired by experience, and experience comes only with time. Cleverness is like sagacity but not identical with it, and natural virtue is related to virtue in the strict sense. Goodness, which is the object of our quest, is not a matter of natural endowment, and innate dispositions can be guided by reason. Once people of good disposition acquire reason (nous), there comes to be a marked difference in conduct.

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