Technology Profile: An Assessment Strategy for Technological Literacy

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Given the scope of technology and the inherent difficulties of measuring such broad phenomena, this article explores two strategies for assessing technological literacy. One approach is drawn from a multiple measurement strategy often used to assess achievement, the test battery approach; the other is based on well-known interest inventories and personality type indicators, the typology approach. Shared between these approaches is the notion of a profile. One's performance or rating could be reported through a profile, that is, "a formal summary or analysis of data, often in the form of a graph or table, representing distinctive features or characteristics" (The American Heritage Electronic Dictionary, 1992).

While it is undeniable that the creation of such measures would be demanding given the conceptual scope of the undertaking, such efforts are called for in a report by the Committee on Technological Literacy—a joint committee of the National Academy of Engineering and the National Research Council, Center for Education (Pearson & Young, 2002). Specific recommendations were made for "the development of one or more assessment tools for monitoring the state of technological literacy among students and the public in the United States" (p. 12).

In principle, a technology profile could provide a means by which one's technological prowess or disposition could be indexed or classified according to a determined scale or system. Such a profile could aid in (a) the identification of potential students for a given program, (b) the comparison of one's capabilities to a known group, (c) the determination of one's technological knowledge and skill in a particular area of technology, or (d) the classification of one's disposition toward technology.

The Test Battery Approach

The battery approach for a technology profile is based on a common method used by many measurement instruments when several dimensions of a phenomenon are to be measured. A single instrument approach is usually avoided because to accommodate the breadth of the phenomenon the test instrument would need to be very large, and thus too time consuming and laborious to administer or complete. In these situations, a battery of tests are employed with each test measuring a specific area of the phenomenon.

The well-known General Aptitude Test Battery and Differential Aptitude Tests are two examples of such multiple test strategies. A more recent and related example can be found in the Technology and Internet Assessment (Ealy, 1999). This assessment battery is designed to determine one's strengths and weaknesses in eight areas related to computer, Internet, and information skills. The eight areas are titled (a) Use of Technology, (b) Specific Computer Skills, (c) Acquisition of Technology Knowledge, (d) Basic Internet Knowledge, (e) Internet Information Skills, (f) Adapting to Technological Change, (g) Impact of Technology, and (h) Ethics of Technology. Such a model could be adapted for measuring the broad spectrum of technological knowledge, skills, and disposition.

Given the array of content now being promoted for the technology education curriculum through the Standards for Technological Literacy document (International Technology Education Association [ITEA], 2000), it is difficult to imagine that a single test approach would adequately measure the intended literacy. In combination with the assessment standards set forth in the recent Advancing Excellence in Technological Literacy document (ITEA, 2003), a single test approach does not seem reasonable. It would seem that the development of a battery of tests would serve both the content and assessment standards better. Just how such a test battery might unfold is unknown; however, certain reports are conceptualized below to help guide an overall development process.

Figure 1. Conceptual representation of a Technology Profile.

Name: ______________________ Test Form: __________

TECHNOLOGY PROFILE
Individual Profile Chart & Cumulative Record

Record of Testing:

Date: _______ Date: _______
Standard: _____ Standard: _____
Score: _______ Score: _______

Date: _______ Date: _______
Standard: _____ Standard: _____
Score: _______ Score: _______

Date: _______ Date: _______
Standard: _____ Standard: _____
Score: _______ Score: _______

Date: _______ Date: _______
Standard: _____ Standard: _____
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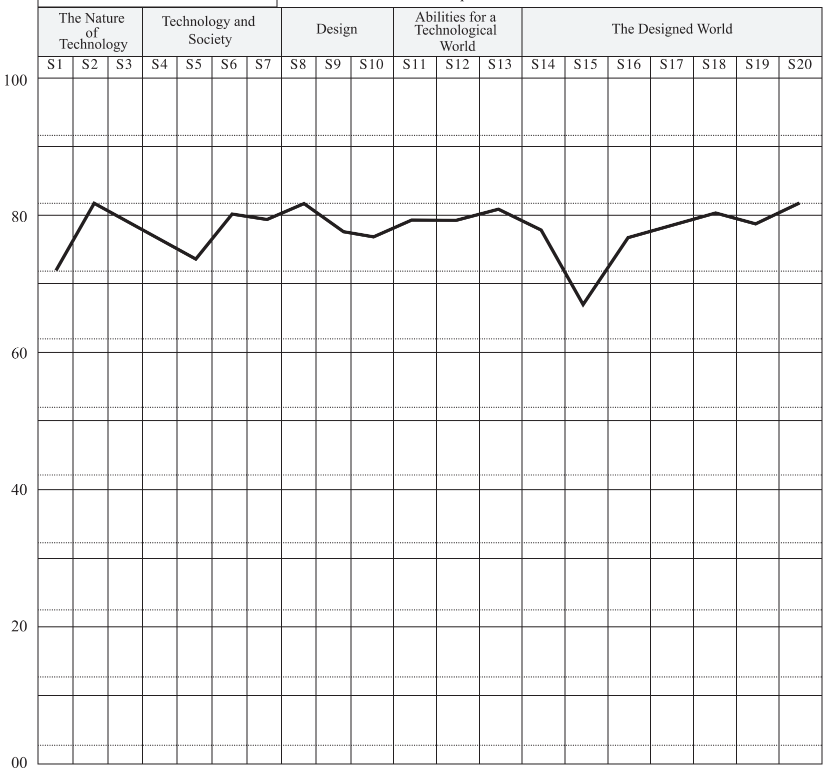
Date: _______ Date: _______
Standard: _____ Standard: _____
Score: _______ Score: _______

Date: _______ Date: _______
Standard: _____ Standard: _____
Score: _______ Score: _______

Bold Line Denotes School Norm

See back for S code descriptions.



S Code Descriptions

The Nature of Technology *Students will develop an understanding of . . . .*
S1: the characteristics and scope of technology.
S2: the core concepts of technology.
S3: the relationships among technologies and the connections between technology and other fields of study.
Technology and Society *Students will develop an understanding of . . . .*
S4: the cultural, social, economic, and political effects of technology.
S5: the effects of technology on the environment.
S6: the role of society in the development and use of technology.
S7: the influence of technology on history.
Design *Students will develop an understanding of . . . .*
S8: the attributes of design.
S9: engineering design.
S10: the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
Abilities for a Technological World *Students will develop the abilities to . . . .*
S11: apply the design process.
S12: use and maintain technological products and systems
S13: assess the impact of products and systems.
The Designed World Students will develop an understanding of and be able to select and use . . . .
S14: medical technologies.
S15: agricultural and related biotechnologies.
S16: energy and power technologies.
S17: information and communication technologies.
S18: transportation technologies.
S19: manufacturing technologies.
S20: construction technologies.

Note: This page is the back of the Technology Profile.

Figure 2. Conceptual representation of a Technology Profile and Summary Report.

For: John J. Jones
3546 Clearwater Creek Road
Somewhere, USA 01010-3546

Date: November 14, 2004

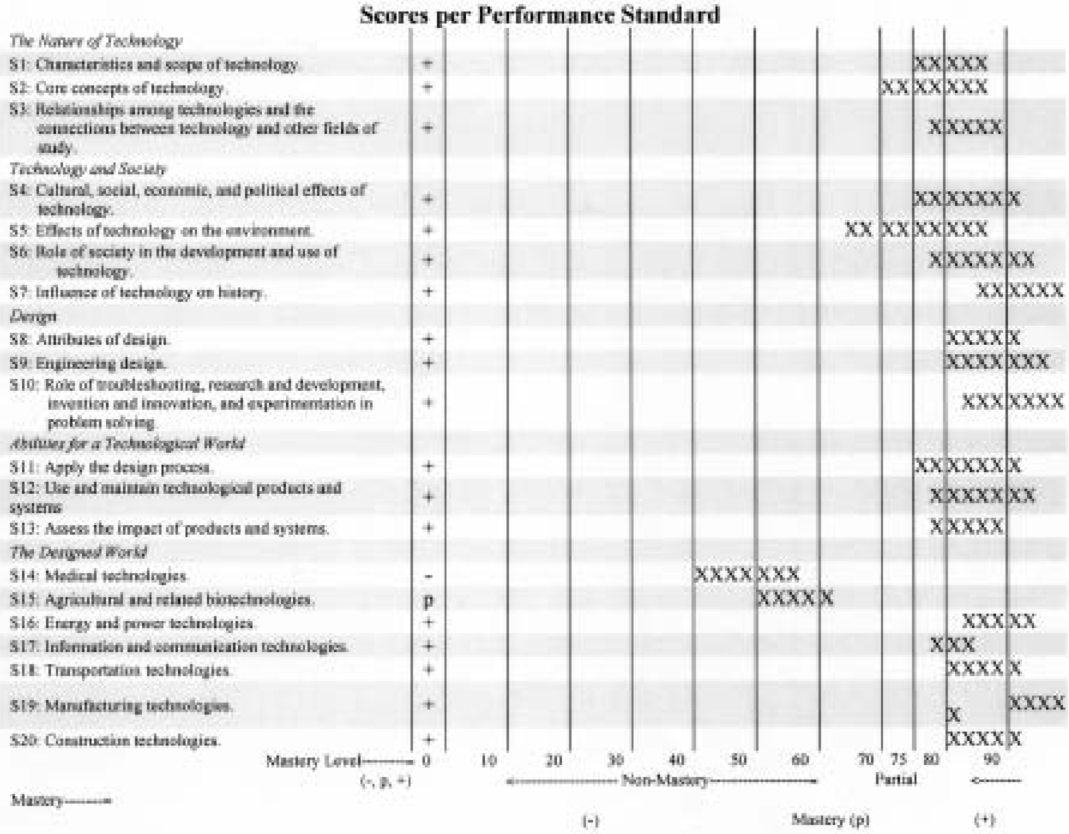
Test Form: A Level: 10

Test Cluster	Score	Comparison Norms		
		School	Regional	National
The Nature of Technology	*81*	80.6	78.2	82.5
Technology and Society	*84*	81.0	80.0	80.9
Design	*87*	82.0	83.9	86.0
Abilities for a Technological World	*85*	83.3	79.4	80.0
The Designed World	*80*	80.8	78.4	78.3
Combined Score	*417*	407.7	399.9	407.7

School: Mountain Crest High School
7834 Mountain Crest Road
Somewhere, USA 01011-7834

Class: TE 310/Wilson
Room: 127

Scores per Performance Standard



Note: On your profile, a bar of X's has been printed in the row for each performance standard. Your score is at the center of the bar. The reason for the bar instead of a single X is that a test is not a perfect measure of your knowledge, skills, or ability. You can be reasonably sure that you stand somewhere within the area covered by the bar.

Technology Achievement Profile

In addition to the test battery design, the notion of a technology profile draws on certain data representation associated with various survey and inventory instruments. This aspect of the profile could serve to compare one's scores on the overall battery of tests with the characteristic scores of others. Scores on the individual tests of the battery (i.e., subtests) could be reported in such a way as to provide an overall portrait of one's performance or rating. Such reporting is often done in the form of charts or derived scores. Two possible models are described below. It should be noted that Figures 1 and 2 are conceptual representations only; the test to generate these reports has not been created or administered. All the data displayed in the profiles, therefore, are fictitious.

The first model, the *Technology Profile* (Figure 1), provides a graphic display of one's performance on 20 different subtests. For our purposes here, the subtests are based on the 20 content standards set forth in the Standards for Technological Literacy (ITEA, 2000). This model promotes the idea of an individual profile chart and cumulative record. The graphical depiction also provides a means for comparing one's scores to other established scores, for example, a cumulative overall school or school district's performance.

The second model, the *Technology Profile and Summary Report* (Figure 2), provides scoring bands for the 20 content standards in addition to grouped scores for the five divisions of the content standards: The Nature of Technology, Technology and Society, Design, Abilities for a Technological World, and The Designed World. The scoring bands (bars of Xs) represent the confidence range for the given test score. Comparison norms for the individual school, region, and nation are also included. One's achieved level of mastery is incorporated into the report as well.

Given these two forms of reporting, one could compare an individual's score to those of his or her classmates or to much broader groups. It would allow for comparisons between the many subcategories of technology. Such an approach could provide a multidimensional portrait of technological literacy.

The Typology Approach

A truly unique approach for a technology profile could come in the form of a typology indicator, that is, a depiction of one's attitudes toward technology. From a general education perspective, given the ephemeral nature of technological knowledge and skills, this approach could prove more meaningful over time. Such an instrument would have greater longevity (i.e., shelf life) and could provide information that a competency scale would normally overlook. The profile could be based on survey and inventory type instruments, for instance, the personality scales of the Myers-Briggs Type Indicator (MBTI) and the Keirsey Temperament Sorter (KTS). Here, one's knowledge, skills, and attitudes regarding technology could be used to sort and categorize individuals according to some scale of technological capacity, interest, or disposition.

The MBTI uses four dichotomy scales to produce 16 different personality types. Two of the four scales deal with mental functions (i.e., thinking/feeling and sensing/intuition) and two deal with attitudes (i.e., extraversion/introversion and perceiving/judging). The KTS divides these 16 types of the MBTI into four major categories (i.e., artisans, guardians, idealists, and rationals). Each of the four categories is then divided into four subcategories, each with its own descriptor (see Table 1). Using the MBTI and KTS as models, a technology disposition profile is discussed in the next section.

Technology Disposition Profile

Developing a technology disposition profile would require the creation of dichotomous scales for a variety of attitudes and sentiments toward technology. In keeping with the MBTI (where the scales follow along mental and attitudinal lines), the scales for a technology disposition profile would follow the same logic, that is, mental and attitudinal. Mental functions could be viewed as the mental dispositions (i.e., habits of mind) of certain creators and users of technology; attitudes could be cast along the lines of application and consequences (e.g., Engineer : Utility :: Artist : Aesthetics or Environmentalist : Conservation :: Producer : Consumption). Such scales might resemble those shown in Table 2.

Table 1. Types and Temperaments According to the Myers-Briggs Type Indicator and Keirsey Temperament Sorter

Artisans	Guardians	Idealists	Rationals
Promoter (ESTP)	Supervisor (ESTJ)	Teacher (ENFJ)	Fieldmarshal (ENTJ)
Crafter (ISTP)	Inspector (ISTJ)	Counselor (INFJ)	Mastermind (INTJ)
Performer (ESFP)	Provider (ESFJ)	Champion (ENFP)	Inventor (ENTP)
Composer (ISFP)	Protector (ISFJ)	Healer (INFP)	Architect (INTP)

Note: E = extraversion, I = intuition, F = feeling, J = judging, N = introversion, P = perceiving, S = sensing, T = thinking.

Table 2. Potential Dichotomy Scales for Attitudes Towards Technology

Creators / Users	Applications / Consequences
Designers / Producers	Products / Costs
Producers / Consumers	Services / Benefits
Management / Labor	Resources / Environment
Government / Citizenry	Political / Economic

Discussion

The notion of a technology profile, as just described, raises a number of questions. For instance, given the 20 content standards developed by the ITEA, is it conceivable that they could serve as the constructs for test development? If each standard was used for a separate instrument, 20 individual tests would likely be viewed as too cumbersome to develop and administer. Would it be more manageable then to use ITEA's five major divisions of the content standards to guide test development? Would five tests be adequate? Given the breadth of technology, five tests would seem limiting especially if one's everyday lived encounters with technology were to be included. Everyday lived encounters go beyond what can be expected from the typical classroom education. There are issues of learned versus acquired literacy here (Gee, 1989).

A possible compromise might draw on both the standards and their divisions. A combination approach may be comprised of 10 separate instruments; for example, the test titles may be as follows: The Nature of Technology, Technology and Society, Design in Technology, Medical Technologies, Agricultural and Related Biotechnologies, Energy and Power Technologies, Information and Communication Technologies, Transportation Technologies, Manufacturing Technologies, and Construction Technologies.

The above discussion has addressed a few of the issues surrounding the more traditional test battery approach; the typology approach would have similar concerns regarding scope and size. Given the number of occupational interest inventories and scales that are available today, would developing a type sorting scale for technological dispositions add a meaningful dimension to our measurement of technological literacy? What might such a measure of beliefs and attitudes add to our understanding of technological literacy?

The typology scale, as conceptualized here, goes beyond occupational interest and fit. It seeks to investigate further than one's conscious knowledge, skills, and motivation. The objective is to gain an understanding of one's dispositions toward technology—those beliefs and attitudes that have both conscious and unconscious origins. It can be argued that one of technologies most serious liabilities as a legitimate domain of knowledge is its growing invisibility. There are two dimensions to this invisibility. First, there is one's familiarity with technology; that is, as one interacts with technology on a daily basis, one's awareness of that interaction is dimmed. This is often explained as a level of *automaticity*, a state in which one acts without attending much conscious effort. In this dimension, the more one interacts with and is dependent upon technology, the less one realizes and appreciates the interaction.

The second dimension of technology's invisibility is based on technology's own evolution. As technology advances, it becomes more invisible. In today's computerized world, we talk about a seamless interface. Essentially, this means an invisible blending of multiple components. This invisibility masks the real complexity of what is transpiring; it simplifies the technology for the human user. This phenomenon of simplification often results in a lack of awareness and appreciation of the technology. The simplification masks many of the implications or impacts of technology on the individual, the society, and the environment.

Closing Thoughts

There remain numerous questions regarding the viability of a profile approach for technological literacy. The test taker's own mental endurance (potential boredom, for instance) must be considered when determining the size and number of tests in a battery. Like many other test batteries, the individual tests can be spread over a period of days, weeks, or perhaps months. Since each test would address a specific area of content, boredom and a sense of repetition could be minimized.

Another consideration must be one of *perception*. How will these tests be viewed by teachers, administrators, parents, or the general public? In our era of high-stakes testing, adding another layer of testing would likely be met with resistance. Consequently, as mentioned earlier, technology's misunderstood nature is one of the greatest challenges when it comes to perception. At the school level, devoting time out of the school day to measure technological literacy will ultimately be gauged against its perceived value with mathematics, language arts, science, and other school subjects. Hence, it must be acknowledged that technology still struggles for a place in the greater sociology of knowledge.

The notion of a technology profile has other entanglements with perception as well, for instance, the negative image of *profiling*. Could one's technology profile be used in a negative way? Could it be used to unfairly stereotype individuals? While one must admit that such an outcome is possible, it is certainly not the intent.

Whether a test is required or elective holds still other perceptual concerns. The technology profile is not envisioned as a mandatory test unless, perhaps, the study of technology achieves a required status in the total school curriculum. It should be further understood that a technology profile may not necessarily be part of the K–12 schooling experience at all. A profile could have value in both school and nonschool settings, as with many other tests related to technical or workforce matters.

Perhaps the most difficult challenge for developing a technology profile, whether for the test battery approach or the typology approach, would be the creation of the test items or statements. Validity, and perhaps reliability, will indeed be a challenge. Even though every human being encounters technology everyday, it is the diversity, combined with a certain level of competency, that is problematic. Here, we can take a lesson from the field of artificial intelligence (AI).

At one time, AI held much promise for aiding complex decision making. It was believed that if we could create a large enough database and access it with an appropriate algorithm that AI would be able to answer almost any complex question. In reality, the diversity of the human knowledge base and the complexity of human situations have proven much more difficult than originally recognized. AI has given us many very useful problem-solving tools but mostly in very restricted environments (e.g., selected medical and engineering applications).

The AI lesson for measuring technological literacy is twofold: (a) context must be limited and (b) multiple, more narrowly defined tests produce better results. Validity hinges primarily on the first point; namely, validity must consider the background and/or setting of the one being tested. Thus, it could be argued that with technology's diversity across human culture, it would not seem unreasonable to design a given test for a particular region of a country or, perhaps, even for urban versus rural encounters with technology. While this may seem to further complicate the issue, its intent is to draw attention to the matter of application. Technology is fundamentally an applied subject by nature. Test items and statements will be valid to the extent that they measure what one *knows about* technology and what one is *able to do* with technology within a given context. To not include these aspects of technology will yield an incomplete measure of technological literacy and thus limit the validity of the overall test.

Finally, the technology profiles conceptualized in this article are intended to promote our thinking about the assessment of technological literacy. With the growing emphasis on standards and their assessment, the technology profile may provide an alternate means for documenting one's achievements and dispositions toward technology. While such an approach would surely require an extensive development effort, it would seem that the complexity and scope of technological literacy warrants such an approach.

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Author Note

Figures 1 and 2 in this article are based on the reports used by the Iowa Tests of Basic Skills and the Comprehensive Tests of Basic Skills.