SKILLS FOR PROFESSIONAL SUCCESS

by

Peter Signell

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Input Skills:

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.”

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.

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Views expressed in a module are those of the module author(s) and are not necessarily those of other project participants.

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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.

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.\(^4\)

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\(^2\) See excerpts from “What Industry Thinks it Needs,” Appendix E.

\(^3\) 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.

5These modules are being produced by Project PHYSNET.

A. “Colleges Get Low Grades”

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

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 in a sample of the treatment situation itself. The problem is that the response, even if they possess a modicum of "criterion validity"—that is, give results better than chance at predicting the criterion of interest—is inevitably so low. To make distinctions among the candidates who remain, we should rely not on tests but on samples of professional competencies themselves.

D. "the Creative Student: an Unmet Challenge"

E. "What Industry Thinks It Needs"

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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?