Discovering The Academic Potential Of Our Children

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The problem with performance with assessment

Not all that shines is gold, but, some things that do not always shine are precious as gold, and so it is with the minds of our children. There may be a lot of value buried in the depths of those databases being built by and with industry, but it is in the depths of time yet to come that the real gold lies, hidden in the future of our youth.

Certain problem solving styles and cognitive behavior reflect academic potential that lead to success in college. Even students who are often bypassed by traditional recruiting activities have been known to demonstrate such potential. Potential often unrealized, wasted, lost. Alternative assessment methodologies are just beginning to touch upon the unknown of human capacity. But many aspects of those programs rely heavily on observation and detailed analysis of generated data, making them labor intensive. These kinds of complex analyses, however, often yield more accurate results for under-served populations than traditional assessment practices. Some mentoring programs that emphasize gathering of data for comparison in various groups, selected by specific characteristics, tend to provide clues for identifying and nurturing promising candidates who are usually bypassed because of early poor academic performance. An approach that helps to compensate for unequal early education preparation, does merit consideration.

Imagine an educational system where all students can realize the full power of their human capacity. A system is possible in which gender and race play no roles in determining performance and expectations. Imagine equal educational opportunity driven by talent and achievement. Those who evaluate students make their future. How we evaluate them decides the future of our nation. We have a national responsibility to ensure that every student is correctly assessed for all the potential that is our nation's to harness and nurture. Assessment practices, more than any other education responsibility, require our national attention. Industrial growth and productivity gains in a global economy are expected to increasingly depend on improvements in our ability to apply and analyze new knowledge. Emerging data mining technologies will attempt to do just that. But that is not enough. Today we are faced with the additional challenge of not indulging in the luxury of bypassing any human potential. We must apply those technologies where they will make the most difference, to mine the potential of our youth.

There is an increasing and compelling national need for making identification of academic promise to enhance the quality and quantity of the American work force by drawing qualified candidates for engineering and high-tech careers from our nation's entire population of students. Properly harnessed, advanced techniques can have considerable impact on alternative assessment practices, and indeed on the discovery of intellectual identity for all students. But, to

begin to apply these concepts on a broad scale means we must use the same strategies for change that the nation's corporations are using to remain competitive. Standardized data analysis of test results is no longer sufficient. In a technology and information driven society, a preferable approach is to combine advanced technology with methods for alternative assessment to identify human potential.

In *Performance Based Assessment and Educational Equity*, Darling-Hammond points out that "efforts to raise standards of learning and performance must rest in part on strategies to transform assessment practice. Normative and multiple choice tests fail to measure complex cognitive and performance capabilities." A believe shared widely, because, the ability to use and construct knowledge, synthesize, and apply information is increasingly valued in education. Assessment and evaluation practices must, absolutely, explore the complexity of problem solving skills, styles and competencies that predict academic success, not just measure it at existing levels. The process of knowledge discovery of student potential would require the detection of patterns that permit these kinds of alternative assessment practices. The current global approach to assessment relies on elicited data, by means of testing, rather than on the discovery of potential. The result is a number that represents a classification of students by means of a single test. This approach is exclusive. We need a more inclusive model.
It may be that the place to find this, more inclusive, model is in Howard Gardner's respected theory of multiple intelligences, which challenges the very premise that there is a single human intelligence and that it can be measured by means of a test, and ranked with a single number. Exploring this related problem, perhaps in the same class of problems, according to Dr. Gardner, eight integrated intelligences compose the measure of human potential. Taking this theory one step further Barkman, in *The Building Tool Room*, has suggested that the ability to recognize and classify intelligence derives from "a natural expertise in identifying patterns." This thesis offers some clues as to what data mining technologies might be able to do for student assessment.

Basic research in education combined with applied data mining research is needed to explore the new possibilities that technology has to offer. Data mining entails the automatic discovery of trends and patterns in large amounts of data. It is a technique based on the interpretation of such patterns in data leading to knowledge discovery. Discovering student strengths and weaknesses is not part of standard achievement testing practices, rather assessing current performance is. What can be learned about students by the use of data mining techniques, however, is highly subjective to the data being collected. Typically, assessment practices do not elicit data that can be useful in the discovery of new knowledge about student potential. Data mining allows for the generation of specific and general queries (about student performance), and these are possible if appropriate data has been collected and is present in the assessment process. The technique promises to discover knowledge, and find new ways of looking at special kinds of data, but for alternative student assessment this data must be created or exist. Assessment practices must be able to extract the kind of data necessary for identification of talent by examining those problem-solving skills and cognitive behaviors that many educators believe are significantly correlated to performance.

The discovery of new knowledge about performance, using data mining, may be able to identify highly qualified individuals who are missed by standard assessment practices, if the necessary data is collected. Recording this class of data requires paying attention and documenting examples of verbalization of concepts, and of the framing of questions. It requires noticing how a student engages other students and faculty, uses available resources, tests ideas, produces

ideas, structures solutions and ultimately solves problems. It includes detecting and documenting the student's ability to construct new knowledge and of other cognitive behaviors known to contribute to high performance and that hide within them the promise of academic success.

A high-tech approach to performance assessment

Data mining holds the promise of discovering human potential, but only if the attributes for human potential are present in the data examined. The discovery of knowledge about student potential without this data could not easily take place. Data warehouses of new classes of student data need to complement emerging approaches for discovering academic potential. It is important to understand where knowledge discovery is headed and how data mining works so that we can start to collect the classes of data that will be needed in order to take full advantage of these techniques in education. The natural expertise that is inherent in parents and educators to detect these patterns must be tapped and a methodology for gathering this data must be devised. Potential that is difficult to detect is often intuitively known by human contact and years of field experience, subjective approaches. To discover these attributes by means of a single test, or a single test mechanism is unrealistic, and not surprisingly, parents have always known best "how bright their children are", while tests have and continue to fail to identify for our nation the potential that exists in so many of our bypassed children. This has been and still is a tremendous loss to society.

By enhancing alternative assessment with data mining knowledge discovery we are afforded an opportunity to rethink assumptions about student promise and the selection process, especially as we grapple to meet the challenges of a rapidly changing society. The typical argument from those reluctant to let go of the standardized testing include the need for and evaluation mechanism that can be broadly and uniformly applied. Advanced techniques that hold some promise for widely and systematically addressing deficiencies in standardized student testing by introducing the practice of knowledge discovery include: decision trees, rule induction, inference engines and neural networks. These require very specialized high-tech skills and cannot be easily deployed by lay-users. Experts and knowledge engineers were trained to deal with such problems even from the early stages of artificial intelligence research. Such training is typically complex because of a) limited access to both domain experts and high-tech experts, and b) shortage of domain expertise and high-tech skills in the same person. The Artificial Intelligence (AI) approach has become a near impossibility and prohibitively expensive for application to educational practice. In order to improve on these approaches in general, techniques for data mining are being devised to address the larger issue of knowledge acquisition and discovery by the lay-user. Data mining is one of the few advanced technique that, in the practice of alternative assessment, a) will help lead to knowledge discovery about human potential and b) will be usable by teachers, parents and students.

The general principle is that of constructing an enriched pattern around the data so that integrating domain specific knowledge becomes possible. Knowledge discovery in alternative assessment will take place when educators are able to address patterns identified by the data-mining tool. Non-technical users will make these patterns amenable to interpretation. Then, in fact, the ability to recognize and classify intelligence will be based on the identification of cognitive behavior patterns. Additional supportive data such as text, images, video, audio, etc. that can help to build the context necessary to fully interpret these patterns can be incorporated in the data mining approach. That ability lends itself well to harnessing student portfolios and

multimedia student projects. A teacher, parent or administrator will be able to easily ask a general or specific question about student performance or potential buried in these portfolios and multimedia folders. The data mining tools in such a way that interesting results are highlighted and academic potential is discovered will interpret these. Using data mining technology we will be able to refine the process of assessment and by using a Web-centric model to apply it, we will be able to simplify implementation. Deploying via the Internet would then produce the systemic change in practices that we desire. But, most importantly, students themselves will be able to assess their own potential.

All these things are at hand because all the necessary technologies exist, and because we know what changes are necessary.

We must:

1. Foster appropriate data collection of learning styles and cognitive behaviors by identifying parameters and gathering key data to facilitate use of new information tools.

2. Build suitable data warehouses for alternative assessment; and, build special applications of student records in data warehouses, designed to accommodate identified key data.

3. Harness this data for data mining of academic potential using special kinds of data mining techniques to discover significant new knowledge that is buried in student work and behavior.

If these new approaches succeed, the social impact will be a community of lay-users (teachers, parents, decision makers, and students) relying more on leading edge technologies and new assessment methods, and less on learned expectations and biases. Our educational system has not yet reconciled student assessment with cognitive science, but it can at least now reconcile with technology. Our community can share a common Web-centric environment supported by a pervasive infrastructure that integrates data mining technologies with alternative assessment practices and with an Internet-based access mechanism. The reason for creating a new infrastructure for performance assessment is to not only expand the perception of who can achieve in school, but also to expand the numbers of those who do. There is no challenge in building a new way of assessing performance, we have the means to do that, the real challenge is in discovering the gold in the future of our children.

About the author

Dr. Miriam J. Masullo is Director, Educational Technology at the National Action Council for Minorities in Engineering - NACME, on faculty loan assignment from the IBM Thomas J. Watson Research Center where she has been a member of the research staff for almost 15 years. Dr.Masullo is an expert in educational technology having received her Ph.D. from the City University of New York for her interdisciplinary work with the departments of computer science and educational psychology. She has been a leading force in the application of artificial intelligence, digital libraries and telecommunications infrastructure to K-12 education. Her current work focuses on equity access and equal education opportunity for all Americans.