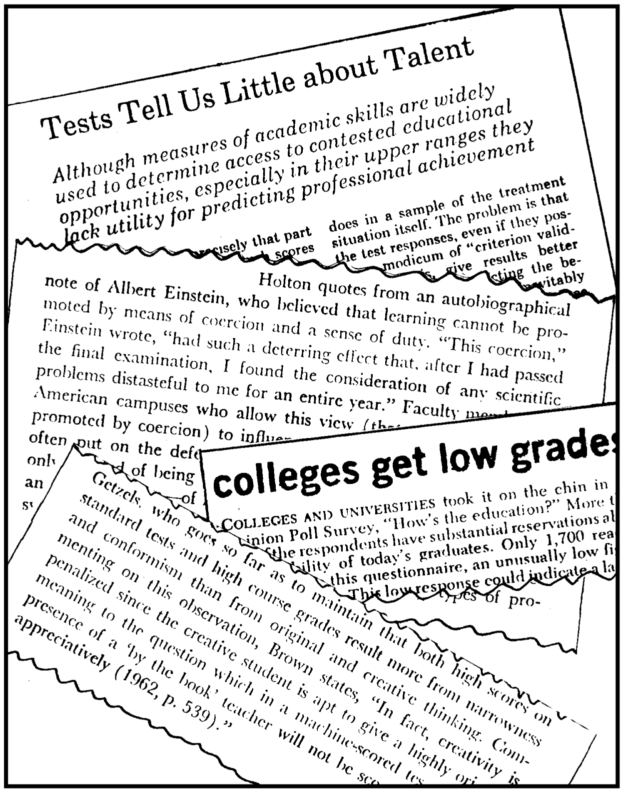
PHYSNET

MISN-0-180

SKILLS FOR PROFESSIONAL SUCCESS



Project PHYSNET Physics Bldg. Michigan State University East Lansing, MI

SKILLS FOR PROFESSIONAL SUCCESS

by

Peter Signell

Title: **Skills for Professional Success**

Author: Peter Signell, Dept. of Physics & Astronomy, Mich. State Univ

Version: 2/1/2000 Evaluation: Stage 1

Length: 1 hr; 16 pages

Input Skills:

1. Vocabulary: correlations (statistical).

Output Skills (Knowledge):

K1. Describe a likely reason why upper-part-of-the-distribution test scores and college grades have not generally correlated with later professional success.

K2. List the six Industry Scientist Attributes (skills) suggested by industrial R & D managers at the MSU Industry/Physics meeting.

K3. State why the Industry Scientist Attributes might be expected to correlate well with later professional success.

K4. Explain how an industrial R & D boss would most likely decide whether an employee was or was not "self-educating."

THIS IS A DEVELOPMENTAL-STAGE PUBLICATION
OF PROJECT PHYSNET

The goal of our project is to assist a network of educators and scientists in transferring physics from one person to another. We support manuscript processing and distribution, along with communication and information systems. We also work with employers to identify basic scientific skills as well as physics topics that are needed in science and technology. A number of our publications are aimed at assisting users in acquiring such skills.

Our publications are designed: (i) to be updated quickly in response to field tests and new scientific developments; (ii) to be used in both classroom and professional settings; (iii) to show the prerequisite dependencies existing among the various chunks of physics knowledge and skill, as a guide both to mental organization and to use of the materials; and (iv) to be adapted quickly to specific user needs ranging from single-skill instruction to complete custom textbooks.

New authors, reviewers and field testers are welcome.

SKILLS FOR PROFESSIONAL SUCCESS

by

Peter Signell

1. Summary of the Conference

1a. Place, Participants. We and a dozen faculty and students met with a group of self-selected representatives of industry:

- Dr. Henry Gomberg, President, K.M.S. Fusion
- Dr. Kent Moncur, Manager, Laser Dept., K.M.S. Fusion
- Dr. Lyle Tiffany, Corp Dir., Instr. and Space Sciences, Bendix
- Mr. Dallas Grenley, College Relations-Recruiting, Dow Chemical
- Dr. Ted Miller, Instrument Applications Lab, Dow Chemical
- Dr. W. Dale Compton, Vice-Pres. for Research, Ford Motor Co.
- Mr. Frank Jameson, Head, Physics Dept. Res. Lab, General Motors Corp.
- Mr. James Lunan, Mgr., Power Plant Res.-Electronics, Chrysler Corp.

The place was a regular meeting room at Michigan State University's Kellog Center for Continuing Education. We led a discussion of skills needed for professional success, using an overhead projector and felt-tip markers. By this means we could correlate comments of the participants in a way which all could see and respond to. There were individual follow-on discussions.

1b. Purpose: A List of Skills. Our purpose in meeting with the industry representatives was to obtain their list of skills most needed for professional success. Normally, faculty get little directly useful feedback from such consumers of their product as industry, government laboratories and graduate schools. For this initial meeting we chose industry since it is the one with the smallest record of feedback. We were interested in obtaining feedback in a form useful for planning our processes and materials.

1c. The Skills List. At the end of the discussions we had a list of skills along with articulated justifications and explanations. We were surprised at the participants' concentration on general skills. Here is their list of high-priority attributes for industry scientists:

INDUSTRY SCIENTIST ATTRIBUTES

1. Knowledgeable, Analyzing, Synthesizing
2. Quality Planners of Problem Solutions
3. Self-Educating
4. Highly Accurate Problem Solvers
5. Good at Evaluating Scientific Reports
6. Effective Communicators of Scientific Results

The real surprise in this list, one we had not foreseen, was #3, *self-educating*. We were also unprepared for the large emphasis put on #6, *communication*. Both of these have startling implications for present-day instruction.

1d. Validity of the List. The participants strongly believed that the newly articulated "Industry Scientist Attributes" would correlate well with professional success in industry. However, we were rather skeptical about any such claims for such predictors of success, since research had shown that course grades, within the upper ranks, were not good predictors. The industry representatives said that this lack of course-grade correlation with professional success was in agreement with their own experiences, but that the new attributes list should provide a basis for good correlates in future studies: the items listed there (or the lack of them) are the very ones upon which industry bases pay-raises, promotions, transfers, and dismissals.

1e. Implementation: Teaching, Not Record Keeping. The industry representatives emphasized that we should begin sensitizing students to the Industry Scientist Attributes very early in their college careers. Thus instruction for even beginning students should be designed around these goals. They said it would be insufficient to merely test students on these attributes: we should actively seek ways to increase the number of students who make use of those skills habitually.

2. New Skill: Communication

2a. "Can't Seem to Get It Out of Them". The industry representatives expressed dismay at the inability of our graduates to "talk their science." The representatives said that the graduates surely know their material, in view of their good grades in relevant courses, but that somehow "they can't seem to get it out of them." The representatives attributed this to an inability of the students to express themselves.[1] The implication for instruction would seem to be a call for a dramatic reversal of the current trend toward machine-graded, multiple-choice examinations. Students' expression on such exams is trivial and unexaminable for feedback and remediation. Apparently we need to have students develop a habit of good scientific communication, and not just know the principles.[2]

2b. Some Implications for Instruction. One scientific communication skill is the ability to present material in the clear format demanded of everyone for journal publication. One need only look at the "chicken tracks" on examination papers in many General Physics courses in order to realize how far we are from that goal. We need instruction which teaches this skill effectively. Just as for journal articles, students should show the structure of problem solutions in a form useful for checking and conflict resolution.

2c. The Executive Summary. The industry representatives emphasized that an industrial scientific report is useless unless it opens with an Executive Summary. This is an overview of the entire report, intended to be easily read by company Vice-Presidents. This is a skill which we could help our students learn.

3. Old Skill: Content

3a. Content Precedes Communication. The industry representatives wished to impress upon us their feeling that knowledge of subject comes before communication: that communication skills are worthless without something to communicate. Perhaps the implication is that training in communication skills should go hand-in-hand with training in purely scientific skills.

[1]See "Colleges Get Low Grades," Appendix A, "Tests Tell Us Little About Talent," Appendix B, and "The Creative Student: an Unmet Challenge," Appendix D.
[2]See excerpts from "What Industry Thinks it Needs," Appendix E.

3b. "Can't Seem To Get It Out Of Them" Revisited. Although no industry representative expressed it this way, the thought occurred to us faculty that perhaps our graduates' communication failures were in part failures of knowledge and insight. If so, we need to redesign our instruction so it can indeed produce *observable* skills and insight.

4. New Skill: Self-Educating

4a. Industry's Problem. The industry representatives said that the persons they hire need to be self-educating. Very few new personnel are self-educating: most of them seem to require three-times-a-week lectures or heavy tutoring in order to keep up in their fields. The companies have tried bringing in university lecturers but that has proved to be too expensive. They have also tried bringing in video-taped university lectures, but they complained that the courses did not really suit their needs. They felt that such courses were too time-consuming and were usually too out-of-date. The industry representatives want employees who are capable of digging the latest developments out of scientific and technical literature, without the need of stand-up lecturers or tutors.

4b. Implementation. Teaching the skill of self-education may require a drastic change in faculty viewpoint. One would presumably reward students who learn to be self-educating and give low marks to those who never graduate from a need for stand-up lecturers or heavy tutoring.[3]

One can foresee a substantial increase in instructional efficiency under such a system. Faculty effort could then be shifted from lecturing to the production of better materials and the production of higher, more general, skills in our graduates.[4]

[3]See "Student Strategies for Success in CBI Physics," (*MISN-0-155) for the way course credit is awarded in CBI courses for "self-education," "communication," and other "Industry Scientist skills."*
[4]See "Levels of Learning Objectives," Appendix C.

4c. Materials For Implementation. We should consider teaching our students to routinely learn from industry-type materials. This would imply the use of materials which have many of the characteristics of technical literature. Such materials are usually produced in supplier industries through the collaboration of scientist technicians and skilled in-house technical writers. Although that course could be followed in developing instructional materials, many of our module authors might consider it quite rewarding to become skilled in producing those materials.

This would not only permit them to be sole authors of their modules, but would also prepare them to teach the skill of "Communicating Scientific Results Effectively."

5. New Skill: Evaluation and Judgment

The industry representatives suggested that students be taught to evaluate and judge the merit and local applicability of scientific reports. This would seem to lend itself particularly well to instructional material. There could be examples with good scientists' evaluations and judgments, along with examples which students could analyze themselves and then compare their results with those of professionals. Such modules would join on smoothly to those on The Treatment of Experimental Data, scheduled for production next year.[5]

Acknowledgments

We wish to thank the Physics Department of Michigan State University for sponsoring the meeting, and especially Professor Peter Schroeder for his fine handling of participant recruiting and physical arrangements. We are very appreciative of the time and effort put in by the industry participants, some of whom put considerable effort into preparing themselves for the meeting. Julian Kateley and Neil S. Dorsey provided us with copies of M.L. Roark's talk, excerpted in Appendix E. Preparation of this module was supported in part by the National Science Foundation, Division of Science Education Development and Research, through Grant #SED 74-20088 to Michigan State University.

[5] These modules are being produced by Project PHYSNET.

A. "Colleges Get Low Grades"

From *Industrial Research*, June, 1977, reprinted by permission.

International Journal of Research, Development, and Quality Assurance

INDUSTRIAL RESEARCH®

SERVING THE $76-BILLION WORLD-WIDE R&D INDUSTRY

OPINION POLL RESULTS

colleges get low grades

COLLEGES AND UNIVERSITIES took it on the chin in our Opinion Poll Survey, "How's the education?" More than half of the respondents have substantial reservations about the capability of today's graduates. Only 1,700 readers responded to this questionnaire, an unusually low figure for this column. This low response could indicate a lack of interest in the subject. Complete results of the survey follow.

1. *Do you feel that the university (or college) graduate of today has been well prepared for a career in industry?*
   An unqualified yes ... 2% In general, yes 31%
   Some, not very many . 45 About half are 12
   An unqualified no ... 10

2. *How does the college training of today's graduate compare with the training of several years ago?*
   Very much better today 9% A little worse today 23%
   A little better today . 30 A lot worse today ... 6
   About the same 32

3. *Do you believe that taxpayers receive adequate return on investment in public institutions of higher education?*
   An unqualified yes .. 11% In general, no 27%
   In general, yes ...... 33 An unqualified no .. 8
   About 50-50 21

4. *How should the curriculum of engineering and science students be changed?*
   More practical appliction, less theory 58%
   More material at less depth 13
   Less material, but at a greater depth 18
   The courses as structured are about optimum ... 11

5. *What aspect of a prospective employe's academic background would most impress you in a decision to hire?*
   Grades .... 9% Prior experience . 32%
   Broadness of subject matter in courses 26
   Depth of study of a few subjects 11
   Course content in subjects taken 22

6. *If you had the opportunity, would you encourage your company to participate in a program of specialized training in cooperation with a local college or university?*
   Strongly encourage .. 45% Oppose 4%
   Encourage .... 46 Strongly oppose 1
   Don't care 4

7. *If a college or university were willing to establish an educating program directed toward your needs, how much support would you want your company to provide?*
   None 4%
   Part time employment for students 21
   Part time or summer employment for faculty 5
   Part time employment for faculty and/or students and financial support to help establish the program 28
   Release time/tuition for employes attending 42

8. *If a local college or university had a seminar to develop an educational program directed toward industrial needs would you want to attend and participate?*
   Yes .... 88% No 12%

B. "Tests Tell Us Little About Talent"

From *American Scientist*, Jan.- Feb., 1976, reprinted by permission.

Michael A. Wallach

Tests Tell Us Little about Talent

Although measures of academic skills are widely used to determine access to contested educational opportunities, especially in their upper ranges they lack utility for predicting professional achievement

Quality educational resources are an inevitably scarce commodity, and the decisions as to which young men and women will gain admission to highly regarded colleges and universities and receive scholarships or fellowships while they are there are difficult ones. How should these decisions be made? The relative merit of candidates is the usual criterion, but the definition of merit is problematic. Typically, "merit" is defined as scores on tests of intellectual abilities and grades in the customary types of academic course work, which themselves are usually determined by some kind of test.

Of course, test scores and grades are not indices of merit in their own right; they are thought to provide a shorthand indication of a student's competencies in the world outside testing and classroom situations. Recent research on the nature of talent indicates, however, that the premise that tests reflect the potential for achievement is false for scores across the upper part of the range on customary assessments of academic skills—precisely that part of their range in which such scores are most often used for selecting recipients of the most contested educational opportunities. The answer is not, as I and some others first thought, to replace tests aimed at assessing academic skills with tests that would reflect a person's "creativity"; rather, tests should be used only to screen out candidates who score too low. To make distinctions among the candidates who remain, we should rely not on tests but on samples of professional competencies themselves.

Disenchantment with the utility of tests in their upper ranges for predicting the sought-for competencies is not limited to the study of talent but has been increasing among most psychologists who attempt to devise ways of assessing human behavior. Traditionally, after theorizing about the relatively abstract dispositions that presumably underlie the display of the behavior, the psychologist attempts to develop tests that would signal the operation of these dispositions. Since the connection from test to criterion is mediated by complex theoretical constructions, the former need have nothing in common behaviorally with the latter. A psychologist could try to evaluate the chances that a particular therapeutic treatment would succeed with a subject by something as unrelated as the way in which the subject completed sentence stems or interpreted ambiguous pictures.

With enough negative evidence in hand from attempts of that sort, we now know (see e.g. Mischel 1972) that more reliable answers are provided by assessing what the subject does in a sample of the treatment situation itself. The problem is that the test responses, even if they possess a modicum of "criterion validity"—that is, give results better than chance at predicting the behavior of direct interest—inevitably reflect other factors as well (see Wallach 1971a; Wallach and Leggett 1972). And the greater the conceptual distance between the test and the performance to be predicted, the less reason there is to believe that the test will tell you what you really want to know. It will tell you about the person's response tendencies in situations that resemble the test rather than in situations that resemble the criterion.

Academic skills tests

Above intermediate score levels, academic skills assessments are found to show so little criterion validity as to be questionable bases on which to make consequential decisions about students' futures. What the academic tests *do* predict are the results a person will obtain on other tests of the same kind. Some of the evidence for this statement is based on accomplishments of directly meritorious kinds during the student years, and we shall consider it first. After that, we will turn to accomplishments in occupational and professional roles. The research along both lines is extensive enough that we can only sample it here—but the sample is representative. Further amplification of this evidence and its meaning can be found in Wallach 1971a, 1971b, and in press; Wing and Wallach 1971; and Wallach and Wing 1969.

Most of what constitutes the usual academic course work, with its di-

Michael A. Wallach is Professor of Psychology at Duke University. He has also held faculty positions at Harvard, MIT, and the University of Chicago. He did his undergraduate work at Swarthmore and is a Harvard Ph.D. Dr. Wallach, who served as editor of the Journal of Personality *from 1963–72, is a past president of the Division on Psychology and the Arts of the American Psychological Association. His research has included the study of cognitive competencies, talents, and skills in children and adults, with particular reference to implications for improving educational policies and practices. He is coauthor of a work on compensatory education,* Teaching All Children to Read, *which will be published in early 1976 by the University of Chicago Press. Address: Department of Psychology, Duke University, Durham, NC 27706.*

C. "Levels of Learning Objectives"

Reprinted from *Learning Objectives for Individualized Instruction: Science*, Cambridge Book Co., New York, NY (1975), reprinted by permission of the publisher.

viii LEARNING OBJECTIVES/Science — Introduction ix

Levels of Learning Objectives / **Levels of Learning Objectives** (continued)

I KNOWLEDGE	II COMPREHENSION	III APPLICATION	IV ANALYSIS	V SYNTHESIS	VI EVALUATION
Emphasis: Recall	*Emphasis:* Grasp of meaning, intent, or relationship	*Emphasis:* Applying appropriate principles or generalizations	*Emphasis:* Breaking into constituent parts and detecting relationships of the parts and the way they are organized and organizing material according to a coherent pattern	*Emphasis:* Putting together elements or parts to form a whole that reflects originality	*Emphasis:* On values, making qualitative or quantitative judgment, using criteria from internal or external sources and standards
choose from a list (judgment not involved) define (give a dictionary definition) fill in the blank (or complete) follow directions identify indicate label list locate (on a map or a given document) match name select (judgment not involved)	classify define (in student's own words) describe explain express in other terms find (as in math) measure paraphrase put in order recognize rewrite simplify suggest summarize trace (on a map, chart, etc.) *Math* add (find the sum) balance calculate compute (using a given formula) divide (find the quotient) factor find square root or raise to power multiply (find the product) perform operations on numbers subtract (find the difference)	apply collect information (supply correct equation or formula) compute construct convert (in math) draw determine (calculate) demonstrate derive differentiate between discuss distinguish between expand express in a discussion estimate find (implies investigation) interpret investigate illustrate (give examples not previously specified) graph keep records locate (information) make participate perform (except in math or in public) plan predict (from known factors) prepare present prove (in math) solve (problems expressed in words) use trace (development, history, process) translate	analyze compare and contrast criticize debate deduce determine differentiate between (by analysis) draw conclusions formulate form generalizations make inferences organize relate (show relationships)	combine and organize design devise develop perform (in public) produce present (an original report or work) write (an original composition)	choose (based on evaluation) decide evaluate judge make a decision

D. "the Creative Student: an Unmet Challenge"

Quotes from *The Creative Student: An Unmet Challenge* by Paul Heist, Jossey-Bass Inc., Publ., San Francisco (1968). Reprinted by permission.

Page 121:

RELATIONSHIP OF GRADES TO ACHIEVEMENT AND TALENT

Research findings clearly justify the distrust which both faculty and students have expressed toward the traditional grading system. Course grades have not been found to constitute a reliable index to any dimension—past, present, or future—of a student's work or life, except other school grades. All the data confirm the view, stated in *The American College* (Webster, Freedman, and Heist, 1962, pp. 816–817), that a student's grade-point average is an inadequate measure of educational growth; see also the studies by P. B. Price, J. M. Richards, and C. W. Taylor cited in Chapter 7.

If course grades in general do not accurately reflect educational growth, the relationship between grades and creativity is even more distant. In Brown's discussion of his Vassar study, in which the faculty nominated ideal students, he cites the work of Getzels, who goes so far as to maintain that both high scores on standard tests and high course grades result more from narrowness and conformism than from original and creative thinking. Commenting on this observation, Brown states, "In fact, creativity is penalized since the creative student is apt to give a highly original meaning to the question which in a machine-scored test or in the presence of a 'by the book' teacher will not be scored correctly or appreciatively (1962, p. 539)."

Page 123:

Holton quotes from an autobiographical note of Albert Einstein, who believed that learning cannot be promoted by means of coercion and a sense of duty. "This coercion," Einstein wrote, "had such a deterring effect that, after I had passed the final examination, I found the consideration of any scientific problems distasteful to me for an entire year." Faculty members on American campuses who allow this view (that learning cannot be promoted by coercion) to influence their teaching and grading are often put on the defensive by "tougher" colleagues. They are not only accused of being "soft" but—and this is the acme of insult for an academic man—of lowering academic standards. Their only answer is that the "tough" professor's way of keeping standards high very likely does his students more harm than good. But such a response only emphasizes the chasm between the two types of professors. Freedman's experience with both kinds (and his studies of

E. "What Industry Thinks It Needs"

Reprinted by permission.

WHAT INDUSTRY THINKS IT NEEDS

(Remarks by Mayford L. Roark, Executive Director-Systems, Ford Motor Company, for Industry Workshop on Information Systems Education. April 6, 1976, Chicago, Illinois)

None of our managers was interested in hiring for any of these skills below the Bachelor's level. Roughly half of the hiring is projected at the Master's level, with about a 50-50 spread in the case of Programmers and Technical Specialists between Computer Sciences and other majors. Systems Analysts and OR Analysts, for the most part, are viewed as coming from tracks other than Computer Sciences.

We can't, of course, recruit people solely on the basis of qualifications for their entry jobs. We need to have some ideas about their future possibilities. There are several reasons why we are particularly attracted to recruits who have long-range potential for general management:

1. Our influence as a systems community within our company is enhanced as our alumni go on to greater things in other areas. An encouraging number of our systems people at Ford have gone on to senior executive positions. We count their success as our success.

2. In the sociology of large organizations, the rewards go to managers more than to technicians. The talented people we want to hire, therefore, must perceive an opportunity for advancement or they will find their careers confining and frustrating.

The most important sign of management potential is communication skill — both oral and written. In the questionnaires, I did not ask about these skills, but several managers emphasized them anyhow as being the most important attributes they will look for in hiring people. Without doubt, these communication skills are the major determinants of who, among our recruits, will adapt to higher levels of responsibility either in or out of the systems function.

I have tried to relate these responses (which seem to me an accurate assessment of our needs) to what I know of the offerings at universities where we recruit. Here are some of the questions that come to mind:

5. Can't more be done to teach students how to document a system, both for users and for technical operations, in clear, understandable English and appropriate top-down charting? Can't they be taught how to write reports, prepare presentations, and develop systems proposals? Can't they be better prepared in the communication skills on which their future advancement will so heavily depend?