

JOURNAL OF RESEARCH AND PRACTICE FOR ADULT LITERACY, SECONDARY, AND BASIC EDUCATION

Published Jointly by The Commission on Adult Basic Education and Rutgers University

RESEARCH

Using Modern Statistical Methods to Analyze Demographics of Kansas ABE GED Students Who Transition to Community or Technical College Programs

By Jeff Zacharakis, Haiyan Wang, Margaret Becker Patterson, and Lori Andersen

How Is Health Related to Literacy, Numeracy, and Technological Problem-Solving Skills among U.S. Adults? Evidence from the Program for the International Assessment of Adult Competencies (PIAAC) *By Esther Prins, Shannon Monnat, Carol Clymer, and Blaire Wilson Toso*

FORUM

Responding to Changes in High School Equivalency Testing

Introduction *By Lennox McLendon*

High School Credentialing in Wisconsin *By Willa Panzer, Mark Johnson, and Beth Lewis*

High School Equivalency Testing in Arizona *By Sheryl Hart*

High School Equivalency Testing in Washington *By Jon Kerr*

Discussion *By Lennox McLendon*

VIEWPOINT

The GED and Minority Language Groups *By Laurel Anderson*

RESEARCH DIGEST

Hemispheric Specialization for Visual Words Is Shaped by Attention to Sublexical Units During Initial Learning *By Yoncheva, Y. N., Wise, J., & McCandliss, B.*
Reviewed by Gary Dean

RESOURCE REVIEW

Building Health Literate Organizations: A Guidebook to Achieving Organizational Change *By Mary Ann Abrams, Sabrina Kurtz-Rossi, Audrey Riddenburgh, and Barbara Savage*
Reviewed by Iris Feinberg

WEB SCAN

Surveying Adult Learners' Technology Skills: What Digital Literacy Skills Do Your Students Have—or Need? *By David J. Rosen*

What teachers say about Fast Forward

- “It’s so easy to use!”
- “It’s great for differentiation in the ABE classroom.”
- “You can just let students go!”
- “We’re surprised by how many people use text-to-speech.”
- “The price is right!”



FASTFORWARD™ COLLEGE AND CAREER READY

At the heart of KET’s Fast Forward learning system is a new online course to help students prepare for GED®, HiSET®, and TASC tests. Designed for classroom use or independent study, Fast Forward’s lets students study at their own pace and in their own space— on a computer, tablet, or smartphone. Teachers can manage, track, and report student enrollment.

See for yourself

Watch a video tour at [YouTube.com/KETadultlearning](https://www.youtube.com/KETadultlearning).
Request a free trial at ketcollegeandcareer.org/freetrial.



[KETCollegeandCareer.org](https://ketcollegeandcareer.org) 800.354.9067



JOURNAL OF RESEARCH AND PRACTICE FOR ADULT LITERACY, SECONDARY, AND BASIC EDUCATION

Published Jointly by The Commission on Adult Basic Education and Rutgers University

MISSION STATEMENT

The Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education is published jointly three times a year by the Commission on Adult Basic Education and Rutgers University. The journal's mission is to provide a forum for sharing research, information, theory, commentary, and practical experiences that will improve the quality of services for adult basic education, literacy, and numeracy learners. These learners are found in publicly funded ABE, ESL, and GED programs; volunteer-based literacy programs; community-based literacy programs; family literacy programs; workplace literacy programs; correctional literacy programs; and many other places.

The Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education provides a forum for sharing research, information, theory, commentary, and practical experiences that will improve the quality of services for adult basic education, literacy, and numeracy learners. These learners are found in publicly funded ABE, ESL, and GED programs; volunteer-based literacy programs; community-based literacy programs; family literacy programs; workplace literacy programs; correctional literacy programs; and many other places.

Manuscripts should be submitted directly to the Journal through the online submission platform which can be found at: <https://coabe.wufoo.com/forms/coabe-journal-submission/>. Submissions should be in Times Roman 12 point font, double-spaced with one-inch margins, and formatted in APA 6th edition style. For full details about maximum page length and other submission issues please look at the author guidelines on the COABE website: [http://coabe.org/html/pdf/Guidelines%20for%20Authors%20\(1\).pdf](http://coabe.org/html/pdf/Guidelines%20for%20Authors%20(1).pdf).

The Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education (ISSN:2169-0480) is published three times a year (April, August, and December) by the Commission on Adult Basic Education and Rutgers University. The mailing address is: COABE, P.O. Box 620, Syracuse, NY 13206. POSTMASTER: Send address changes to COABE, P.O. Box 620, Syracuse, NY 13206.

Subscription Information: All subscription inquiries, orders, back issues, claims, and renewals should be addressed to COABE Journal, COABE, P.O. Box 620, Syracuse, NY 13206; telephone: 1-888-44-COABE; fax: 1-866-941-5129; e-mail: journal@coabe.org.
Subscription Price: Institutions: \$109.00; **Non-member individuals:** \$65.00. For individuals outside of the United States, please contact the above for more information about prices. **Claims:** Claims for undelivered copies must be made no later than six months following the month of publication. COABE will supply replacement issues when losses have been sustained in transit and when the reserve stock will permit.

Member Subscription Information: Members may add a subscription to the journal onto their membership for the additional cost of \$35.00. Please contact COABE at the following address for more information: COABE Journal, COABE, P.O. Box 620, Syracuse, NY 13206; telephone: 1-888-44-COABE; fax: 1-866-941-5129; e-mail: journal@coabe.org; website: www.coabe.org. Requests for replacement issues should be made within six months of the missing or damaged issue. Beyond six months and at the discretion of COABE, replacement issues will be supplied when losses have been sustained in transit and when the reserve stock permits.

Abstracting and Indexing: Please visit <http://coabe.org/html/abeljournal.html> under Journal Archives for more information.

Copyright Permission: Permission request to photocopy or otherwise reproduce material published in this journal should be submitted to COABE at journal@coabe.org.

Advertising and Reprints: Current advertising rates and specifications may be obtained by contacting Sharon Bonney at sharonbonney@coabe.org or info@coabe.org. To order reprints, please email journal@coabe.org. Acceptance of advertising in this journal in no way implies endorsement of the advertised product or service by COABE or by Rutgers University. COABE reserves the right to reject any advertising it deems to be inappropriate for this journal.

Change of Address: Six weeks advance notice must be given when providing a change of address. Please include the old address and the new address, together with your name, to journal@coabe.org.

TABLE OF CONTENTS

JOURNAL OF RESEARCH AND PRACTICE FOR ADULT LITERACY, SECONDARY, AND BASIC EDUCATION

Volume 4, Number 3, Winter 2015

3 Letter From the Editors

Research

- 5 Using Modern Statistical Methods to Analyze Demographics of Kansas ABE/GED Students Who Transition to Community or Technical College Programs
By Jeff Zacharakis, Haiyan Wang, Margaret Becker Patterson, and Lori Andersen
- 22 How Is Health Related to Literacy, Numeracy, and Technological Problem-Solving Skills among U.S. Adults? Evidence from the Program for the International Assessment of Adult Competencies (PIAAC) *By Esther Prins, Shannon Monnat, Carol Clymer, Blaire Wilson Toso*

Forum: Responding to Changes in High School Equivalency Testing

- 43 Introduction *By Lennox McLendon*
- 44 High School Credentialing in Wisconsin *By Willa Panzer, Mark Johnson, and Beth Lewis*
- 48 High School Equivalency Testing in Arizona *By Sheryl Hart*
- 51 High School Equivalency Testing in Washington *By Jon Kerr*
- 54 Discussion *By Lennox McLendon*

Viewpoint

- 57 The GED and Minority Language Groups *By Laurel Anderson*

Research Digest

- 65 Hemispheric Specialization for Visual Words Is Shaped by Attention to Sublexical Units During Initial Learning *By Yoncheva, Y. N., Wise, J., & McCandliss, B.*
Reviewed by Gary Dean

Resource Review

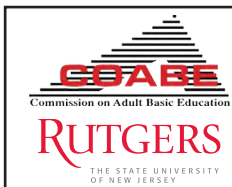
- 69 Building Health Literate Organizations: A Guidebook to Achieving Organizational Change
By Mary Ann Abrams, Sabrina Kurtz-Rossi, Audrey Riddenburgh, and Barbara Savage
Reviewed by Iris Feinberg

Web Scan

- 72 Surveying Adult Learners' Technology Skills: What Digital Literacy Skills Do Your Students Have—or Need? *By David J. Rosen*



The Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education is published three times per year. You can subscribe anytime during the year. Subscriptions will begin with the first issue after your form has been processed. You can subscribe to the journal online by visiting joincoabe.org and clicking on Journal or by scanning this QR Code with any bar code reader.



JOURNAL OF RESEARCH AND PRACTICE FOR ADULT LITERACY, SECONDARY, AND BASIC EDUCATION

Published Jointly by The Commission on Adult Basic Education and Rutgers University

THE COABE JOURNAL, CELEBRATING 36 YEARS AS A MAJOR VOICE IN ADULT EDUCATION

Dear Colleagues,

We are pleased to present the Fall issue of the journal. We have put together an exciting issue that includes an important study by Zacharakis et al., a Viewpoints article by Laurel Anderson, and a Forum on how states have responded to revisions to the GED and additional high school equivalency options. Additionally, we are inaugurating a series of articles based on research commissioned by the American Institutes for Research (AIR) that analyzed data from the PIAAC (Program for the International Assessment of Adult Competencies). This survey of adult skills was an international effort conducted in 33 countries. The aim was to help countries (both individually and comparatively) understand the state of adult learning as a way to inform policies related to adult education and training. The surveys were developed by the Organization for Economic Cooperation and Development (OECD) with each participating country coordinating its own data collection process. The U.S. Department of Education's Office of Career, Technical, and Adult Education (OCTAE) conducted the U.S. Survey through a partnership with the National Center for Educational Statistics (NCES).

The research article by Jeffrey Zacharakis, Haiyan Wang, Margaret Patterson, and Lori Andersen analyzes data from Kansas regarding the demographics of students who transition from Adult Basic Education (ABE)/General Educational Development (GED) programs in Kansas. Not only did they find five demographic features that were predictive of successful completion of a two-year postsecondary program, but also argue that their analysis strategy can help others answer similar kinds of questions. This is an extremely important study we hope will be emulated by others in an effort to better understand the dynamics of this transition.

The first article in our PIAAC series is authored by Esther Prins, Sharon Monnat, Carol Clymer, and Blaire Toso. This study used the PIAAC data to analyze the relationship between self-reported health and literacy, numeracy and technological problem solving competencies. They found that the scores on all three scales were significantly related to health. Their findings have implications for policy makers and for individuals working with these populations.

Our Forum introduces a discussion of some of the ways that states are responding to changes in the high school equivalency testing and the development of alternative testing and credentialing options. Lennox McLendon, the recently retired Executive Director of the National Adult Education Professional Development Consortium, introduces the Forum and also provides a helpful synthesis that looks across the state descriptions and identifies key issues in supporting students' progress toward high school equivalency completion. The main part of the forum consists of descriptions of how three states are making high school equivalency available to adult learners. They are written by Willa Panzer, Mark Johnson, and Beth Lewis reporting from Wisconsin; Sharyl Hart from Arizona; and Jon Kerr from Washington. We feel that this forum makes an important contribution to informing conversations on this important topic, and we hope that it will encourage further debate and discussion.

Finally, the last article in this issue is a Viewpoints column by Laurel Anderson on the problems raised by the lack of a non-English version of the new GED test. In this perspective piece, Anderson raises an important issue about meeting the needs of the diverse populations served by adult basic education programs and the importance of responding adequately to all learners.

We have three columns in this issue that we believe our readers will find useful. They include David Rosen's review of web-based surveys and national assessments focusing on the relationship between literacy and technology skills. This review is particularly germane to the research articles using the Kansas and PIAAC data included in this issue. Also included in this issue is a review by Iris Feinberg of a book by Abrams, Kurtz-Rossi, Riffenburg, and Savage entitled *Building Health Literate Organizations: A Guidebook to Achieving Organizational Change*. Finally, we are pleased to include Gary Dean's review of a research article by Yoncheve, Wise, and McCandliss that discusses recent neurological research on learning. We are saddened to announce that this is Dr. Dean's last review. He has decided to step down as a columnist for this journal. Gary Dean has contributed immeasurably to the development of the journal and we recognize his willingness to continue for the first year of our editorship despite the many conflicting claims to his time. We thank him for his contribution.

Sincerely,

Amy D. Rose
Co-Editor

Alisa Belzer
Co-Editor

Heather Brown
Co-Editor



JOURNAL OF RESEARCH AND PRACTICE FOR ADULT LITERACY, SECONDARY, AND BASIC EDUCATION

Published Jointly by The Commission on Adult Basic Education and Rutgers University

EDITORIAL TEAM

journal@coabe.org

Amy D. Rose, *Co-Editor*
Northern Illinois University
DeKalb, IL

Alisa Belzer, *Co-Editor*
Rutgers University
New Brunswick, NJ

Heather Brown, *Co-Editor*
University of North Carolina at Charlotte
Charlotte, NC

Nora Devlin, *Editorial Assistant*
Rutgers University
New Brunswick, NJ

EDITORIAL ADVISORY BOARD

Alisa Belzer
Rutgers University

Jim Berger
Western Kentucky University

Daphne Greenberg
Georgia State University

Rena Harrison
COABE

Amy D. Rose
Northern Illinois University

David J. Rosen
Newsome Associates

JoAnn Weinberger
Center for Literacy

STAFF

Sharon Bonney, *Executive Director*
info@coabe.org

Michelle Chiles, *Office Manager*

Maria Polinsky, *Graphic Designer*

CONSULTING EDITORS

Matiul Alam, University of British Columbia
Sonya L. Armstrong, Northern Illinois University
Tannis Atkinson, University of Waterloo
Hal Beder, Rutgers University
Aaron Benavot, UNESCO and University at Albany-SUNY
Jim Berger, Western Kentucky University
Stephanie Doyle, Victoria University of Wellington
Brendaly Drayton, Pennsylvania State University
Sam Duncan, UCL Institute of Education
Connie Eichhorn, Metropolitan Community College
Susan Finn Miller, Lancaster-Lebanon Intermediate Unit 13
Barbara Garner, Jewish Vocational Service
Elisabeth Gee, Arizona State University
Gabrielle Gerhard, Curriculum Research Group
Lynda Ginsburg, Rutgers University
Daphne Greenberg, Georgia State University
Allen G. Harbaugh, Boston University
Tom Heaney, Adult Learning Unleashed
Bob Hughes, Seattle University
Erik Jacobson, Montclair State University
D. Michelle Janysek, Texas State University
Cathy Kozlowicz, Literacy Council of Greater Waukesha, Inc.
Marguerite Lukes, City University of New York
Larry G. Martin, University of Wisconsin-Milwaukee
Nancy E. McEachran, Bellevue College
Daryl F. Mellard, University of Kansas
J. Ryan Monroe, Carlos Rosario International Public Charter School
Ron Mottern, Mottern Institute
Andres Muro, El Paso Community College
Andy Nash, World Education, Inc.
Robert E. Nolan, Oklahoma State University
Susan Noyes, University of Southern Maine
Richard Orem, Northern Illinois University
Margaret Becker Patterson, Research Allies for Lifelong Learning
Dolores Perin, Teachers College, Columbia University
Esther Prins, Pennsylvania State University
John R. Rachal, University of Southern Mississippi
Robert F. Reardon, Texas State University
Stephen Reder, Portland State University
Petra A. Robinson, Louisiana State University
Leah Katherine Saal, Loyola University Maryland
John Sabatini, Educational Testing Service
Steven W. Schmidt, East Carolina University
Joni Schwartz, LaGuardia Community College
Marilyn J. Shaw, Sharing, Inc.
Jane R. Shore, Educational Testing Service
Cristine Smith, University of Massachusetts-Amherst
Thomas J. Smith, Northern Illinois University
Karin Sprow Forté, Penn State Harrisburg
Maurice Taylor, University of Ottawa
Lyn Tett, University of Huddersfield
Robert G. Thomas, Central Coast Adult School
Barbara Van Horn, Pennsylvania State University
Lurong Wang, University of Toronto
JoAnn Weinberger, Center for Literacy
Jeff Zacharakis, Kansas State University
Cynthia Zengler, Ohio Board of Regents
Mary Ziegler, University of Tennessee

Using Modern Statistical Methods to Analyze Demographics of Kansas ABE/GED Students Who Transition to Community or Technical College Programs

Jeff Zacharakis

Kansas State University

Haiyan Wang

Kansas State University

Margaret Becker Patterson

Research Allies for Lifelong Learning

Lori Andersen

University of Kansas

Abstract

This research analyzed linked high-quality state data from K-12, adult education, and postsecondary state datasets in order to better understand the association between student demographics and successful completion of a postsecondary program. Due to the relatively small sample size compared to the large number of features, we analyzed the data with Nearest Shrunken Centroid (PAM), a statistical method developed for cancer and genomic research. Our findings conclude that there are five features that are predictive of an adult education student's successful completion of a postsecondary program.

Introduction

The goal of this research was to analyze the high-quality state data that linked the Kansas K-12, adult education, and postsecondary datasets in order to better understand the association between adult education student demographics and successful completion of postsecondary programs. We have two well-defined classes (completers vs. non-completers). The purpose is to identify covariates that are predictive of the given class. Such data are typically analyzed with a classification method, in which there are explanatory variables and response variable, and the purpose is to identify contributions of different explanatory variables and predict the response variable. Commonly used classical methods such as logistic regression, CART, linear discriminant analysis, and quadratic discriminant analysis have

limitations due to curse of dimensionality, i.e., a relatively small sample size with an extremely large number of features (potential predictors). In this research a statistical method, Nearest Shrunken Centroid (PAM), was used to identify student demographic and coursework information that were associated with student success. PAM (referred to Prediction Analysis of Microarrays) was developed for genomic and cancer research to analyze small samples with a large number of features. PAM can handle multi-class as well as two-class cases. In Tan, Naiman, Xu, Winslo, and Geman (2005), PAM was applied to nine two-class and 10 multi-class cancer genomics datasets. The advantages of using PAM are: (1) It is particularly developed for feature selection and classification in datasets with high dimensional explanatory variables but limited sample size, in which case frequently used classical methods such as logistic regression, CART, linear discriminant analysis, and quadratic discriminant analysis face the limitation due to curse of dimensionality; (2) PAM is extremely computationally efficient because it does variable selection through thresholding that gets rid of variables with small effects easily in a single step for each thresholding parameter value; and (3) PAM has high classification accuracy because it aims at maximizing the posterior probability of belonging to a class given the observed data. It is particularly powerful when the explanatory variables are continuous. Even with binary explanatory variables, the performance of PAM is surprisingly good and robust compared to other methods tailored for high dimensional classification problems.

The significance of this study is that specific sets of features that associate with completion were identified for students who were enrolled in a public high school, transitioned to an adult learning center, earned their GED credential, and transitioned to

a postsecondary institution. It is also significant because this research used a statistical method not normally used in education research, and has potential to be used with other adult student datasets that have small sample size and large numbers of features.

Research Problem

This research used Kansas' linked student data that was collected by secondary, adult education, and postsecondary schools between 2007 and 2012. Each case in the dataset represents a student who attended both a Kansas public secondary school and an adult education center, and then transitioned into a Kansas postsecondary program. In the field of adult education, little quantitative research exists on demographic-specific patterns of adult education students who successfully transition to postsecondary education after earning a GED credential and factors.

This research systematically explores this linked dataset to determine if demographic factors and coursework patterns are associated with student pathways from secondary education through adult education to postsecondary education. This type of research has the potential to identify adult basic education (ABE), adult secondary education (ASE), and English as a second language (ESL) student factors that increase the odds of successfully completing a postsecondary program. Findings can be used to develop policies and design interventions that increase student achievement and help state adult education programs achieve their goals by exploring sensitivities to factors. Our research contributes to the national literature on adult education students' pathways into postsecondary education linked to student academic achievement. What we have learned suggests that the pathways of these adult education students are, in fact, quite complex.

Background

Nationally, there is great interest in identifying the education pathways that adults follow when transitioning from secondary to postsecondary education, and both public and private-funded research are currently examining this issue. One such investment is a two-year project conducted by the National Center for Higher Education Management Systems (NCHEMS) with funding from the Bill and Melinda Gates Foundation, which examined state policies that foster student progression and success in the “adult re-entry pipeline” (Boeke & Zis, 2011; Ewell, Kelly, & Klein-Collins, 2008). In 2007, the U.S. Department of Education, Office of Vocational and Adult Education (OVAE is now the Office of Career, Technical and Adult Education or OCTAE), also signaled its continued commitment to address this issue by awarding four grants through the *Ready for College: Adult Transitions Programs* to implement projects focused on improving the quality of ASE, so that out-of-school youth can successfully transition to postsecondary education.

OCTAE is especially interested in what can be learned from state adult education databases, and requires that each state keep data on those students who successfully transition to postsecondary programs. In the Adult Education Annual Report to Congress (U.S. Department of Education, Office of Vocational and Adult Education, 2007), data from OVAE show that only one-third of adult education students with a documented goal to enroll in postsecondary education or training actually transition within an academic year period. Bragg, Kim, and Barnett (2006) note that over 90% of high school sophomores self-report that they want to go to college and 70% want to complete a four-year degree. For many, these dreams are never realized. According to the U.S. Department of Education,

the *status dropout* rate in 2009 for 16-24 year olds who have not graduated or earned a GED credential was overall about 8%, with 5% for Whites, 9% for Blacks, and 18% for Hispanics (IES-NCES, 2012a, p. 240). In 2009, about 75% of the high school students graduated on time, and in Kansas the rate was 80% (IES-NCESa, 2012). The end result is that approximately 6,000 Kansas high school students each year do not graduate on time, and many enter one of Kansas’ adult education centers to pursue a GED credential.

Of those who take the GED test nationally, an estimated 60% indicate that they do so in order to begin postsecondary education. However, not all GED passers follow up on their intentions. Data matched from two cohorts (consisting of a half million students each from 2003 and 2004) of the GED test-taking population with National Student Clearinghouse postsecondary data indicate that nearly 43% of GED passers enroll in postsecondary education, yet only 12% of enrollees graduate within six years (Patterson, Zhang, Song, & Guison-Dowdy, 2010; Zhang, Guison-Dowdy, Patterson & Song, 2011). Typically, adults with GED credentials enroll in a community college, at least initially, to continue their education (Reder, 2007).

The problem of persistence and retention as factors of student success in higher education has been studied for decades (Acee, Cho, Kim, & Weinstein, 2012; Bean & Metzner, 1985; Pascarella, 1985). These studies tend to focus on student integration, social support systems, personal commitment, high school achievement, social economic conditions, and institutional practices. Horn (2014) delineates five broad interrelated factors that determine student retention and completion in postsecondary education: institutional practices, social identification, goal commitment, academic engagement, and student

success. Institutional practices include academic advising, faculty engagement, financial aid, remedial education, and student assessment. Social identification includes internalization of student norms, sense of belonging, and quality of relationships with teachers and peers. Goal commitment includes postsecondary credential, time to completion and level of vocational and civic engagement. Academic engagement includes time on task, deep conceptual learning, and interest and enjoyment. And student success includes academic achievement, and persistence and completion. Miller's (2014) synthesis of graduation rates for nontraditional students posits that there are multiple factors affecting adult student postsecondary completion. His study indicates that student completion rates are affected by degree type and enrollment intensity where certificates have higher completion rates than associate or bachelor degrees, and fulltime students graduate at higher rates than part-time students.

Prior research on adult student pathways, for the most part, has been descriptive, often simplified, and does not associate demographic and other factors with various pathways through adult education programs to postsecondary education. Nor has this prior research been used to investigate implications for adult education interventions. For example, our dataset connects student information with the adult education center they attended. If location is predictive of success, we can investigate practices, curricula, and other factors around program effectiveness in high and low performing adult education centers, and then replicate what works in high performing education centers in low performing centers.

Kansas Background

In Kansas, members of the 2003 cohort enrolled in community colleges at a rate of nearly 30%, with

11% graduating from their postsecondary program in six years (Patterson, 2010). The 2004 Kansas cohort members enrolled in postsecondary programs (at all levels) at a rate of 41.8%, and 10% graduated within six years (Research Allies for Lifelong Learning, 2013). While assisting adult education students with their postsecondary education transition goals has been a component of Kansas adult education programs since the 1998 Workforce Investment Act legislation, concentrated transition efforts and performance-based funding for Kansas adult education programs did not begin in earnest until 2005, which suggests that these percentages likely underrepresent the actual percentages for postsecondary transition outcomes of Kansas adult education students.

In 2010, the Kansas Board of Regents (KBOR) adopted a 10-year strategic plan, *Foresight 2020*, which set long-range achievement goals for all of the entities "to ensure the state's higher education system meets Kansans' expectations," including all of state's adult education centers (p. 1). Presently, Kansas' adult education programs serve 8,000 to 9,000 students each year, out of 230,000 Kansans who are eligible adults (Developmental Education Working Group, 2014). In order to meet *Foresight 2020* goals with limited state and federal funds, there is a need to better understand which type of student, based on individual and institutional demographics, is more likely to succeed in an adult education program and transition into a postsecondary education program.

We also know that it is possible for adult education students to enter a postsecondary program without having earned their GED credential. Many of these students never enroll in an adult education center. All Kansas community and technical colleges have open enrollment so adult education students can enroll without having a high school diploma or GED credential. Yet at the same time we know that GED

students do not do as well in terms of persistence and graduation as high school graduates in postsecondary programs (Guison-Dowdy & Patterson, 2011a; 2011b). Many high school dropouts who enroll in a community or technical college are placed in developmental education courses, which still require tuition and extend the time to completion. Moreover students who enter developmental education are less likely to complete a postsecondary program (Bailey, 2009a; 2009b). There are multiple pathways for students entering postsecondary, many of which bypass a high school credential. The percentage of students who successfully enroll in and complete a postsecondary program is significantly lower for those who follow such nontraditional pathways.

Method

The goal of this research was to identify predictive factors of an adult education student who earns a GED credential and successfully completes a postsecondary program. Some factors may be malleable where an intervention can be designed to strengthen student achievement. For example, if years completed in high school is predictive of future success in adult education and postsecondary education, then an intervention can be developed to keep at-risk students in high school as long as possible.

Successful completion of a postsecondary program is only counted in our study if it occurs between 2007 and 2012. Hence if a student is still making progress in 2012 but has not completed a postsecondary program they are counted as a non-completer. Postsecondary education in this research refers to any education program at a technical college, community college, college or university, but does not include adult education programs hosted by technical and community college.

Dataset

All students in our dataset met these requirements: between 2007 and 2012 they attended a Kansas public high school, enrolled in a Kansas public adult learning center, and transitioned into Kansas public postsecondary school. The total number of student records that met these criteria was 2,258. This total included duplicate cases where the same student had multiple records across different years, in multiple adult education centers, or multiple postsecondary institutions in multiple years. We removed all duplicate cases, as we were only interested in the final year they were enrolled in an adult education center, the first year in a postsecondary program, and whether or not they completed a postsecondary program, which reduced our dataset to 532 unique cases (students).

KBOR has oversight of all public adult education centers, technical and community colleges, four-year colleges, and universities. KBOR also has a data-sharing agreement with the Kansas State Department of Education. This administrative structure and interagency agreement allowed us to use linked student data from high school, adult education, and postsecondary education. In addition, all Kansas public adult education centers use the same data collection and testing protocol, including several audits and quality assurance steps. As a result the Kansas' adult education dataset is of very high quality.

The demographic composition of 532 cases of our sample is mostly young adults, predominantly white, with slightly more females than males.

For each student our dataset contains these variables:

- Whether the student enrolled in a developmental education course at a community or technical college, including development English, reading, math and any developmental course;

- Whether the student declared a major in a postsecondary program. This variable has five categories: declared major in an associate degree program, declared major in a stand-alone program (a certificate requiring less than 16 credit hours), declared major in a longer certificate program, declared major in a STEM program, and no declared major;
- If the student earned a GED credential;
- If the student completed a high school diploma and also enrolled in an adult education program;
- If the student received public assistance—self reported;
- If the student received a Pell Grant;
- The student's gender;
- The student's race—self reported;
- The student's age;
- The last fiscal year the student was in an adult education program;
- Total hours the student was in an adult education program;
- Each adult education center's institutional ID;
- Each technical and community college institutional ID;
- The student's first postsecondary year;
- The student's time in post-secondary program; and
- The student's pass rate (there are three levels of pass rate: enrolled but did not pass any courses in a postsecondary program, passed at least one course but less than 50% of their courses, and passed 50% or more of their courses).

We are particularly interested in the main effect and two and three-way interactions of these variables, and

how the interactions are associated with completing a postsecondary program.

Statistical Method

The main effects (single factor), two-way, and three-way interactions of all main-effect variables were included in our analysis. This leads to a model with 26,534 potential predictors, which we refer to as features in this paper. To estimate the effects of such a large number of predictors in a classic regression model, the sample size needs to be much greater than the number of features, generally a cases-to-predictors (n to p) ratio of 10:1 or more is required. Since the sample size is 532, which is much smaller than the total degrees of freedom of all the variables and their interactions, classical regression models fail due to insufficient degrees of freedom in calculating the sum of squares of error. In this analysis, we employed a modern method that had been developed for high-dimensional data, in which the number of predictors can be much higher than the sample size.

The Nearest Shrunken Centroids method was used to analyze the data. It is one of the most popular classifiers employed in cancer classification problems using microarray data from genomics (Tibshirani, Hastie, Narasimhan, & Chu, 2002). It is more commonly known as the Prediction Analysis of Microarrays (PAM). It can work with multi-class and two-class systems where there can be multiple or two outcomes and each outcome comprises a class. In our study there were two classes, one for failing to complete any program (class 1), and the other one for successfully completing one program (class 2). A standard *centroid* for each class is computed for each feature, which is the average of the feature values for students in the same class. The feature profile of each student is used in comparing each class centroid

with the overall centroid to classify cases. The PAM identifies important features by shrinking each centroid toward the overall centroid and removing features below the threshold. Cross-validations were used to choose the threshold parameter of the amount of shrinkage that minimizes the classification error. PAM is powerful for two reasons: it uses thresholding to reduce noise, and the original classifier before achieving the shrunken centroids is the Naive Bayes classifier. This original classifier assumes that the conditional distribution of feature variable given in a class is normally distributed with feature specific variance. If the conditional distribution of feature values given students in each class is correctly specified, the Naive classifier gives the optimal classification according to Bayes Theorem. PAM can perform feature selection in its modeling process. Feature selection and class modeling were conducted together seamlessly.

One potential limitation of the PAM process is the assumption that the predictors follow a normal distribution within the classes. However, violation of this assumption in the sparse direction (for example, when there are a lot of zero values in the dataset) does not pose a threat to its classification accuracy. An example of such robustness to violation of the normality assumption in the sparse direction is the application of PAM on the Leukemia3 dataset in Tan et al. (2005), which contained 7 cancer classes and 12,558 feature variables. More than 65% of the feature values were zero. Even in such an extreme situation, PAM gave the highest classification accuracy of 93.75% among all tested methods (Tan et al., 2005; Wang, Dai, Chen & Yuan, 2013). In our dataset many of the feature values are also zero. All the analyses in this study used R version 3.0.1.

Data Analysis

We conducted two types of analyses. The first type was an external 10-fold cross-validation. The subjects in each class of the entire dataset were randomly partitioned into 10 subsets. Then the subjects in class 1 and those in class 2 from each subset were combined to yield a single subset that includes both students from class 1 and students from class 2 with the same ratio as the original dataset. In the 10-fold cross-validation, there were 10 model fittings and 10 predictions. This validation was an iterative process in which each subset is left aside as a test set and remaining subsets were used as the training set to build the model. The obtained model was then validated on the test set to assess the prediction performance of the model. The process continued until every subset had been used as the test data. In the end, the predicted classifications from all subsets were compared to the observed classifications to assess the proportion of correctly classified students by their program completion status. In this external cross-validation, the feature selection and model fitting were performed 10 times so that there would be 10 models and different sets of selected features for different training sets. Since the model fitting did not use any data from the test set, the resulting reported accuracy is representative of the performance for other independently observed data. This cross-validation procedure establishes the validity of the model.

The second type of analysis was to conduct model fitting (and feature selection) with the entire dataset. Afterward, the selected features and model were used in 10-fold cross-validation. Even though there was classification accuracy reported from this analysis, the accuracy is not generalizable to future datasets since all subjects have been used during the feature selection and model fitting process. The PAM method

selects features but does not provide p -values as in classical regression analysis. After the features were selected, we ran a logistic regression model. If we use the default cutoff of 0.5 on the posterior probability to determine the predicted class, the overall accuracy of the logistic regression model was high. Unfortunately, it did not correctly classify any of the program completers. When different cutoff values were used on the posterior probability as shown in a ROC curve, the simple logistic regression and the Firth logistic model using the features selected by PAM produce similar area under the ROC curve as the PAM. Without the feature selection step from PAM, neither the logistic regression nor the Firth logistic model could provide best fit to our data that have relatively small sample size and a dichotomous outcome variable with a highly disproportionate distribution in addition to high dimensional explanatory variables. Therefore, PAM can be used as a feature selection tool prior to an application of logistic or Firth logistic regression model.

Findings

We first consider the results obtained by setting the objective function to be the overall classification accuracy in order to find the optimal threshold parameter(s) and select predictors using the training data. In this case the overall percent of correctly classified samples is maximized over all possible feature subsets achieved by using different values of the threshold parameter. Table 2 reports the number of samples classified into each class as well as classification accuracy as a percentage within each class.

Table 2 shows that the PAM model better predicts who will not complete any program than who will successfully complete a program. Non-completion is predicted correctly in 418 of 462 cases (90.48%

accuracy), but completion is only predicted correctly in 43 of 70 cases (61.43% accuracy).

The distribution of the outcome variable is highly unbalanced. In such case, maximizing the overall classification accuracy may not accurately predict who completes a program. A better performance measure on unbalanced datasets is the Matthews Correlation Coefficient (MCC) defined as:

$$MCC = \frac{TP \times TN - FP \times FN}{\sqrt{(TP + FN)(TN + FP)(TP + FP)(TN + FN)}}$$

where TP is the number of true positives (i.e. correctly classified students who completed a program), TN is the number of true negatives (i.e. correctly classified students who did not complete a program), FP is the number of false positives (i.e. students who did not complete a program but were misclassified) and FN is the number of false negatives (i.e. students who completed a program but were misclassified). The values of MCC are in the range of [-1, 1] with value 1 indicating a perfect prediction and -1 an extremely opposite prediction. It should be noted that the thresholding parameter in PAM was estimated by minimizing the 5-fold cross-validation accuracy within the training data. It is possible to change the objective function to replace the 5-fold cross-validation accuracy by cross-validation MCC.

Table 3 gives the result of PAM using MCC as the objective function during the model training and feature selection process.

It can be seen in Table 3 that 432 of 462 non-completers (93.51%) are correctly classified and 40 of 70 completers (57.1%) are correctly classified. Compared to the results in Table 2, a summary from the external cross-validation is that using MCC as the objective function yield higher overall accuracy and MCC values.

Next we report the PAM results from fitting

models with parameters and number of predictors selected using the entire dataset. Figure 1 shows the variation in the MCC as the threshold value is increased.

The highest MCC was achieved initially with 14,082 features and then the MCC was reduced as the value of the thresholding parameter increased, and then MCC increased again for thresholding parameter values between 10 and 12. Increasing the thresholding parameter corresponds to reducing the number of selected features. The objective in creating this model is to maximize the MCC and obtain a theoretically interpretable model. For interpretability reasons, the maximum number of features was limited to 1000. Figure 1 shows that the maximum value of the MCC and an acceptable number of features (< 1000) occur at a threshold of 11.33; the same value of MCC occurred for multiple values of the threshold.

The models of the predictors of program completion created using PAM, with the best MCC, show that students with interactions of the following variables were more likely to succeed: declared major in a stand-alone program, improved their pass rate from one level to the next, did not enroll in developmental education, the first postsecondary year enrolled is 2011, and were older. Hence, interactions of these variables result in the highest likelihood of completing a program in order of importance as follows (: indicates interaction of the two variables):

- Declared major in a stand-alone program : pass rate : age
- Declared major in a stand-alone program : pass rate
- No developmental education : declared major in a stand-alone program : pass rate
- Declared major in a stand-alone program :

pass rate : no developmental math

- Declared major in a stand-alone program : postsecondary year 2011: pass rate

To check for potential bias in the results from our PAM model, we used Firth's logistic regression model, which is a penalized likelihood approach to reduce small-sample bias in maximum likelihood estimation of logistic model with rare events. In our case, we have 70 completers and 462 non-completers. The "completers" are therefore rare events. Even though the Firth's model is meant to reduce bias for small sample size, it was developed for traditional settings where the number of features is not overwhelmingly high. We have 26,534 features with the sample size of 532. It is not possible to complete model fitting or variable selection using Firth's model. An application of Firth's model to a reduced dataset that contains only some selected features would be helpful to increase the prediction accuracy of the completers. PAM does a good job of feature selection. Surprisingly, the Firth model with the features selected by PAM gives even better prediction results than PAM itself (in terms of prediction for the completers). Therefore, a combined application of PAM doing feature selection and Firth model doing prediction would be more beneficial than applying either method alone.

We then plotted the ROC curves using the fitted probability of completers with the models using the selected features. The ROC curves report the true positive rate (vertical axis) and false positive rate (1- horizontal axis) at varying levels of cut-off threshold for the posterior probability. The plots are shown in Figure 2. The left-most panel is from Firth logistic regression model, the middle panel is from simple logistic model, and the right-most panel is from the PAM model. All three models produced nearly identical area under the curve (AUC). This indicates that the features selected by PAM are not

limited to have predictive power with PAM but also have good predictive power for logistic regression or Firth logistic regression model.

Discussion

Though it is tempting to attribute success to one variable or a main effect, the features that are most predictive are two- and three-way interactions. Analyzing each individual variable or main effect feature may provide a glimpse as to why these interactions are probable predictors but in this analysis no individual feature was predictive of an adult education student successfully completing a postsecondary program. “Declaring a major in a stand-alone program” and “increasing pass rate” is in each of the five features that were most predictive of a student successfully completing a postsecondary program. Not taking developmental education was in two of these features, and age and entering postsecondary in 2011 were in one feature.

Declaring a major in a stand-alone program (a certificate requiring less than 16 credit hours) when interacting with other features appears to enhance a student’s odds of completing a postsecondary program. This result might be explained by the shorter required time commitment and a higher perception of goal attainability. If declaring a major is an indicator of a clear sense of goals, this may be suggestive of other positive factors such as stronger motivation, greater clarity of purpose, more maturity, more confidence, and higher level of comfort in formal schooling. It could also be due to the fact that most of these short-duration programs are more technical than academic, therefore not requiring higher levels of reading, writing and mathematics, and that most of these programs are designed as career programs where the curriculum is tied to job skills. More research is needed to better understand why a

declared major in a longer program, such as certificate or associate degree program when compared to a stand-alone program, was not identified in our research as a factor to increase the likelihood to complete a postsecondary program.

Increasing student pass rate in a postsecondary program was also in all the interactions that increased a student’s odds of successfully completing a postsecondary program. It can be interpreted as a sign of persistence and retention, as well as higher academic ability. The policy implication is that keeping a student in a postsecondary program where they continually make progress is more likely to associate with successful completion than dropping all courses in any given semester.

Not enrolling in developmental education was in two of the interactions, which concurs with Bailey’s (2009a) findings that only 44% of students who enrolled in developmental education courses completed the recommended remedial courses within three years (p. 14). The problems with developmental courses are that they do not lead to a degree, they burden students with additional tuition costs, and they further delay a student’s career and education goals. Not enrolling in developmental education courses might also be associated with having higher ability and being more prepared for a postsecondary program.

First year of postsecondary education was in 2011 and an increase in age are only in one predicted feature. When comparing the year of entry in a postsecondary program, we discovered that being in the 2011 cohort had a greater likelihood to succeed when compared to other years when those individuals declared a major in a stand-alone program and improved their pass rate. This may represent a research limitation as our study classified students as non-completers even though they were still enrolled in 2012. Also, since

2011 cohort occurs near the end of our study period (2007-2012), its significance may be accounted for via improved advising, counseling or other student support structures given the state's efforts to improve retention in Kansas technical and community colleges. Age when aligned with declaring a major and pass rate may logically indicate that older students have clearer goals and stronger levels of persistence and motivation even though 97% of the students in our dataset are younger than 25 years. Both of these variables are only significant when associated with other factors, hence to understand their level of significance requires more research.

While it may seem counterintuitive that single factors (main effects) are not predictive but their interactions are, these interactions do indicate the complexity of why students go down one pathway instead of another. If a single factor were a significant predictor of completing a postsecondary program, PAM would have identified it. Our research therefore raises questions regarding the value of using single-factor analyses that do not consider interactions to understand events. Similar to understanding factors that determine what causes cancer, the reasons why someone succeeds or fails in education is equally complex and with the advancement of new statistical methods we now have the tools to better understand the interactions of main effect factors in postsecondary completion.

Implication for Practitioners

Based on our observations and conversations with adult education directors and teachers in Kansas, collecting student data is time consuming and resource intensive. Yet research is not possible without high quality data. To value the time they spend collecting data, practitioners need to see the benefits of how data are analyzed and used. Our

findings have potential to inform and strengthen the work and commitment of adult education practitioners. High-performing ABE and ASE students need advice and support as they transition into postsecondary programs (Guison-Dowdy & Patterson, 2011b), and the quality of this advising depends upon having credible information grounded in quality data, analysis, and research.

Our study concurs that developmental education does not always result in successful completion of a postsecondary program (e.g., Bailey, 2009a; 2009b). One strategy some adult education centers in Kansas use is to allow students to reenroll in the center, in lieu of taking developmental education courses, where they can study and prepare to retake the college placement test at no cost. Bypassing lengthy developmental coursework not only reduces tuition costs but also frees up resources to start courses in the adult's major (Patterson, 2014).

Our study also suggests that students who enroll in short-term postsecondary certificate programs are more likely to complete them. These certificates not only allow students to move into the workforce more quickly, but also allow them to experience success one step at a time in a first college program (Guison-Dowdy & Patterson, 2011b). Certificate programs should be viewed as a gateway experience into college (Zhang et al., 2011), and when successfully completed they provide students a choice: skilled employment, or pursuing additional, even more rigorous college programs. Many adults with an associate or bachelor degree first earned a certificate. This scaffolding approach to transitioning successfully requires timely academic advising and student support. The interaction of short-term certificate goals with passing courses and age points to a particular need for this advising and support for younger adults who persist less often.

We realize that collecting data, allowing students to reenroll in ASE instead of developmental education, and providing more academic advising are heavy burdens to place on adult education practitioners and centers that are already overworked and underfunded. Yet our research suggests that these processes are essential for ABE and ASE students to successfully transition into and complete postsecondary programs.

Limitations

There are several limitations to this research. Though our dataset is of high quality, our findings are still dependent upon the available variables of this dataset that links secondary, adult education, and postsecondary data. We also were limited to employing the existing demographic features in this database, some of which is self-reported. Hence we cannot address the influence of advising, a sense of wellbeing, inaccurate self-reports, maturity, and other factors that may predict student success in postsecondary programs. Another limitation is that to our knowledge this is the first study to analyze student demographics and coursework using these methods, hence we have no similar studies with which to compare our study. And this research is limited to only those students who met the criteria of being in a Kansas secondary school, adult education program, and postsecondary program between 2007 and 2012. This time frame limits the age range to younger adult education students, counts a student as a non-completer even though they are still enrolled and making progress after 2012, and does not account for those students who bypass an adult education program or gain a high school credential by passing the GED test without instruction. As we were interested only in completers and non-completers, further research using PAM is needed

on non-completers who were still enrolled after 2012.

This study did not include subjects that had multiple records covering more than one year. If these subjects were included, correlation among records from the same subject needs to be considered during the modeling. This would incur problems in two regards. (1) A majority of subjects only have records for one year and only a small portion of subjects have records for more than a year. Including both into the same model makes it difficult to model the correlation appropriately since subjects with only a one-year record does not contribute to the estimation of correlation structure. (2) So far the study of methods with correlated data and high dimensional explanatory variables is still an active research topic. There are some theoretical results that exist but we have not seen any methods that have general applications.

Conclusion

Since 2007 in Kansas, between 1,700 and 2,200 students annually pass the GED test and earn their Kansas State High School Diploma. It is important to note that not all of these students pass through an adult education program. Also approximately 1,000 adult education students enroll annually in postsecondary education or training programs (OVAE-NRS, Table 5), though not all earn a GED credential. Based on what we know, the majority of students who earn a GED credential and transition into a postsecondary program enroll in Kansas' community and technical colleges. And, increasing the numbers of these students who successfully transition to and complete a postsecondary program is closely aligned with KBOR's goal to double the number of adult education students entering postsecondary programs after attending adult education. This goal reinforces why analyzing state data is critical to better understand

demographic-specific patterns and factors of adult education students who successfully transition to postsecondary programs.

Our findings do not show that individual factors were predictive in the five predictive interactions; rather, it is the five two- and three-way interactions that were predictive. These interactions illustrate the complexity of understanding student pathways between adult education and postsecondary programs. In order to capture this complexity we had to use a statistical method (PAM) developed for cancer research that is designed to analyze relatively small samples with large numbers of features. Higher quality national and state student databases present an important research opportunity to facilitate better understanding of the predictive factors in student success. Often these datasets contain many demographic features relative to the size of the sample. For example the USA-PIAAC (Program for the International Assessment of Adult Competencies) dataset contains many features for a relatively small data sample, 5,000 adults (IES-NCES, 2012b). To isolate one or two features to explain or predict an effect using a classical model does not take into consideration the interaction with other features. The methods we used identified complex interactions associated with adult pathways and success.

Our research findings also provide insight into how linked SLDS datasets can be used to study student achievement, as well as teacher and program effectiveness. Nationally there is a movement to increase student transitions to postsecondary education and identify the best models for doing so, with a focus on certain subpopulations, namely adult education students. The type of analyses used in this study has the potential to be applied to other state adult student datasets, and further our understanding of why some students passing through adult education programs succeed or fail in postsecondary programs. ❖

Jeff Zacharakis is a Professor of Adult Education at Kansas State University.

Haiyan Wang is an Associate Professor of Statistics at Kansas State University.

Margaret Becker Patterson is Senior Researcher with Research Allies for Lifelong Learning; she is leading the national Adult Learner Leadership in Education Services (ALLIES) evaluation for VALUEUSA, the national organization of adult learners.

Lori Andersen is a research associate for Dynamic Learning Maps at the University of Kansas.

References

- Acee, T. W., Cho, Y., Kim, J. I., & Weinstein, C. E. (2012). Relationships among properties of college students' self-set academic goals and academic achievement. *Educational Psychology, 32*(6), 681-698.
- Bailey, T. (2009a). Challenge and opportunity: Rethinking the role and function of developmental education in community colleges. *New Direction for Community Colleges, 2009*(145), 11-30.
- Bailey, T. (2009b). *Rethinking developmental education in community college* (Policy Brief, Vol. 40). New York: Community College Research Center.
- Bean, J. P., & Metzner, B. S. (1985). A conceptual model of nontraditional undergraduate student attrition. *Review of Educational Research, 55*(4), 485-540.
- Boeke, M., & Zis, S. (2012). *State policies on the adult re-entry pipeline state case studies*. Boulder, CO: National Center for Higher Education Management Systems. Retrieved from http://www.nchems.org/c2sp/documents/GatesAdultCaseStudies_Final.pdf.
- Bragg, D. D., Kim, E. & Barnett, E. A. (2006). Creating access and success: Academic pathways reaching underserved students. *New Directions for Community Colleges, 2006*(135), 5-29
- Developmental Education Working Group (2014). *Developmental education working group report*. Topeka, KS: Kansas Board of Regents
- Ewell, P., Kelly, P., & Klein-Collins, R. (2008) *Adult learning in focus: National and state-by-state data*. Chicago, IL: Council for Adult and Experiential Learning and National Center for Higher Education Management Systems. Retrieved from <http://www.cael.org/adultlearninginfocus.htm>
- Guison-Dowdy, A., & Patterson, M.B. (2011a). *Journeys through college 1: Postsecondary transitions and outcomes of GED test passers*. Washington, DC: American Council on Education.
- Guison-Dowdy, A., & Patterson, M.B. (2011b). *Journeys through college 2: Postsecondary experiences of GED test passers*. Washington, DC: American Council on Education.
- Horn, A.S. (2014). *Determinants of student success: An integrative perspective to orient policy and practice*. Minneapolis, MN: Midwest Higher Education Compact.
- IES-NCES (2012a). *The condition of education 2012*. Washington D.C.: Department of Education. Retrieved from <http://nces.ed.gov/pubs2012/2012045.pdf>
- IES-NCESa (2012b). *Program for international student assessment (PISA) 2012 public-use data files*. Washington D.C.: Department of Education. Retrieved from <http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2014028>
- Kansas Board of Regents. (2010) *Foresight 2020*. Retrieved from <http://www.kansasregents.org/>
- Miller, N. B. (2014). Nontraditional student graduation rate benchmarks. *The Journal of Continuing Education, 62*(3), 141-151.
- OVAE-NRS, Kansas Statistical Data, Table 5, 2007, 2008, 2009, 2010. Retrieved from: <http://wdcrobc01p01.ed.gov/CFAPPS/OVAE/NRS/tables/index.cfm>
- Pascarella, E. T. (1985). Students' affective development within the college environment. *The Journal of Higher Education, 56*(6), 640-663.
- Patterson, M.B. (2010). *GED tests passers in postsecondary institutions of up to two years: Following up on enrollment and graduation*. Washington, DC: GED Testing Service.
- Patterson, M.B. (2014). Post-GED-Credential prospects for adults with special needs. *Journal of Research and Practice for Adult Literacy, Secondary, and Basic Education, 3*(3), 22-35.
- Patterson, M.B., Zhang, J., Song, W., & Guison-Dowdy, A. (2010). *Crossing the bridge: GED credentials and postsecondary educational outcomes, year one*. Washington, DC: GED Testing Service.
- Reder, S. (2007). *Adult education and postsecondary success*. New York: Council for the Advancement of Adult Literacy. Retrieved from <http://www.caalusa.org/content/rederpolicybriefrev10807.pdf>
- Research Allies for Lifelong Learning. (2013). *Crossing the bridge: Adults with GED credentials going to college (2004 - 2010)*. Retrieved from http://www.researchallies.org/Crossing_the_Bridge.html
- Tan, A. C., Naiman, D. Q., Xu, L., Winslow, R. L., & Geman, D. (2005). Simple decision rules for classifying human cancers from gene expression profiles. *Bioinformatics, 21*, 3896-3904.
- Tibshirani, R., Hastie, T., Narasimhan, B., & Chu, G. (2002). Diagnosis of multiple cancer types by shrunken centroids of gene expression. *Proceedings of the National Academy of Sciences, 99*(10), 6567-6572.
- U.S. Department of Education, Office of Vocational and Adult Education (2007) *Adult Education and Family Literacy Act of 1998: Annual Report to Congress 2006-2007*. U.S. Department of Education. 2007. Retrieved from www.nrsweb.org/reports/congress_report.aspx.
- Wang, H., Dai, Z., Chen, M.S., & Yuan, Z. (2013). TSG: A new algorithm for binary and multi-class cancer classification and informative genes selection. *BMC Medical Genomics, 6*: (Suppl 1): S3.
- Zhang, J., Guison-Dowdy, A., Patterson, M. B., & Song, W. (2011). *Crossing the bridge: GED credentials and postsecondary educational outcomes (Year Two Report)*. Washington, DC: GED Testing Service.

Table 1—*Student Demographics*

Gender	%
Male	47
Female	53
Age	%
16-19	59
20-24	38
25+	3
Ethnicity	%
African American	8
Hispanic	10
White	70
All Other	12

Table 2—*PAM Prediction of Classes*

PAM Prediction			
	Class 1-predicted	Class 2-predicted	Percent Accuracy
Class 1-actual	418	44	90.48
Class 2-actual	27	43	61.43
Overall Percent			86.65
MCC			0.474

Cross-tabulated counts of the observed sample class with the predicted class from 10-fold external cross-validation using classification accuracy as the objective function during the model training. Observed: 462 in class 1 (fail to complete any program) and 70 in class 2 (successfully complete a program). The percent refers to the percent of correctly classified samples in a row. MCC is the Matthews Correlation Coefficient.

Table 3—*PAM Prediction using MCC*

PAM Prediction			
	Class 1-predicted	Class 2-predicted	Percent Accuracy
Class 1-actual	432	30	93.51
Class 2-actual	30	40	57.1
Overall Percent			88.72
MCC			0.506

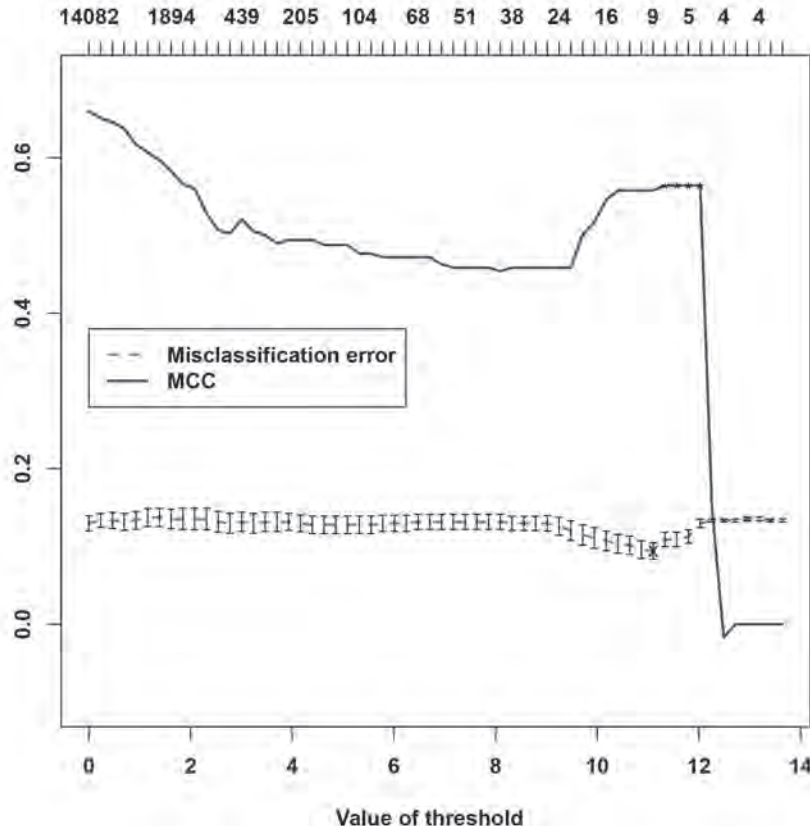
Cross tabulated counts of the observed sample class with the predicted class from 10-fold external cross-validation using MCC as the objective function during training. Table legend is same as in Table 2.

Table 4—*Firth Prediction with Features Selected by PAM*

Firth Prediction with probability cut-off of 0.5			
	Class 1-predicted	Class 2-predicted	Percent Accuracy
Class 1-actual	448	14	96.97
Class 2-actual	46	24	65.71
Overall Percent			88.45

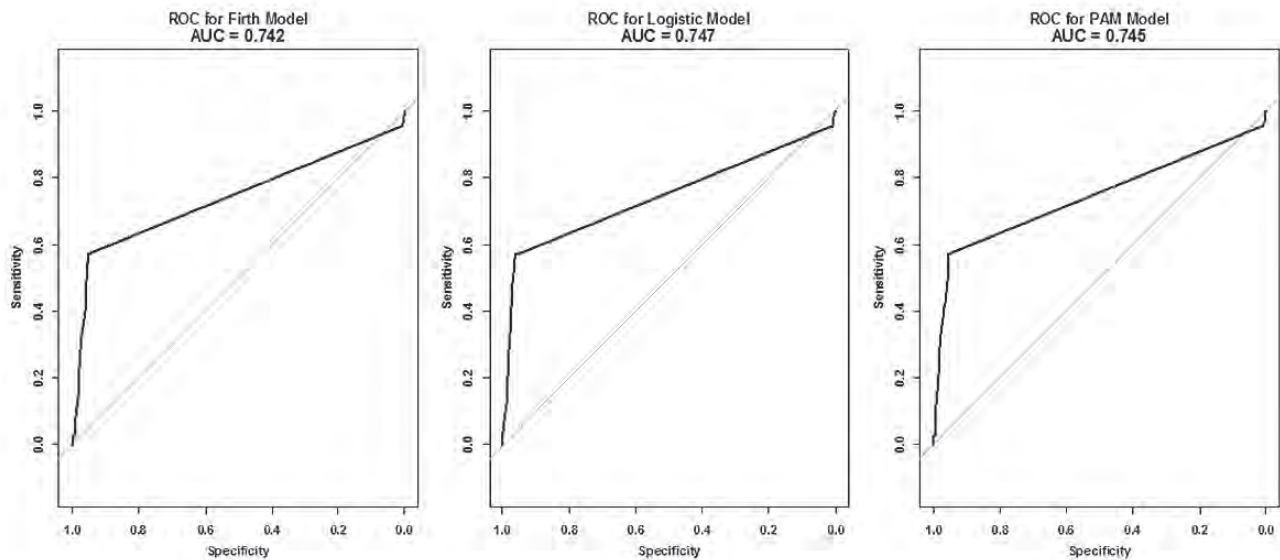
Cross tabulated counts using the Firth logistic regression model with five features selected by PAM. Table legend is same as in Table 2.

Figure 1—PAM Misclassification error and MCC vs. threshold value



The horizontal axis on top labels the number of features selected as the threshold parameter was given in the horizontal axis at the bottom. The ‘*’ labels the MCC of models that has the highest MCC values among models using less than 1000 predictors.

Figure 2—ROC curves of the fitted Firth logistic regression, simple logistic regression, and PAM models using the selected features from PAM.



How Is Health Related to Literacy, Numeracy, and Technological Problem-Solving Skills among U.S. Adults? Evidence from the Program for the International Assessment of Adult Competencies (PIAAC)

Esther Prins

Pennsylvania State University

Shannon Monnat

Pennsylvania State University

Carol Clymer

Pennsylvania State University

Blaire Wilson Toso

Pennsylvania State University

Credits: This paper was been commissioned by American Institutes for Research (AIR), funded through a contract with the National Center for Education Statistics (NCES). A previous version of this article was published on the AIR website and in the proceedings of the 2015 Adult Education Research Conference. Dr. Monnat would like to acknowledge support from the Population Research Institute at Penn State, which receives core funding from the National Institute of Child Health and Human Development (R24-HD041025).

Abstract

This paper uses data from the Program for the International Assessment of Adult Competencies (PIAAC) to analyze the relationship between U.S. adults' self-reported health and proficiencies in literacy, numeracy, and technological problem solving. Ordinal logistic regression analyses showed that scores on all three scales were positively and significantly related to health. After controlling for respondents' socioeconomic and demographic characteristics, only literacy remained significant, but the magnitude of the literacy effect diminished substantially. These results

suggest that socioeconomic resources such as formal education, parents' education, and employment are the *pathway or mechanism* through which literacy, numeracy, and technological problem solving are related to health. Therefore, literacy, numeracy, and technological problem solving should be viewed as social determinants of health. Policy implications include the need for literacy and ESL instruction, coupled with efforts to increase college completion and access to health insurance and support services for people with disabilities.

Introduction

Higher educational attainment is strongly associated with better health, but we know far less about how other social determinants—namely, literacy and numeracy proficiency and technological problem-solving skills—shape health outcomes. National literacy assessments such as the Program for the International Assessment of Adult Competencies (PIAAC) indicate that these proficiencies are highly correlated with health status. For instance, official PIAAC reports such as *Time for the U.S. to Reskill?* (Organisation for Economic Co-operation and Development, 2013) conclude, “In the U.S., the odds of reporting ‘fair’ or ‘poor’ health are four times higher for those with low literacy skills (below Level 2) than for those with strong skills (Level 4/5)” (p. 24). Citing PIAAC data, the Centers for Disease Control (2015) states, “Adults with higher literacy scores report better health, which suggests they have a stronger set of skills to prevent disease and protect their health” (n.p.). However, these findings do not adjust for background characteristics that shape one’s chances of acquiring and improving both literacy and health, including race, educational attainment, age, parental education, and other traits. This means they are not comparing apples to apples. To draw accurate conclusions about the distinctive contribution of literacy, numeracy, and technological problem-solving proficiencies to health, we must account for adults’ sociodemographic attributes.

Accordingly, this study uses U.S. PIAAC data to answer the following research question: Are literacy, numeracy, and technological problem-solving scores associated with self-rated health (SRH) after controlling for race/ethnicity, socioeconomic status (SES), and other respondent characteristics?¹ We find that all three proficiencies are positively associated with SRH. After adjusting for sociodemographic characteristics, only literacy remained significant,

but the magnitude of the effect was substantially attenuated. This suggests that literacy, numeracy, and technological problem-solving are all related to adult health, and that relationships between these skills and health operate largely through socioeconomic status. In other words, the same set of socioeconomic resources that help us improve health also boost literacy, numeracy, and technological problem-solving scores. By exploring these relationships, this study adds to the burgeoning literature in adult education and health (Collins, Bryant, & Rocco, 2014; Diehl, 2011; English, 2012; Hill, 2011; Mooney & Prins, 2013; Papen, 2009; Prins & Mooney, 2014).

Literature Review

To frame our analyses, we borrow from conceptual frameworks that emphasize formal educational attainment as a social determinant and fundamental cause of health and health disparities (Link & Phelan, 1995). Educational attainment is considered a social determinant because it influences access to and use of health-promoting resources through employment and associated economic rewards (e.g., higher income, access to health insurance, ability to live in safer neighborhoods), social-psychological mechanisms (e.g., sense of control, access to social support), and health lifestyle choices such as diet and exercise (Braveman, Egerter, & Williams, 2011; Link & Phelan, 1995; Mirowsky & Ross, 2003; Reynolds & Ross, 1998; Ross & Wu, 1995). Prior research consistently finds that people with higher educational attainment enjoy better health than those with less education (Adler et al., 1994; Kawachi & Berkman, 2001; Kitagawa & Hauser, 1973).

In a similar fashion, literacy, numeracy, and technological problem solving may enhance adult health through comparable mechanisms—above and beyond one’s formal educational credentials. Figure 1 illustrates how our focus on these proficiencies fits within the social determinants of health framework,

namely as a way to access the socioeconomic opportunities and resources required to improve one's health.

Literacy capabilities have many implications for health, including the ability to read, understand, and draw conclusions from health-related information. Surprisingly few studies, however, have examined the relationship between health and *print literacy*. The PIAAC's literacy scale measures reading comprehension on tasks from many life domains. It defines literacy as "understanding, evaluating, using and engaging with written text to participate in the society, to achieve one's goals and to develop one's knowledge and potential" (National Center for Education Statistics, 2014a). However, instead of examining print literacy writ large, most studies have focused on *health literacy*, using instruments that measure reading and, in some cases, math ability only on health-related topics such as interpreting medicine labels. Thus, print and health literacy overlap, but are not synonymous.

Low print or health literacy is disproportionately prevalent among adults with limited income, formal schooling, and English proficiency, as well as the elderly and Latinos, African Americans, and Native Americans (Heinrich, 2012; Kalichman & Rompa, 2000; Kutner, Greenburg, Jin, & Paulsen, 2006; Rothman et al., 2006; Rudd, 2007). Even among people with similar education and income, some studies have found that print or health literacy proficiency independently shapes their health behaviors, decisions, and use of information and services (Baker, Parker, Williams, Clark, & Nurss, 1997; Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011; Easton, Entwistle, & Williams, 2010; Kalichman & Rompa, 2000; Nielsen-Bohlman, Panzer, & Kindig, 2004; Ronson & Rootman, 2009; Weiss, Hart, McGee, & D'Estelle, 1992). Although the causal mechanisms are debated, adults with lower print and health literacy scores tend to have worse health, "including

knowledge, intermediate disease markers, measures of morbidity, general health status, and use of health resources" (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004, p. 1228). The link between these low scores and adverse health outcomes is concerning, yet we should also recognize that these tests do not capture the capabilities and strategies people use to understand written information in everyday life or health professionals' skill in communicating health information to patients (Mooney & Prins, 2013).

The PIAAC defines numeracy as "the ability to access, use, interpret, and communicate mathematical information and ideas, to engage in and manage mathematical demands of a range of situations in adult life" (NCES, 2014b). Overall, U.S. adults have more difficulty with numeracy than literacy. For example, 61% of U.S. PIAAC respondents scored at Level 2 or below (out of five levels) on the numeracy scale, compared to 50% for literacy (OECD, 2013). Many adults, including those with high levels of education, struggle with quantitative abilities such as calculating insulin dosage or understanding the risk of developing cancer (Ancker & Kaufman, 2007; Reyna, Nelson, Han, & Dieckmann, 2009; Rothman, Montori, Cherrington, & Pignone, 2008). This is troubling because mathematical calculations, reasoning, and understanding influence risk assessment and decision making (Lipkus & Peters, 2009; Reyna et al., 2009), interpretation of numerical and graphical information (Rothman et al., 2006), and health behaviors such as following medication dosing schedules (Estrada, Martin-Hryniewicz, Peek, Collins, & Byrd, 2004; Rothman et al., 2008). For example, in one study, low numeracy scores explained women's and African Americans' lower HIV medication management scores (Waldrop-Valverde et al., 2010). The evidence regarding numeracy and health, however, is still thin and inconclusive, largely because many studies have not controlled for confounding factors such as educational attainment (Berkman et al., 2011).

This study also focuses on technological problem-solving skills because they are increasingly necessary for managing health, accessing information, and navigating the health care system in a technologically complex, information-saturated environment (Baur, 2008; Brodie et al., 2000; Norman & Skinner, 2006). The PIAAC defines problem solving in technology-rich environments (PS-TRE) as “using digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks” (NCES, 2014c). Technological problem solving can influence health *directly*—for instance, by enabling people to obtain information and social support, learn about medication, examine treatment options, and so on (Kalichman et al., 2003, p. 111)—and *indirectly* by providing “access to most of the important social determinants of health including employment, housing, education and social networks” (Baum, Newman, & Biedrzycki, 2014, p. 349).

Many adults, however, struggle with technological problem-solving skills. Fifty-four percent of U.S. PIAAC respondents scored at Level 1 or below (out of four levels) on the PS-TRE scale (meaning they had difficulty using technology to complete more complex tasks), failed a test of basic functional computer skills, or had no computer experience (OECD, 2013, p. 84). In addition, access to digital technologies, Internet usage for health, and the ability to use technology tools in health situations are unequally distributed by income, educational attainment, race/ethnicity, age, and literacy ability (Baum et al., 2014; Birru & Steinman, 2004; Gilmour, 2007; Kontos, Blake, Chou, & Prestin, 2014; Zarcadoolas, Blanco, Boyer, & Pleasant, 2002). Most prior studies on health and technology rely on self-rating of knowledge and skills, whereas the PIAAC directly measures technological problem-solving proficiency.

Method

Data

Data for this study come from the public use files of the 2012 PIAAC Survey of Adults Skills. The Survey of Adult Skills is an international survey of adults aged 16-65 conducted in 24 countries. It is designed to measure key cognitive and workplace skills needed for people to participate successfully in societies and economies. Our analyses used data from the U.S. PIAAC assessment. A total of 5,010 U.S. respondents completed this survey.

Variables

Our outcome of interest, self-rated health, was based on the following question: “In general, would you say your health is excellent, very good, good, fair, or poor?” We selected self-rated health because it is an accurate, comprehensive measure of health outcomes (e.g., mortality, hospitalizations, health care utilization) in the United States and internationally (Idler & Benyamini, 1997). So as not to lose any variation in our outcome, we maintained self-rated health in its ordinal scale (all five levels) for all analyses.

The independent variables of interest were respondents’ literacy, numeracy, and PS-TRE scores. Each respondent has ten plausible value scores on each of these scales. Respondents do not answer every literacy, numeracy, and PS-TRE question, but rather respond to a fraction of the assessment. Accordingly, PIAAC developed plausible values to obtain consistent estimates of literacy, numeracy, and PS-TRE. These are imputed values that resemble individual test scores and have approximately the same distribution as actual values. We used the analytic techniques that are designed for analyzing plausible values (Pokropek & Jakubowski, 2013; Von Davier, Gonzalez, & Mislevy, 2009).

Some respondents did not answer the PS-

TRE items either because they had no computer experience or failed a test of basic computer skills. Thus, these respondents were excluded from the PS-TRE analyses.

PIAAC literacy, numeracy, and PS-TRE scores range from 0 to 500. Literacy and numeracy have five proficiency levels (Below Level 1 to Level 4/5) and PS-TRE has four (below Level 1 to Level 3). At Level 2 or below, adults are more likely to have difficulty completing the requisite tasks. For more information on PIAAC proficiency levels, see the National Center for Education Statistics (<http://nces.ed.gov/surveys/piaac/measure.asp>).

We adjusted our regression models for potential mediators and confounders that have been found to influence adult health status (Idler & Benyamini, 1997). These included age (24 or less [ref], 25-34, 35-44, 45-54, 55 or older); sex (male=ref); race/ethnicity (non-Hispanic white [ref], non-Hispanic black, Hispanic, Asian, other race); educational attainment (less than high school [ref], high school graduate, certificate from trade school or other, associate degree, bachelor's degree, master's degree or higher); employment status (employed [ref], unemployed, pupil/student/apprentice/internship, retired, unable to work due to disability, and homemaker or other); lives with a spouse/partner; has children aged 12 or younger; household size; nativity (born in the U.S. or abroad); mother's and father's educational attainment; any vision or hearing problems or diagnosed learning disability; health insurance status; and an English proficiency score comprised of a summed measure of respondent's self-reported ability to speak, read, write, and understand spoken English.

PIAAC respondents are only asked for their employment earnings, thus excluding income from transfers and assets such as retirement, social security, public assistance, child support, interest, and rent from property. The 35% of respondents who did not report any employment income differed

significantly from those with a valid response; they were more likely to be in the youngest or oldest age categories, to have not completed high school, and to be unemployed. We decided to exclude earnings as a control variable, thus ensuring that our sample reflected the most generalizable representation of U.S. adults. After deletion of cases with missing information on our items of interest, our sample sizes ranged from 4,647 to 3,942.

Analytic Approach

We begin by presenting basic descriptive statistics of our sample. To examine the associations between self-rated health and basic skills (without control variables), we present mean scores with 95% confidence intervals for literacy, numeracy, and PS-TRE across the five health categories. These confidence intervals enable us to determine whether average literacy, numeracy, and PS-TRE scores are significantly different across the self-rated health categories (e.g., are literacy, numeracy, and/or PS-TRE scores significantly higher among respondents who reported excellent versus poor health). We then follow with a series of ordinal logistic regression models that predict relationships between the independent variables and odds of being in a better self-rated health category (i.e., odds of having better health).

For each independent variable we first present a model that includes only that variable, without controlling for anything else. This enables us to determine whether there is an association between that independent variable and self-rated health before accounting for other important respondent characteristics that may affect both that independent variable (e.g., literacy) and their health or that may explain the association between skills and adult health. We then integrate all mediators and confounders into the second model. We weighted all analyses with the final sample weight provided with the data.

Results

Associations between Self-Rated Health and Literacy, Numeracy, and Technological Problem-Solving Skills

Descriptive statistics for self-rated health, literacy, numeracy, problem-solving skills, and our control variables are presented in Table 1. The literacy score ranged from 103 to 424 (average = 272), and numeracy ranged from 45 to 427 (average = 255). Both of these average scores fall within Level 2 (226 to 275). The PS-TRE score ranged from 114 to 425 (average = 278). This average score translates to Level 1 (241 to 290). Over half of respondents (57.9%) rated their health as very good or excellent. The majority (67%) of the sample was non-Hispanic white, 14% were Hispanic, 11% were non-Hispanic black, 5% were Asian, and the remaining respondents were “other race.” The majority (87%) of the sample had at least a high school diploma, but less than half (46%) had any post-high school formal education. Most respondents were employed (65%) and were living with a spouse or partner (71%). About half of the sample was female, less than a quarter had a child aged 12 or younger, and about 15% was foreign-born. The majority of respondents’ parents had obtained a high school diploma or better. Almost a quarter of respondents reported having vision or hearing problems or a diagnosed learning disability, and nearly 80% had health insurance. Less than 5% were unable to work due to a disability. Finally, respondents had an average English proficiency score of 4.87, indicating overall strong proficiency in the sample (lower scores indicate better proficiency).

Figures 2-4 display the average literacy, numeracy, and PS-TRE scores by level of self-rated health. For all three items, there is a positive relationship between scale scores and self-rated health; respondents with higher scores report better self-rated health. The bars representing the confidence intervals around

the means indicate that respondents who reported excellent or very good health had significantly higher literacy, numeracy, and PS-TRE scores than respondents who reported good, fair, or poor health. Those who reported good health also had significantly higher literacy and numeracy scores (but not PS-TRE scores) compared with those who reported fair or poor health.

Results of regression analyses predicting self-rated health from literacy, numeracy, and technological problem solving, before accounting for any control variables, are presented in Table 2. Models 1a, 2a, and 3a demonstrate that literacy, numeracy, and technological problem solving are all significantly and positively associated with health. Ten-point increases on the literacy, numeracy, and PS-TRE scales are associated with 10.5%, 8.5%, and 7.6% greater odds, respectively, of being in a better self-rated health category (e.g., moving from good to very good health).²

Additional characteristics that may be associated with both self-rated health and skills in literacy, numeracy, and PS-TRE or that may represent the pathways through which adult skills influence health are included in Models 1b, 2b, and 3b (Table 3). After introducing these covariates, numeracy and technological problem solving were no longer statistically significant predictors of health. In addition, the effect size for literacy was reduced but remained significant. This finding suggests that although literacy, numeracy, and technological problem-solving are associated with adult health, those associations largely operate through other individual characteristics. Specifically, we found that socioeconomic status variables attenuated the associations between the adult skills and health.

Regarding the association between literacy and health, a 10-point increase on the literacy scale is associated with 2.6% greater odds of being in a better health category. To illustrate what this means,

let's assume that two respondents have identical characteristics on all the control variables that we included; the only difference is their literacy, numeracy, or PS-TRE score. Let's say that Lucía and María are both married, Latina women aged 25-34; they do not have a high school education, are employed, do not have health insurance, were born in the U.S., speak English very well, etc. María has a literacy score of 230 (the average for U.S. adults without a high school degree) and reports poor health. Lucía's score is 240, so she has about 3% greater odds of reporting fair health. However, having a higher numeracy or PS-TRE score does not increase Lucía's odds of reporting better health when accounting for the fact that all other women's characteristics are identical.

We found a number of other important predictors of adult health, including educational attainment, employment status, and nativity. For example, having a bachelor's degree was associated with about 92% greater odds of being in a better health category than having less than high school, and having a master's degree or higher was associated with over twice the odds (212%) of being in a better health category compared with those who did not finish high school. Being retired or unable to work due to disability were associated with about 39% and 96% lower odds, respectively, of reporting better health compared to those who are employed. Foreign-born respondents had almost 50% greater odds of being in a *better* self-rated health category compared with U.S.-born respondents, consistent with research on the immigrant health paradox whereby immigrants report better health than non-immigrants despite fewer socioeconomic resources and lower literacy scores (Martinez, Aguayo-Tellez, & Rangel-Gonzalez, 2014; Prins & Monnat, 2015). Other important predictors of adult self-rated health included having a vision/hearing problem or learning disability,

parental education, age, health insurance, and English proficiency.

Discussion

This paper explored proficiencies in literacy, numeracy, and technological problem solving as potential social determinants of adult health in the U.S. Our study is the first to use PIAAC data to analyze this topic. The results indicate that although all three proficiencies are positively related to self-rated health, these skills largely operate through socioeconomic status indicators to influence adult health. Only literacy remained significant after accounting for other respondent characteristics. Consistent with previous research, we found a positive association between numeracy and self-rated health (Lipkus & Peters, 2009; Reyna et al., 2009; Rothman et al., 2006; Rothman et al., 2008; Waldrop-Valverde et al., 2010) and technological problem-solving skills and health (Birru & Steinman, 2004; Gilmour, 2007; Zarcadoolas et al., 2002). However, unlike previous research—including official PIAAC presentations (Schleier, 2013, slide 8)—we tested whether that relationship remained after controlling for various individual characteristics, and found that these other characteristics were driving the association between numeracy and health. Additional research is needed to determine the mechanisms by which literacy enhances health, after accounting for other individual characteristics, and whether our findings apply to adults in other PIAAC countries.

One limitation of our analyses is that we were unable to include respondents who did not answer the PS-TRE items because they had no computer experience or failed a test of basic computer skills. Given technological disparities in the U.S., these respondents are likely to be older and to have lower incomes and levels of education than those who answered PS-TRE questions. Another limitation is

that the PS-TRE scale may not tap into the kinds of technological problem-solving skills that people use to analyze Internet-based health information and to navigate other technologically complex health-related tasks.

Our regression analyses showed that beyond literacy, numeracy, and technological problem-solving skills, there are many other important drivers of adult health, namely educational attainment, being unable to work due to disability or retirement, immigration status, parental education, having vision/hearing problems or a learning disability, English proficiency, and health insurance. A strength of our study is that, unlike many previous studies, our analysis accounted for these important respondent characteristics. This allowed us to identify the independent contribution of literacy to health, disentangled from other characteristics that may influence both literacy and health—particularly educational attainment, employment status, and English language ability. Thus, our study elucidates the fact that higher literacy scores are associated with better health *among people who otherwise have identical social, economic, and demographic traits*.

These findings underscore the need to couple literacy, numeracy, and technological problem-solving instruction with other interventions that can enhance health. Educators and policy makers cannot change some of the sociodemographic characteristics that strongly predicted health, including sex, age, being born in the U.S. or abroad, having hearing/vision problems or a learning disability, or being retired or unable to work because of a disability. However, other variables that significantly increase the chances of better self-rated health are promising areas for policy intervention when coupled with training in adult learning skills, especially for adult basic education participants who face multiple forms of social and economic exclusion. Initiatives and

policies to increase college completion are crucial, since this will have a multi-generational influence on health and on literacy, numeracy, and technological problem-solving for adult learners, their children, and future generations. This recommendation dovetails with the growing national emphasis on postsecondary transitions for GED students and graduates (Office of Career, Technical, and Adult Education, 2010; Reder, 2007; Zhang, Guison-Dowdy, Patterson, & Song, 2011). It is also consistent with other PIAAC analyses. For instance, among the PIAAC countries, the U.S. and Germany have the strongest relationship between health and literacy and “the most entrenched multigenerational literacy problem;” this reflects an “educational caste system” in both nations, whereby parents transmit educational (dis)advantage to their children (Lunze & Paasche-Orlow, 2014, p. 17). The authors conclude that “Promoting social mobility by making higher education more accessible for those whose parents did not have the chance to access it might thus not only promote literacy and social capital, but indirectly also promote public health” (p. 17). In addition, our study suggests the need to expand ESL instruction, increase access to health insurance, and provide support services for people with disabilities and vision/hearing problems.

The results of our regression analyses reveal that the very socioeconomic resources that help us improve health—formal education, parents’ education, and employment—are the same ones that enable us to obtain higher literacy, numeracy, and PS-TRE scores on assessments like the PIAAC. In other words, we accumulate a constellation of socioeconomic resources over a lifetime, and these resources are related *both* to better health *and* stronger basic proficiencies. This suggests that socioeconomic resources are the *pathway or mechanism* through which literacy, numeracy, and technological problem solving are related to health. They work in tandem to

shape our life chances, including physical well-being and our literate, mathematical, and technological capabilities. And since people do not have access to the same resources, educators and policy makers should target those with greatest unmet literacy and economic needs and the least education—precisely the population that many adult basic education programs serve.

The results of this study should be considered in light of some additional limitations not already addressed. First, the PIAAC cannot be used to determine causality because the data are cross-sectional (collected at one point in time). We cannot show that literacy, numeracy, or technological problem solving leads to better health or vice versa, only that a significant relationship exists. Longitudinal studies are needed to examine the causal relationships between these proficiencies and adult health throughout the life course. Second, due to recall bias respondents may have answered some of the PIAAC questions inaccurately (e.g., parents' education). Third, we could not control for respondent income because the PIAAC includes only employment earnings. Income from all sources, including transfers and assets, is an important health-promoting resource. Fourth, like other standardized basic skills assessments that measure proficiency, the PIAAC does not necessarily capture people's ability to critically analyze or use health information (Pleasant, 2008) or the many ways people use literacy, numeracy, and technology in their daily lives. The latter is important because engagement in literacy practices can increase proficiency (Reder, 2009). Finally, the PIAAC does not assess writing, which may be crucial for managing and advocating for one's health, or capture the notion of distributed or mediated literacy, referring to the literacy (as well as numeracy and technological) tasks that we can accomplish with others' assistance.

This study points to many avenues for future research, including comparison of these results with international PIAAC data. Exploring health care utilization as the dependent variable can help us understand how these proficiencies shape adults' use of health care services, particularly preventative health services such as flu shots, mammograms, or screening for various diseases. For instance, do limited literacy, numeracy, and technological problem-solving proficiencies impede people from using these services, even after accounting for their self-rated health, insurance status, income, education level, and other characteristics? Finally, the U.S. PIAAC National Supplement study, which will include unemployed, younger, and older adults, can be used to examine how access to health insurance for these sub-groups may change the relationship between health indicators and literacy, numeracy, and PS-TRE scores before and after implementation of the Affordable Care Act (ACA). The ACA has reduced Americans' uninsured rate from 18.0% in 2013 to 11.6% in 2015 (Marken, 2015). Our study provides a foundation for these types of future research.

Our findings contribute to the growing interest in adult education, basic proficiencies, and health and integrating health-related topics into adult basic education and ESL classes (Chervin, Clift, Woods, Krause, & Lee, 2012; Collins et al., 2014; Diehl, 2011; English, 2012; Hill, 2011; Mooney & Prins, 2013; Papan, 2009; Prins & Mooney, 2014). The results suggest that although literacy, numeracy, and technological problem solving are not magic bullets, they should all be viewed as a potential social determinants of health. When coupled with the other recommendations outlined in this paper, skill development can help expand disenfranchised adults' access to the social and economic resources and opportunities that they need to flourish. ❖

Esther Prins is an Associate Professor of Adult Education at Penn State and Co-Director of the Goodling Institute for Research in Family Literacy and Institute for the Study of Adult Literacy. Her work examines the social and cultural aspects of adult and family literacy, especially the ways that programs can challenge gender, racial, economic, and cultural inequalities. Her research has been published in journals such as the *American Educational Research Journal*, *Teachers College Record*, and *Adult Education Quarterly*. She is the recipient of the 2010 Imogene Okes Award for Outstanding Research in Adult Education from the American Association for Adult and Continuing Education.

Shannon Monnat is an Assistant Professor of Rural Sociology, Demography, and Sociology in the Department of Agricultural Economics, Sociology, and Education at Penn State. Her research interests include social and spatial disparities in health care access, use, behaviors, and outcomes; policy and program participation impacts on health; and the Great Recession and spatial inequality in the U.S.

Dr. Carol Clymer is a Research Associate in the College of Education and Co-Director of the Institute for the Study of Adult Literacy and the Goodling Institute for Research in Family Literacy. She has over 30 years of experience managing and evaluating programs to improve the education and employment prospects of low-income and/or low-skilled individuals. She has written and managed federal, state, local, and privately-funded grant projects, securing over \$10 million in funding, and has authored numerous publications.

Blaire Willson Toso is a Research Associate for the Institute for the Study of Adult Literacy and the Goodling Institute for Research in Family Literacy at The Pennsylvania State University. She has led research and evaluation initiatives on issues pertaining to family literacy, adult literacy, mothering, immigrants, and student leadership. Her research has been published in journals such as the *American Educational Research Journal*, *Adult Education Quarterly*, and *Mothering and Literacies*.

¹Our original PIAAC paper commissioned by the American Institutes for Research and National Center for Educational Statistics explored several other research questions, including the relationship between self-rated health and participation in adult education and whether people with differing racial/ethnic backgrounds and levels of formal education accrue similar health advantages from developing basic proficiencies and participating in adult education. Due to limited space, we excluded these analyses from this article. For the full paper, see Prins, Monnat, Clymer, and Toso (2015).

²Because literacy, numeracy, and PS-TRE skills are so highly correlated, they cannot be included in the same regression models due to risk of multicollinearity, that is, the inability to distinguish how each proficiency contributes to health.

References

- Adler, N. E., Boyce, T., Chesney, M. A., Cohen, S., Folkman, S., Kahn, R. L., & Syme, S. L. (1994). Socioeconomic status and health: The challenge of the gradient. *American Psychologist*, 49, 15-24.
- Ancker, J. S., & Kaufman, D. (2007). Rethinking health numeracy: A multidisciplinary literature review. *Journal of the American Medical Informatics Association*, 14(6), 713-721.
- Baker, D. W., Parker, R., Williams, M., Clark, W. S., & Nurss, J. (1997). The relationship of patient reading ability to self-reported health and use of health services. *American Journal of Public Health*, 87, 1027- 1030.
- Baum, F., Newman, L., & Biedrzycki, K. (2014). Vicious cycles: Digital technologies and determinants of health in Australia. *Health Promotion International*, 29(2), 349-360.
- Baur, C. (2008). An analysis of factors underlying e-health disparities. *Cambridge Quarterly of Healthcare Ethics*, 17(4), 417-428.
- Berkman, N. D., Sheridan, S. L., Donahue, K. E., Halpern, D. J., & Crotty, K. (2011). Low health literacy and health outcomes: An updated systematic review. *Annals of Internal Medicine*, 155(2), 97-107.
- Birru, M. S., & Steinman, R. A. (2004). Online health information and low-literacy African Americans. *Journal of Medical Internet Research*, 6(3), e26.
- Braveman, P., Egerter, S., & Williams, D. R. (2011). The social determinants of health: Coming of age. *Annual Review of Public Health*, 32, 381-398.
- Brodie, M., Flournoy, R. E., Altman, D. E., Blendon, R. J., Benson, J. M., & Rosenbaum, M. D. (2000). Health information, the Internet, and the digital divide. *Health Affairs*, 19(6), 255-265.
- Centers for Disease Control. (2015). Health literacy in the United States. Retrieved from <http://www.cdc.gov/healthliteracy/training/page669.html>
- Chervin, C., Clift, J., Woods, L., Krause, E., & Lee, K. (2012). Health literacy in adult education: A natural partnership for health equity. *Health Promotion Practce*, 13(6), 738-746.
- Collins, J. C., Bryant, L. O., & Rocco, T. S. (Eds.). (2014). *Health and wellness concerns for racial, ethnic, and sexual minorities. New Directions for Adult and Continuing Education, No. 142*. San Francisco, CA: Jossey-Bass.
- DeWalt, D. A., Berkman, N. D., Sheridan, S., Lohr, K. N., & Pignone, M. P. (2004). Literacy and health outcomes: A systematic review of the literature. *Journal of General Internal Medicine*, 19, 1228-1239.
- Diehl, S. J. (2011). Health literacy education within adult literacy instruction. In L. H. Hill (Ed.), *Adult education for health and wellness. New Directions for Adult and Continuing Education, No. 130* (pp. 29-41). San Francisco, CA: Jossey-Bass.
- Easton, P., Entwistle, V. A., & Williams, B. (2010). Health in the “hidden population” of people with low literacy. A systematic review of the literature. *BMC Public Health (online)*, 10(1), 459.
- English, L. M. (Ed.). (2012). *Adult education and health*. Toronto: University of Toronto Press.
- Estrada, C. A., Martin-Hryniewicz, M., Peek, B. T., Collins, C., & Byrd, J. C. (2004). Literacy and numeracy skills and anticoagulation control. *The American Journal of the Medical Sciences*, 328(2), 88-93.
- Gilmour, J. A. (2007). Reducing disparities in the access and use of Internet health information. A discussion paper. *International Journal of Nursing Studies*, 44(7), 1270-1278.
- Heinrich, C. (2012). Health literacy: The sixth vital sign. *Journal of the American Academy of Nurse Practitioners*, 24(4), 218-223.
- Hill, L. H. (Ed.). (2011). *Adult education for health and wellness. New Directions for Adult and Continuing Education, No. 130*. San Francisco, CA: Jossey-Bass.
- Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior*, 38, 21-37.
- Kalichman, S. C., Benotsch, E. G., Weinhardt, L., Austin, J., Luke, W., & Cherry, C. (2003). Health-related Internet use, coping, social support, and health indicators in people living with HIV/AIDS: Preliminary results from a community survey. *Health Psychology*, 22(1), 111.
- Kalichman, S. C., & Rompa, D. (2000). Functional health literacy is associated with health status and health-related knowledge in people living with HIV-AIDS. *Journal of Acquired Immune Deficiency Syndromes*, 25(4), 337-344.
- Kawachi, I., & Berkman, L. F. (2001). Social ties and mental health. *Journal of Urban Health*, 78(3), 458-467.
- Kitagawa, E. M., & Hauser, P. M. (1973). *Differential mortality in the United States: A study in socioeconomic epidemiology*. Cambridge, MA: Harvard University Press.
- Kontos, E., Blake, K. D., Chou, W. Y., & Prestin, A. (2014). Predictors of eHealth usage: Insights on the digital divide from the Health Information National Trends Survey 2012. *Journal of medical Internet research*, 16(7), e172.
- Kutner, M., Greenburg, E., Jin, Y., & Paulsen, C. (2006). *The health literacy of America's adults: Results from the 2003 National Assessment of Adult Literacy*. (NCES 2006-483). Washington, DC: National Center for Education Statistics. Retrieved from <http://nces.ed.gov/pubs2006/2006483.pdf>.

- Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*, 80-94.
- Lipkus, I. M., & Peters, E. (2009). Understanding the role of numeracy in health: Proposed theoretical framework and practical insights. *Health Education and Behavior*, 36, 1065-1081.
- Lunze, K., & Paasche-Orlow, M. K. (2014). Limited literacy and poor health: The role of social mobility in Germany and the United States. *Journal of Health Communication*, 19(sup2), 15-18.
- Marken, S. (2015, October). U.S. uninsured Rate at 11.6% in third quarter. Retrieved from <http://www.gallup.com/poll/186047/uninsured-rate-third-quarter.aspx>
- Martinez, J. N., Aguayo-Tellez, E., & Rangel-Gonzalez, E. (2014). Explaining the Mexican-American health paradox using selectivity effects. *International Migration Review*. doi: 10.1111/imre.12112
- Mirowsky, J., & Ross, C. E. (2003). *Education, social status, and health*. New York, NY: Aldine De Gruyter.
- Mooney, A., & Prins, E. (2013). Addressing the health literacy needs of adult education students (Practitioner's Guide #4). University Park, PA: Goodling Institute for Research in Family Literacy. Retrieved from <https://www.ed.psu.edu/goodling-institute/professional-development/practitioner-guide-4>
- National Center for Education Statistics. (2014a). Literacy domain. Retrieved from <http://nces.ed.gov/surveys/piaac/literacy.asp>
- National Center for Education Statistics. (2014b). Numeracy domain. Retrieved from <http://nces.ed.gov/surveys/piaac/numeracy.asp>
- National Center for Education Statistics. (2014c). Problem solving in technology-rich environments domain. Retrieved from <http://nces.ed.gov/surveys/piaac/problem-solving.asp>
- Nielsen-Bohlman, L., Panzer, A. M., & Kindig, D. A. (2004). *Health literacy: A prescription to end confusion*. Washington, DC: National Academies Press.
- Norman, C. D., & Skinner, H. A. (2006). eHealth literacy: Essential skills for consumer health in a networked world. *Journal of Medical Internet Research*, 8(2), e9.
- Office of Career, Technical, and Adult Education. (2010). Transitions to postsecondary education. Retrieved from <http://www2.ed.gov/about/offices/list/ovae/pi/AdultEd/transition.html>
- Organisation for Economic Co-operation and Development. (2013). Time for the U.S. to reskill? What the Survey of Adult Skills says. Retrieved from http://skills.oecd.org/documents/Survey_of_Adult_Skills_US.pdf
- Papen, U. (2009). Literacy, learning and health: A social practices view of health literacy. *Literacy and Numeracy Studies*, 16(2), 19-34.
- Pleasant, A. (2008). A second look at the health literacy of American adults and the National Assessment of Adult Literacy. *Focus on Basics*, 9(B), 46-50.
- Pokropek, A., & Jakubowski, M. (2013). PIAACTOOLS: Stata programs for statistical computing using PIAAC data. Retrieved from http://www.oecd.org/site/piaac/PIACTOOLS_16OCT_for_web.pdf
- Prins, E., & Monnat, S. (2015). Examining associations between self-rated health and proficiency in literacy and numeracy among immigrants and US-born adults: Evidence from the Program for the International Assessment of Adult Competencies (PIAAC). *PLOS one*, 10(7), e0130257.
- Prins, E., Monnat, S., Clymer, C., & Toso, B. W. (2015). Examining associations between adult health and literacy, numeracy, technological problem-solving skills, and post-initial learning in the U.S. Washington, DC: American Institutes for Research and the National Center for Education Statistics.
- Prins, E., & Mooney, A. (2014). Literacy and health disparities. In J. C. Collins, L. O. Bryant, & T. S. Rocco (Eds.), *Health and wellness concerns for racial, ethnic, and sexual minorities. New Directions for Adult and Continuing Education*, No. 142 (pp. 25-35). San Francisco: Jossey-Bass.
- Reder, S. (2007). Adult education and postsecondary success. Policy brief prepared for the National Commission on Adult Literacy. New York, NY: Council for Advancement of Adult Literacy.
- Reder, S. (2009). The development of literacy and numeracy in adult life. In S. Reder & J. Bynner (Eds.), *Tracking adult literacy and numeracy skills: Findings from longitudinal research* (pp. 59-84). New York, NY: Routledge.
- Reyna, V. F., Nelson, W. L., Han, P. K., & Dieckmann, N. F. (2009). How numeracy influences risk comprehension and medical decision making. *Psychological Bulletin*, 135(6), 943-973.
- Reynolds, J., & Ross, C. E. (1998). Social stratification and health: Education's benefit beyond economic status and social origins. *Social Problems*, 45, 221-247.
- Ronson, B., & Rootman, I. (2009). Literacy and health literacy: New understandings about their impact on health. In D. Raphael (Ed.), *Social determinants of health* (2nd ed., pp. 170-185). Toronto: Canadian Scholars' Press.
- Ross, C. E., & Wu, C.-I. (1995). The links between education and health. *American Sociological Review*, 60(5), 719-745.
- Rothman, R. L., Housam, R., Weiss, H., Davis, D., Gregory, R., Gebretsadik, T., . . . Elasy, T. A. (2006). Patient understanding of food labels: the role of literacy and numeracy. *American Journal of Preventive Medicine*, 31(5), 391-398.

- Rothman, R. L., Montori, V. M., Cherrington, A., & Pignone, M. P. (2008). Perspective: The role of numeracy in health care. *Journal of Health Communication, 13*(6), 583-595.
- Rudd, R. E. (2007). Health literacy skills of U.S. adults. *American Journal of Health Behavior, 31*, 8-18.
- Schleier, A. (2013). Skilled for life? Key findings from the survey of adult skills. Retrieved from <http://www.slideshare.net/OECD/oeed-skills-outlook-key-findings-from-the-survey-of-adult-skills>
- Von Davier, M., Gonzalez, E., & Mislevy, R. (2009). What are plausible values and why are they useful. *IERI monograph series: Issues and methodologies in large scale assessments* (Vol. 2, pp. 9-36). Princeton, NJ: IEA-ETS Research Institute.
- Waldrop-Valverde, D., Osborn, C. Y., Rodriguez, A., Rothman, R. L., Kumar, M., & Jones, D. L. (2010). Numeracy skills explain racial differences in HIV medication management. *AIDS and Behavior, 14*(4), 799-806.
- Weiss, B. D., Hart, G., McGee, D. L., & D'Estelle, S. (1992). Health status of illiterate adults: Relation between literacy and health status among persons with low literacy skills. *The Journal of the American Board of Family Practice, 5*(3), 257-264.
- Zarcadoolas, C., Blanco, M., Boyer, J. F., & Pleasant, A. (2002). Unweaving the Web: An exploratory study of low-literate adults' navigation skills on the World Wide Web. *Journal of Health Communication, 7*(4), 309-324.
- Zhang, J., Guison-Dowdy, A., Patterson, M. B., & Song, W. (2011). *Crossing the bridge: GED credentials and postsecondary educational outcomes (Year Two Report)*. Washington, DC: GED Testing Service.

Table 1—*Descriptive Statistics for Self-Rated Health, Literacy, Numeracy, PS-TRE, and Control Variables*

Percentages or mean (std)		Min	Max
Literacy	271.60 (48.6)	102.9	424.3
Numeracy	255.33 (55.9)	44.7	426.9
PS-TREa	278.49 (43.1)	114.1	425.0
<i>Self-Rated Health</i>			
Excellent	24.1		
Very Good	33.8		
Good	28.0		
Fair	10.7		
Poor	3.4		
<i>Race/Ethnicity</i>			
Non-Hispanic white	66.7		
Non-Hispanic black	11.4		
Hispanic	14.1		
Asian	5.3		
Other race	2.5		
<i>Educational Attainment</i>			
Did not complete high school (ref)	13.5		
High school graduate/some college	40.9		
Certificate from trade school or other	8.6		
Associate degree	9.2		
Bachelor's degree	16.9		
Master's degree or higher	10.9		
Female	51.1		
<i>Employment Status</i>			
Employed	65.1		
Unemployed	7.8		
Pupil, student, apprentice, internship	10.1		
Retired	3.5		
Disabled	4.5		
Homemaker or other	9.0		
Lives with a spouse or partner	71.4		
Has children aged 12 or younger	22.2		
Number of people living in household	3.22 (1.53)	1.0	7.0
Foreign born	14.9		

Table 1—*Descriptive Statistics for Self-Rated Health, Literacy, Numeracy, PS-TRE, and Control Variables (continued)*

Percentages or mean (std)		Min	Max
<i>Mother's Educational Attainment</i>			
Did not complete high school	25.8		
Completed high school	47.4		
Attended college or more	26.8		
<i>Father's Educational Attainment</i>			
Did not complete high school	27.0		
Completed high school	44.8		
Attended college or more	28.2		
Has vision/hearing problems or diagnosed learning disability	22.8		
<i>Age</i>			
24 or less	18.1		
25-34	20.6		
35-44	20.2		
45-54	21.8		
55 or older	19.4		
Has health insurance	79.8		
English proficiency level (lower score=better)	4.87 (2.1)	4.0	16.0

Note: Means and standard deviations for literacy, numeracy, and PS-TRE were calculated using the PIAACDES method within PIACTOOLS in Stata to account for plausible values.

N=4,647 for literacy and numeracy

aN=3942 for PS-TRE

All values are weighted

Table 2—Odds Ratios and 95% Confidence Intervals from Unadjusted Ordinal Logistic Regression Models of Self-Rated Health Regressed on Literacy, Numeracy, and PS-TRE Skills

	LITERACY		NUMERACY		PS-TRE	
	OR	95% CI	OR	95% CI	OR	95% CI
Literacy	1.105***	1.090-1.120	-----	-----	-----	-----
Numeracy	-----	-----	1.085***	1.073-1.098	-----	-----
PS-TRE	-----	-----	-----	-----	1.076***	1.057-1.095

Note: The literacy, numeracy, and PS-TRE estimates represent changes of 10-point increments. Calculated using plausible values with PIAACTOOLS (piaacreg) in Stata.

***p<.001; weighted; two-tailed tests

N=4,647 (literacy and numeracy); N=3,942 (PS-TRE)

Table 3—Odds Ratios and 95% Confidence Intervals from Adjusted Ordinal Logistic Regression Models of Self-Rated Health Regressed on Literacy, Numeracy, and PS-TRE Skills

	LITERACY			NUMERACY			PS-TRE		
	Model 1b	OR	95% CI	Model 2b	OR	95% CI	Model 3b	OR	95% CI
Literacy	1.026*	1.004-1.049	-----	-----	-----	-----	-----	-----	-----
Numeracy	-----	-----	-----	1.010	0.922-1.028	-----	-----	-----	-----
PS-TRE	-----	-----	-----	-----	-----	-----	1.004	0.983-1.026	-----
<i>Race/Ethnicity</i>									
Non-Hispanic white (ref)	-----	-----	-----	-----	-----	-----	-----	-----	-----
Non-Hispanic black	0.850	0.696-1.038	-----	0.825	0.675-1.010	-----	0.772*	0.611-0.975	-----
Hispanic	1.284	0.984-1.676	-----	1.004	0.771-1.308	-----	0.991	0.719-1.367	-----
Asian/Pacific Islander	0.690**	0.522-0.911	-----	0.677**	0.513-0.894	-----	0.688*	0.476-0.994	-----
Other race	0.895	0.608-1.317	-----	0.895	0.608-1.317	-----	0.868	0.565-1.333	-----
<i>Educational Attainment</i>									
Did not complete high school (ref)	-----	-----	-----	-----	-----	-----	-----	-----	-----
High school graduate	1.082	0.829-1.413	-----	1.102	0.846-1.436	-----	1.016	0.740-1.396	-----
Certificate from trade school or other	1.112	0.765-1.617	-----	1.135	0.901-1.431	-----	1.048	0.700-1.570	-----
Associate degree	1.334	0.998-1.783	-----	1.387	1.044-1.843	-----	1.262	0.884-1.803	-----
Bachelor's degree	1.917***	1.393-2.639	-----	2.016***	1.473-2.758	-----	1.865**	1.305-2.664	-----
Master's degree or higher	2.212***	1.588-3.081	-----	2.375***	1.722-3.275	-----	2.166***	1.484-3.162	-----
Female	0.892	0.789-1.010	-----	0.902	0.800-1.017	-----	0.923	0.813-1.049	-----

Table 3—Odds Ratios and 95% Confidence Intervals from Adjusted Ordinal Logistic Regression Models of Self-Rated Health Regressed on Literacy, Numeracy, and PS-TRE Skills (continued)

	LITERACY		NUMERACY		PS-TRE	
	Model 1a	Model 1b	Model 2a	Model 2b	Model 3a	Model 3b
Employed (ref)	-----	-----	-----	-----	-----	-----
Unemployed	0.641**	0.478-0.861	0.642**	0.477-0.865	0.698*	0.512-0.951
Pupil, student, apprentice, internship	0.934	0.709-1.232	0.954	0.727-1.253	0.891	0.673-1.180
Retired	0.613**	0.453-0.828	0.614**	0.455-0.829	0.700	0.457-1.074
Disabled	0.041***	0.029-0.059	0.041***	0.029-0.057	0.029***	0.018-0.045
Homemaker or other	0.856	0.659-1.114	0.862	0.661-1.123	0.861	0.624-1.187
Lives with a spouse or partner	1.106	0.951-1.286	1.110	0.954-1.290	1.021	0.839-1.242
Has children aged 12 or younger	1.042	0.850-1.277	1.036	0.845-1.270	1.033	0.810-1.317
Number of people living in household	1.037	0.985-1.091	1.026	0.494-2.132	1.040	0.982-1.101
Foreign born	1.483**	1.145-1.921	1.142	0.742-1.758	1.448*	1.079-1.943
<i>Mother's Educational Attainment</i>						
Did not complete high school (ref)	-----	-----	-----	-----	-----	-----
Completed high school	1.231*	1.044-1.452	1.246**	1.057-1.469	1.384**	1.133-1.690
Attended college or more	1.194	0.968-1.472	1.221	0.990-1.506	1.353**	1.084-1.688
<i>Father's Educational Attainment</i>						
Did not complete high school (ref)	-----	-----	-----	-----	-----	-----
Completed high school	1.058	0.924-1.211	1.067	0.932-1.222	1.039	0.888-1.215
Attended college or more	1.361**	1.130-1.639	1.385**	1.150-1.669	1.391**	1.130-1.712

Table 3—Odds Ratios and 95% Confidence Intervals from Adjusted Ordinal Logistic Regression Models of Self-Rated Health Regressed on Literacy, Numeracy, and PS-TRE Skills (continued)

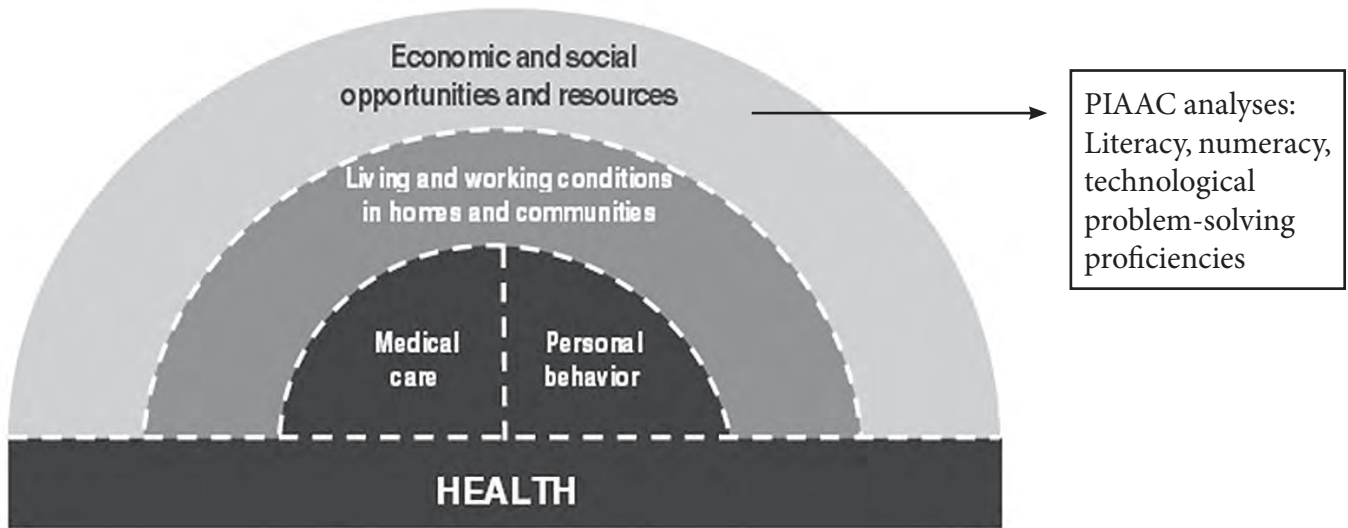
	LITERACY		NUMERACY		PS-TRE	
	Model 1b	Model 2b	Model 2b	Model 3b	Model 3b	Model 3b
Age						
18-24 (ref)	-----	-----	-----	-----	-----	-----
25-34	0.635**	0.494-0.816	0.634**	0.493-0.815	0.670*	0.487-0.920
35-44	0.492***	0.377-0.642	0.491***	0.377-0.639	0.510***	0.371-0.702
45-54	0.339***	0.339-0.642	0.462***	0.336-0.636	0.498***	0.346-0.716
55 or older	0.365***	0.365-0.622	0.469***	0.358-0.613	0.564**	0.411-0.775
Has health insurance	1.054*	1.054-1.482	1.270**	1.071-1.506	1.331**	1.088-1.629
English proficiency level (lower score=better)	0.924***	0.887-0.963	0.919***	0.881-0.957	0.919**	0.869-0.973

Note: The literacy, numeracy, and PS-TRE estimates represent changes of 10-point increments.

Calculated using plausible values with PIAACTOOLS (piaacreg) in Stata.

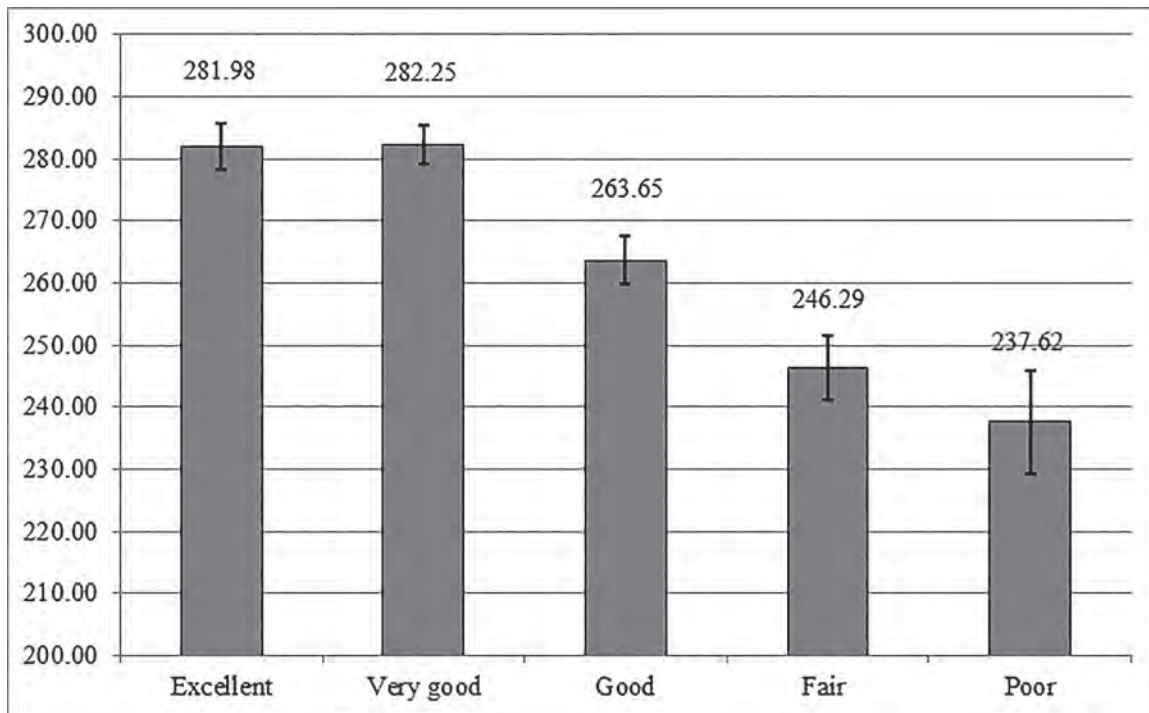
*p<.05; **p<.01; ***p<.001; weighted; two-tailed tests
N=4,647 (literacy and numeracy); N=3,942 (PS-TRE)

Figure 1—*Social Determinants of Health*



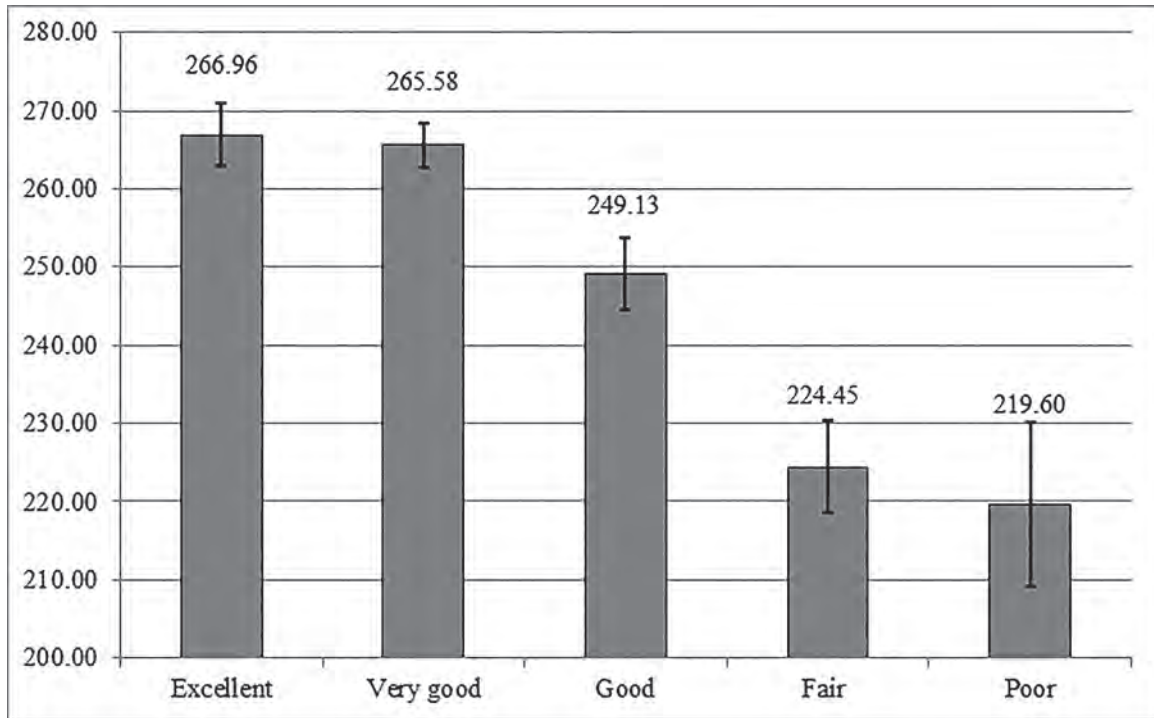
Adapted from Braveman et al. (2011, p. 383)

Figure 2—*Distribution of Mean Literacy Scores by Self-Rated Health*



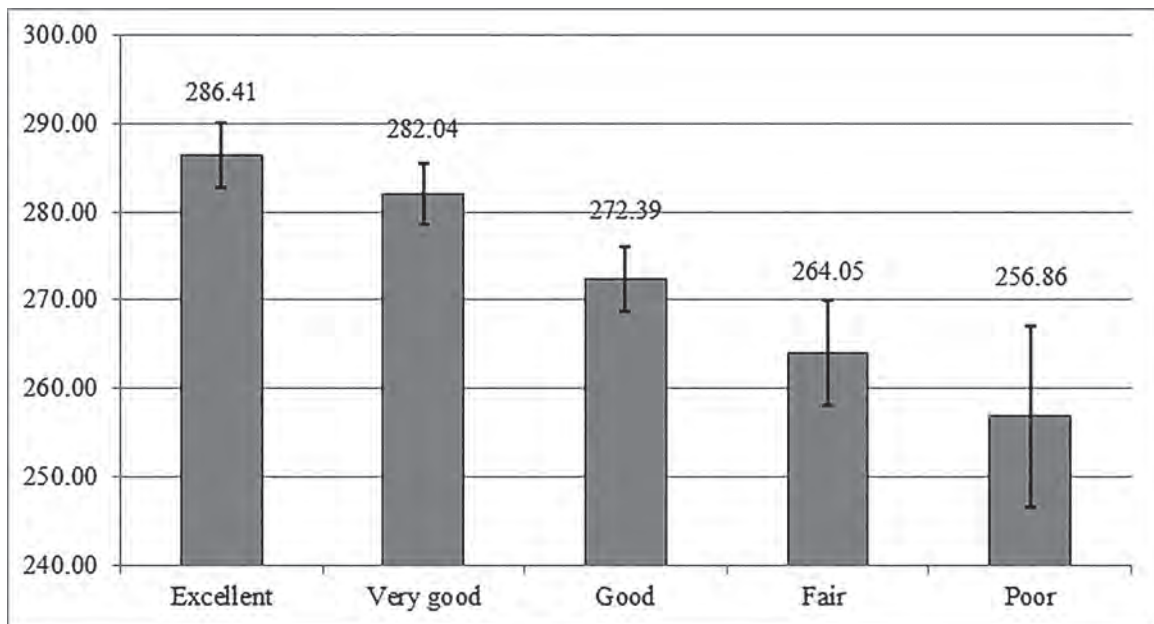
Note: weighted; calculated using plausible values with PIAACTOOLS in Stata; bars represent 95% confidence intervals; non-overlapping bars represent significant differences in means at the $p < 0.05$ level

Figure 3—*Distribution of Mean Numeracy Scores by Self-Rated Health*



Note: weighted; calculated using plausible values with PIAACTOOLS in Stata; bars represent 95% confidence intervals; non-overlapping bars represent significant differences in means at the $p < 0.05$ level

Figure 4—*Distribution of Mean PS-TRE Scores by Self-Rated Health*



Note: weighted; calculated using plausible values with PIAACTOOLS in Stata; bars represent 95% confidence intervals; non-overlapping bars represent significant differences in means at the $p < 0.05$ level

FORUM: RESPONDING TO CHANGES IN HIGH SCHOOL EQUIVALENCY TESTING

Introduction

Lennox McLendon

Executive Director, National Adult Education
Professional Development Consortium (retired)

One of adult educators' goals is to enable our students to prosper: to obtain employment with a family-sustaining income, guide and provide for their families, and contribute to their communities. At the inception of federally-funded adult education in the 1960s, that goal was clear. In order to prosper, an adult needed to read, write, and be comfortable with the four math operations. There were many good paying "lift and put" jobs for which that level of education sufficed. Work, family responsibilities, and community demands have grown increasingly more complicated and complex since then and helping undereducated, under-prepared adults gain and demonstrate increasingly higher levels of learning has been and will continue to be an ever changing challenge.

The three briefs that follow are snap shots of three states' responses to providing instruction and assessment that reflect the latest surge in what it takes for adults to prosper. As you will see, some states focus on one option while others have developed and/or are developing a variety of options. With each option, the state is providing a means for adults to document college- and career-ready levels of learning. ❖

Lennox McLendon is the recently retired Executive Director of the National Adult Education Professional Development Consortium.

FORUM: RESPONDING TO CHANGES IN HIGH SCHOOL EQUIVALENCY TESTING

High School Credentialing in Wisconsin

Willa Panzer

State Director of Adult Basic Education
Wisconsin Technical College System

Mark Johnson

Education Director, Adult Secondary
Wisconsin Technical College System

Beth Lewis

State GED and HSED Administrator
Wisconsin Department of Public Instruction

Wisconsinites interested in pursuing a high school credential rely on the unique collaboration between the State GED Administrator at the Wisconsin Department of Instruction (DPI), the State Director of Adult Basic Education (ABE) and staff of the Wisconsin Technical College System (WTCS), and the many providers of instruction throughout the state. While the WTCS is the primary provider of Adult Basic Education in Wisconsin, all high school credentialing is approved by the State Superintendent and the DPI. Successful completion of the tests of General Educational Development (GED) results in the awarding of a Certificate of General Educational Development. Additional and unique options, described in this article, exist to earn a High School Equivalency Diploma (HSED).

GED

Since Wisconsin already had six different options for students interested in obtaining a high school

equivalency credential, our state approached the change in the GED tests and the emergence of other national credentialing options knowing that students (and our instructional programs) already had credentialing flexibility available to them. The partners in the state's adult education system (DPI, WTCS and its local colleges, community-based organizations and the Department of Corrections) knew they could continue to work together to provide these multiple options for individuals to complete a high school equivalency credential.

Under Administrative Code, Wisconsin requires that all individuals who are seeking a GED or High School Equivalency Diploma (HSED) complete an orientation led by qualified staff at one of our state-approved testing centers. The orientation includes counseling on the options for earning a credential, information on eligibility for each of them, and a reading assessment. The individual's college and career aspirations are also discussed. This information helps the person choose the best option for high school

equivalency completion as well as for helping them achieve their other personal goals, such as post-secondary transition and/or employment.

Wisconsin had already begun to convert to GED computer-based testing when the two other national credential options (TASC and Hi-SET) came on to the scene. Rather than immediately proceed with the arduous process of changing Administrative Code to reflect the Hi-SET and/or the TASC, Wisconsin decided to stay the course with its six options. Another consideration at that time regarding the two new credentials was the recognition and national portability of the GED. However, our GED Test Administrator has not ruled out the possibility of offering more than one test in the future, and the two newer tests can be used (as can other assessments) to serve as documentation for our competency-based HSED (described in more detail in the next section).

Other Credentialing Options

In addition to the GED tests, state code provides five additional HSED options and identifies the specific requirements for each. The first requires students to successfully complete the GED and also fulfill additional requirements in health, civics, career awareness and employability skills which can be met through a variety of courses and assessments. This is an option for all adult students, but is required for students 17 years of age as these extra four components are required for all secondary students in the state. (Wisconsin's compulsory age of attendance is 18). The second option is an HSED based on completion of at least 22 high school credits which can be taken in either high schools or post-secondary settings. The third is an HSED based on completion of a specified number of post-secondary credits that can be applied to meet high school graduation requirements as specified in state statute. This is possible because many technical college programs do not require that students have a high school diploma (Other

factors such as transcript analysis and appropriate placement testing are used instead.) The fourth option is an HSED based on the student having earned a foreign diploma in high school or college. The final option (which is the focus of the next section) is a competency-based HSED curriculum completed by participating in an approved program. This allows students to demonstrate competency through a highly structured curriculum that mirrors the rigor of the GED assessment criteria but does not require the high stakes testing of the GED or equivalent tests.

WTCS 5.09 HSED—A Career Pathway Focused Approach

Since its inception, we have seen increased interest in the competency-based HSED to supplement our standard GED programming. It has historically been one of the more utilized options in Wisconsin, and interest is growing at a steady pace. In place for more than 30 years, the competency-based program (referred to locally as the 5.09 for its location in administrative code) was originally designed for displaced homemakers and English language Learners. Over the years the program has successfully served a variety of audiences, including English Language Learners, students with severe test anxiety and persons with disabilities for whom adequate documentation for accommodations was not available. The program has been operated by our technical colleges, prisons, and community based organizations. Frequently tied to workforce and employment programs, a natural progression with career pathways has occurred.

Recently the Wisconsin Technical College System undertook a major update to its existing system-recommended approach to the competency-based HSED. The WTCS HSED (which we will refer to hereafter as the 5.09) was specifically designed to accommodate students' career pathway goals,

and programs are strongly encouraged to structure their intake, educational delivery, assessment and advising to encourage students to explore various career options, understand the incremental steps and credentials available to them in a particular career cluster or pathway area, and build skills that lead to success in their chosen cluster or pathway. Simply offering the program in order to deliver an isolated high school credential without integrating career-pathway guidance would be a disservice to students. As such, it is recommended that local 5.09 programs build in content that focuses on post-secondary transition, including such tasks as reviewing the economic payoff of post-high school credentials, taking a post-secondary placement test, and completing the Free Application for Federal Student Aid (FAFSA) where appropriate.

It is important to note the 5.09 HSED is in no way meant to operate as an independent program separate from institutional educational programming requirements. For instance, in WTCS institutions, teacher certification, student and course reporting, adherence to the Indicators of Quality Performance, WTCS ABE curriculum standards, WTCS standards for quality assessment and other appropriate expectations must still be followed.

The updated 2015 WTCS 5.09 HSED includes 76 competencies distributed across the various subject areas of communications, math, social sciences, civics, life and physical sciences (including physics, chemistry and environmental science), health, and employability skills/career awareness. The competencies were selected based on faculty analyses of state and national educational standards (including the College and Career Readiness Standards), entry-level expectations of the state's postsecondary institutions, etc. Each competency has further subdivision of detail in its learning objectives that describe the supporting knowledge, skills, and attitudes needed to show mastery of a given

competency. Each is also clarified with performance criteria and, usually, conditions for assessment. Various supporting material is available, including a mastery competency checklist and assessment checklists for each area.

The 5.09 HSED includes both required and flexible components. Satisfactory completion of this HSED program requires completion of the required 76 minimum competencies and an additional 8-10 competencies as defined by the local program to support the student's specific career and/or educational goals. Additional competencies may reflect one or more of the following areas:

- Work readiness
- College readiness
- Additional college-level preparatory communication and/or math
- Additional competencies related to general college readiness (i.e. student success courses, study skills courses, etc.)
- Competencies related to an initial post-secondary credential
- Competencies related to a work-based learning experience (such as an internship)
- Competencies related to a service learning experience
- Competencies of interest and value to the student such as additional work in areas of health, financial or family literacy

More detailed information on instructional personnel expectations, student eligibility, the program's structure and processes, etc. is available in the WTCS ABE 5.09 Guidance Document.

Partnerships are Key

As highlighted by the key partnership between DPI and WTCS governing Adult Basic Education and high school credentialing in Wisconsin, all HSED and GED efforts require collaboration between

different agencies and institutions. In the case of the 5.09 HSED for example, the DPI gives the initial approval to colleges and other institutions to offer 5.09 programs. DPI then continues to review programs and offer annual renewal authorizations. In carrying out these 5.09 program renewals DPI will look at data including students' work and post-secondary enrollment information, performance on Accuplacer or similar post-secondary readiness assessments, student enrollment and retention data, and other factors. In response, the institution offering the program continues to monitor student performance in these areas and continue to improve their offerings.

The unique HSED options in Wisconsin have proven extremely successful and have offered replicable models for other states looking to improve opportunities for their own students. ❖

Willa Panzer is State Director of Adult Basic Education, Wisconsin Technical College System.

Mark Johnson is Education Director, Adult Secondary, Wisconsin Technical College System

Beth Lewis is State GED and HSED Administrator, Wisconsin Department of Public Instruction

FORUM: RESPONDING TO CHANGES IN HIGH SCHOOL EQUIVALENCY TESTING

High School Equivalency Testing in Arizona

Sheryl Hart

Deputy Associate Superintendent
Arizona Department of Education
Adult Education Services

Background

According to the U.S. Census Community Survey (2009-2013), in Arizona there are currently almost 725,000 adults 18 and older who lack a high school diploma. The need for both an education system and a testing system to assist adults in earning a secondary diploma is critically important for Arizona's economic development and growth.

For decades, Arizona used the General Educational Development (GED) Test to award the Arizona High School Equivalency (HSE) Diploma, as the GED Test was the only test available, recognized and accepted in the United States as the measure by which adults could demonstrate the educational attainment equivalent to high school completion. With the adoption nationwide of academic standards aligned to college and career readiness, vendors began to develop assessments that would demonstrate the educational attainment equivalent to high school completion. For the first time, multiple vendors had high school equivalency tests available for use by states.

In the fall of 2013, Arizona issued a Request for Proposal (RFP) for the selection of one or more

assessment(s) aligned to college and career readiness standards to be used in awarding the Arizona HSE Diploma. Two vendors applied and the proposals were evaluated by a committee consisting of adult educators and assessment specialists. One proposal met or exceeded all requirements in the RFP and one proposal fell below expectations, specifically in the areas of alignment with college and career readiness standards and the proposed target pass score. As a result, in January 2014 the Arizona State Board of Education awarded the contract for HSE Testing in Arizona only to GED Testing Service, LLC. The new computer-based 2014 GED Test was implemented as the only assessment used to award HSE diplomas in Arizona.

As it awarded the contract to GED Testing Service, the State Board of Education recognized that the marketplace for assessments designed to demonstrate high school equivalency aligned with college and career readiness standards was in its infancy, and reiterated its commitment to providing choice to those seeking an Arizona HSE Diploma. The State Board requested that at a later date a new RFP be issued to identify any additional rigorous assessments that are aligned to college and career

readiness standards, with the intention of providing multiple testing options for Arizona adults as they seek to obtain an HSE Diploma.

Impact of GED 2014 in Arizona

Since the implementation of GED 2014, Arizona has experienced tremendous decreases in both participation and pass rates associated with HSE testing, as described below.

Decrease in Participation

2,249 HSE diplomas were issued in Arizona in 2014, compared to approximately 13,000 in both 2012 and 2011 and almost 17,000 in 2013.

Of course, it is reasonable to expect a decrease in participation and diplomas issued after the implementation of a new test. There was a definite surge in testing during the year leading up to the new test (2013) with examinees trying hard to finish testing under the old test. This “surge” in testing would naturally lead to a dip in the number of examinees and test completers the following year. The decrease in HSE testing participation in Arizona was much more pronounced than would be expected, however, at only 17% of an average year. Possible reasons for this decrease that are unique to the GED 2014 revision include:

- Cost of testing increased to \$140 for entire GED 2014 battery compared to a range of \$75- \$125 prior to 2014;
- Computer-based registration process and testing may be a barrier for some examinees;
- Requirement of a credit card to pay for testing may be a barrier for some examinees;
- Some existing testing center locations closed and this resulted in temporary service gaps in some areas of the state;
- Perception that GED 2014 is much more

difficult prevented some examinees from attempting the new test.

In 2015, participation appears to be increasing somewhat but is still significantly below levels prior to the implementation of GED 2014. From January through July of 2015, seven months of testing, 2,120 HSE diplomas have been issued. If this rate continues through the year, Arizona will be on track to increase the number of diplomas by 62%; however, that is still only 28% of the approximately 13,000 diplomas usually issued each year.

Decrease in Pass Rate

In 2014, Arizona had a 63% HSE testing pass rate with GED 2014, compared to 76% in 2012 and 81% in 2013 (the surge year). The content area with the lowest pass rate is math (59% in 2014).

Again, it is reasonable to expect a decrease in the pass rate with the implementation of a new test. For GED 2014, a big reason for the significant decrease in the pass rate appears to be that the new test is no longer the “compensatory” model that allowed examinees with scores below passing in certain subject areas to make it up in other subject areas. With GED 2014, all passers must have passing scores in all content areas. Math is by far the subject that most often prevents examinees from passing.

The pass rate in Arizona has been steadily improving since the initial implementation of GED 2014. For examinees testing during the time period of January through July of 2015, the pass rate is at approximately 70%.

Beyond looking at the pass rate, Arizona is monitoring the number and percent of examinees that pass one or more subject tests “with honors” indicating college and career readiness. In all four subject areas only about 5% or less of Arizona’s examinees are passing with honors. We are particularly

interested in this indicator for those examinees that are enrolled in a state-funded adult education program. Under WIOA performance measures that go into effect on July 1, 2016, a secondary diploma is counted as an outcome only for those individuals who then go on to enter postsecondary education or training or enter the workforce within one year after exit. Arizona is very interested in gathering and analyzing data on those learners passing GED 2014 with honors to see if there is a correlation to achieving additional postsecondary and employment outcomes.

Next Steps

Because the State Board of Education was clear in its desire to have assessment options that provide choice to those seeking the HSE diploma in Arizona, Arizona intends to issue a Request for Information (RFI) in the next few months to determine the current status of assessments used to award HSE diplomas nationwide. This information will be used to inform the timing and scope for the next RFP process. While Arizona is committed to providing choice for HSE diploma seekers, it is equally committed to ensuring that, if there are multiple assessments adopted, there be parity between the assessments in both content and rigor and that earning a HSE diploma in Arizona is an indication of skill attainment that is in line with the skills needed for success in employment and postsecondary training, regardless of which assessment an examinee takes. ❖

Sheryl Hart is Deputy Associate Superintendent of Adult Education Services at the Arizona Department of Education.

FORUM: RESPONDING TO CHANGES IN HIGH SCHOOL EQUIVALENCY TESTING

High School Equivalency Testing in Washington

Jon Kerr

Director, Basic Education for Adults
Washington State Board for Community & Technical Colleges

In 2013, as new high school equivalency exams were being developed and implemented across the nation and states were deciding which test was best for their population, Washington state identified the need to adopt the most rigorous test so that preparation to take it would equip students with the skills to be able to move directly from adult education programming into college-level classes and higher skilled employment. We also identified an even greater need for a rigorous alternative to a high school equivalency exam.

Washington stakeholders know that post-secondary education and credentials are key to economic mobility for individuals and to the state's ability to fill high demand jobs, yet too many low-income adults are locked out of the opportunity to earn postsecondary credentials valued by employers. Many have significant basic skills deficits or difficulty juggling work and family obligations while in school. Consequently, they are falling further and further behind because they lack the skills and credentials they need to qualify for good jobs. Unfortunately, our systems that are responsible for helping them upgrade their skills—adult education, workforce

development and post-secondary education—are challenged to provide the type of education they need to compete in the workforce.

These traditional silos of adult education programming have in the past created numerous barriers for transition from basic education courses to college level. Prerequisites, college entrance and placement tests, lack of access to federal financial aid have been hurdles for these students, along with the fact that in the past Adult Education programming was designed only to get students to 10th grade competency. With the increased rigor of a competency-based diploma and the requirement to get students college-ready rather than to just a 10th grade competency level, efforts have been undertaken to lower these barriers. As a result, college and career pathways are being implemented across the system to provide a seamless and accelerated guided pathway to success.

High School 21+, an example of this effort, was developed to provide adults with a new way to get a second chance at earning a Washington state high school diploma. High School 21+ is a competency-based diploma program that recognizes adult

learners' life and work experiences as well as course credits and classroom time. HS 21+ accomplishes this by awarding credit not only for course work but also for prior learning accomplished through work, military, and life experience. As the name implies, students must be 21 or older to participate. When they start the program, learners meet one-on-one with an advisor to develop a customized plan. The advisor evaluates any transcripts as well as life and work experience and administers assessments to find any educational or work-readiness gaps. The student and advisor then work together to make a plan to meet remaining requirements in order to earn a diploma. The program's focus on competency allows students to demonstrate mastery at their own pace, actually attaining readiness for college-level course work rather than just passing a standardized test.

One of the key differences that sets High School 21+ apart from other non-traditional diplomas or equivalencies is that it recognizes life experience. Competency can be shown in multiple ways in addition to what is reflected in a transcript. For example, learners can create prior learning portfolios that demonstrate applicable experience in the work, life, and military arenas. This program meets students where they are and takes advantage of all applicable life skills and experiences.

To receive a diploma, students must demonstrate competency in reading, writing, and math in the context of science, history, government, occupational studies, fine arts and digital literacy by fulfilling the Washington state high school graduation requirements. The community and technical college system in Washington created an evaluation tool that includes guidelines and examples of prior learning that can be used to fulfill all of the various subject area requirements. The tool details the types of activities that can provide evidence of competency

and provides guidance on how to collect and evaluate proven competencies from the multiple methods used for teaching and learning.

Because there are multiple ways to demonstrate competency and thanks to contextualized instruction, students can move quickly through the program as outcomes are met. Upon completion, they are better prepared to enter college-level programs and earn certificates, than students who completed a traditional high school equivalency exam. This is due to the fact that the rigorous, contextualized, direct instruction and support programming mirror the college experience. Therefore, in addition to merely learning the information required to pass a test, students acquire the college navigation and employability skills that enable them seamlessly to move into college level programs or the workforce. Just like those who pass the GED, they are also eligible to apply for federal financial aid.

As a result of the creation of HS 21+, all basic skills programming in Washington is now contextualized and competency based, preparing students to meet their education and career goals whatever they may be – high school diploma, high school equivalency, transition to college, or higher skilled employment. The concentration on meeting standards and contextualized instruction, along with grading, increases expectations and rigor in the program. This allows students to upgrade their skills while working toward their education and career goals.

HS 21+ expands high school completion options already offered by community and technical colleges to include a comprehensive approach that aligns with adult learning styles and includes competency-based assessments. These measure progress in closing gaps in academic and work readiness, and verify the academic, career and personal competencies needed

in further education, training, or employment.

While Washington state continues to offer the new GED, HS 21+ offers an alternative based on measuring competencies earned through work and life experience. Twenty-nine of the 34 community and technical colleges in the state now offer HS 21+, paving the way for adults to earn college credentials and degrees at Washington colleges. The benefits of participating in the program were illustrated best by a recent graduate of HS 21+ who said, “Never in my wildest of dreams did I ever think that it would be possible to graduate with a cap, gown and a high school diploma. I can’t wait to see what the future has in store for me!” ❖

Jon Kerr is the Director of Basic Education for Adults, Washington State Board for Community & Technical Colleges

FORUM: RESPONDING TO CHANGES IN HIGH SCHOOL EQUIVALENCY TESTING

Discussion

Lennox McLendon

Executive Director, National Adult Education
Professional Development Consortium (retired)

The three snapshots capture ways that states are exploring and developing instructional and assessment services that enable adults to attain a high school completion document and attest that they are college and career ready. Most states retained the GED test but a growing number are providing other options including the ETS HiSET and McGraw-Hill's TASC (National Adult Education Professional Development Consortium, 2015). When GED was the only test available, it was usual for a state to "sole source" that assessment. Now that there are three standardized, national options, states are usually obliged by state procurement law to put their request for assessments out for bid.

This situation has contributed to the interesting development of options like those included in the Wisconsin and Washington briefs. They are aligned with a growing trend in the field of using Prior Learning Assessment and Recognition (Coalition of Lifelong Learning Organizations, 2013). These examples complement the nationally standardized assessments (GED, TASC HiSET, External Diploma Program college entrance tests) that have also been designed to assess prior learning. We often

recognize that "adults bring a lot of experience to class" but except for the External Diploma Program provided in eight states (National External Diploma Program, n.d.), there have been few opportunities for either prior learning assessment or competency-based demonstrated learning. Yet two of the briefs above include options other than the high school equivalency test to demonstrate prior learning and/or enable adults to demonstrate the required skill levels. It will be interesting to follow the impact of those options and expansion of similar alternatives in other states. Whether a state opts to continue to use just one high school completion assessment and instructional program or devise a number of options, they all face three constants: a national set of standards on which to base the work, state-wide professional development to prepare teachers and tutors and the knowledge that another reinvention of adult education is in our future.

College and Career Readiness Standards

When I was a teacher (ABE, GED, ESL, Adult High School), a local director, a state staff person, and a state director, we had no curriculum. In many

cases, the diagnostic sheet from the TABE test and the Official GED Practice Test were the instructional guides. Each test identified the skills the student needed and our task was to find materials to improve those skills. When basic skills (reading, writing, math, English) were all an adult needed to prosper, that was all the curriculum we needed. We resisted a state curriculum and, heaven forbid, a national curriculum. However, adult education's focus is no longer "local." "Lift and put" jobs that provide a family sustaining wage are rare. Adults compete in a global market. This has given rise to more systematically answering the question, "What do adults need to know and be able to do to compete in that global market?" The answers to this question are the source of new thinking about curriculum.

In response, OCTAE's *National College and Career Readiness Standards for Adult Education* (CCR) provide us with a valuable resource which we have never had or perhaps never needed before (Pimentel, 2013). It identifies what adult needs to know to compete in a global market. Importantly, it does NOT tell us "how" to teach; it simply identifies "what" students need to know and be able to do. That distinction provides us with a clear set of standards while ensuring us the flexibility to contextualize the content around the interests of the students and the high demand jobs in the local service area.

Each brief above refers to the CCR as the basis for both the commercially produced high school assessments as well as the foundation for alternative strategies states are developing/using to assess and certify adults' learning. "Unpacking" the standards and aligning them with instructional resources and local contexts is a multi-year process. States, in a variety of ways, are supporting teachers who are aligning resources and capturing the instructional methods and resources in web-based resource data

bases. CCR provides a needed structure to help us organize college and career readiness learning but it also requires significant professional development and planning time for teachers.

Professional Development

One important program component was omitted from the three briefs above. That component continues to consume a wealth of energy and funding. As a result of the CCR and updating the commercial assessments, a significant focus on the professional development is needed to help teachers upgrade their skills and teaching methods to address the requirements of the new assessments and the CCR. Over the decades when the GED upgraded its tests to reflect more rigorous graduation requirements, major effort focused on helping teachers learn how to prepare students for the higher standards. This latest upgrade of the tests and introduction of other assessments along with the introduction of the CCR demands the same.

One of the possible causes of the widely reported lower initial pass rate on the new high school equivalency assessments may be the time it takes to provide the necessary professional development for the instructional staff in a state. In May of 2013, the adult education state directors' national organization (NAEPDC) in collaboration with the Center for Literacy, Education and Employment at the University of Tennessee (CLEE) conducted a national institute to provide states with professional development models and language arts and mathematics strategies aligned to the new standards and assessments.¹ The participants' task was to return to their state and develop the professional development for all the teachers in their state. That institute was held only seven months before the new tests began to be used.

Because 80% of adult teachers are part-time,

¹See materials at <http://clee.utk.edu/ccrtdi/ccr-institutematerials/>

preparing teachers for major changes in our field requires much more lead time and extensive training over time. Creating the options described in the Wisconsin and Washington paper adds to the existing tasks of supporting and preparing teachers.

Reinventing the Reinvented Adult Education

States face a challenge upgrading their instructional and assessment systems to respond to the increased skill levels adults need to prosper. Everything we do fosters our efforts to enable undereducated, under-prepared adults to gain the skills they need to compete for jobs with family

sustaining incomes, guide and provide for their families, and contribute to their communities. The skills to address those three spheres will continue to rise with no end in sight. As a result, as we look to the future, we will be challenged to continue to reinvent adult education.

To paraphrase the Washington State's student's quote, "I cannot wait to see what the future has in store for us." ❖

Lennox McLendon is the recently retired Executive Director of the National Adult Education Professional Development Consortium.

References

- Coalition of Lifelong Learning Organizations. (2013, October 7). *Prior learning, assessment & recognition*. Retrieved from http://www.thecollo.org/docs/COLLO_Symposium_2013_-_Prior_Learning_Assessment_and_Recognition.pdf
- National Adult Education Professional Development Consortium. (2015). *High school equivalent assessment summary*. Retrieved from <http://www.naepdc.org/HSE%20Summary+%20Updated%201-27-15.xlsx>
- National External Diploma Program. (n.d.). *About NEDP*. Retrieved from <https://www.casas.org/nedp/about>
- Pimentel, S. (2013). *College and career readiness standards for adult education*. Washington, DC: U.S. Department of Education, Office of Vocational and Adult Education. Retrieved from <http://lincs.ed.gov/publications/pdf/CCRStandardsAdultEd.pdf>

The GED and Minority Language Groups

Laurel Anderson

Carlos Rosario

International Public Charter School

Abstract

A recent overhaul to the GED exam has made it significantly more difficult for all students to pass, further adding to the burden of those who must take it in a second language. The revamped 2014 version of the exam highlights the need for accommodations for speakers of minority languages who must take the test in English. In fact, there is plenty of precedent and research to make a compelling case for why and how GED Testing Service should better support all non-native English speakers.

Introduction

Of the 39 million adults in the United States without a high school diploma, over 700,000 of them take the General Education Development (GED) exam each year (GED Testing Service [GEDTS], 2013). For them, the GED offers a chance for a better life and a path out of poverty into college or a more rewarding career (Cardoza, 2013). The GED is also a way for adult immigrants in the United States to gain a foothold in American society. Many who immigrate to the U.S. come with limited education from their home countries—refugees from war torn countries with broken education systems, women denied access to schooling, or teenagers who left school early to provide for their families. For them, the GED is a path to college, to learning a trade, or simply to finding a job in the United States.

For non-native speakers of English, language adds to the challenge of passing the GED exam. Not only must these students grapple with complex academic material and hone critical thinking skills, they must do so in a language other than their own. GED Testing Service addresses this challenge by offering native speakers of Spanish and French the option to take

the test in their own language. French and Spanish, however, are the only language variations available, leaving speakers of other minority languages with no choice but to take the exam in English. Surprisingly, GED Testing Service offers no accommodations for those who are obliged to take the test in a second language.

Meanwhile, a recent overhaul to the GED exam has made it significantly more difficult for all students to pass, further adding to the burden of those who must take it in a second language. This revamped 2014 version of the exam highlights the need for accommodations for speakers of minority languages who must take the test in English. As GED preparation programs and their students adjust to the new exam, and as GED Testing Service collects data and feedback, this is an opportunity to revisit the topic of language accommodation for minority groups and discuss specific accommodations that would put these students on more equal footing. In fact, there is plenty of precedent and research to make a compelling case for why and how GED Testing Service should better support all non-native English speakers.

America's Largest High School

The GED testing program began in 1942 as a way to educate young members of the U.S. military whose educations were interrupted by World War II. Since then, it has moved beyond veterans and become a pathway to high school credentials for over 18 million adults. In 2012, over 700,000 adults took at least one of the five parts the exam, which measures skills in writing, reading, social studies, science, and mathematics. Of the approximately 607,000 adults who completed the entire exam, 418,000 met the passing standard by earning scores equal to or higher

than those earned by the top 60% of graduating high school seniors (GEDTS, 2013). Today, the GED certificate accounts for 13% of high school diplomas in the United States (Crissey & Bauman, 2012).

For years, a GED certificate was dismissively referred to as the “Good Enough Diploma” because passing the exam was much easier than earning a traditional high school diploma (Cardoza, 2013). In 2011, an ACE/GED report documented the lower persistence and attainment rates of GED recipients compared to traditional high school graduates who moved on to college (Guison-Dowdy & Patterson, 2011). For example, although the majority of the adults who passed the GED test indicated further education as a reason for testing, only 40% of them enrolled in college within six years of receiving their GED, the majority of which dropped out within a year (Guison-Dowdy & Patterson, 2011). In 2011, in response to criticism that a GED was no longer commensurate with the standards and expectations of today's employers and colleges, GED Testing Service partnered with the American Council on Education (ACE) and Pearson Learning Solutions to collaborate on the largest overhaul in the exam's history.

The revamped version, launched in January 2014, has raised the bar in multiple ways. In addition to assessing content knowledge, the new test will require test-takers to apply background knowledge, to reason in mathematics and language arts and to analyze multiple documents in social studies. There is more emphasis on critical thinking and less on simple reading comprehension, more extended written responses, and fewer multiple-choice questions. The new version is aligned with grade 12 Common Core State Standards as well as the expectations of colleges and employers. These changes also come with a significant increase in the cost to take the exam. The

minimum cost of the new 2014 exam has increased to \$120 and fewer states are offering subsidies to ease the burden on test-takers (GEDTS, 2015).

Preliminary numbers from GED Testing Service indicate that 58,524 people nationwide earned the GED in 2014, down from 540,535 in 2013 and 401,388 in 2012 (Montagne, 2015). Not surprisingly, the new test is causing anxiety among adults who aspire to get their GED and the programs that support them. Candidates fear that they are not ready for the test and educators worry that it may take an additional year or two to prepare them to take it (Cardoza, 2013). Two other companies, Educational Testing Service (ETS) and McGraw-Hill, have created alternative high school equivalency programs, the High School Equivalency Test (HiSET) and the Test Assessing Secondary Completion (TASC), respectively, and states are weighing their options. Between the higher standards and financial costs involved with the GED, ten states have decided to drop the program in favor of the HiSET or TASC (Smith, 2014). The increase in competition might motivate GED Testing Service to accommodate as many people as possible, but more importantly, America's Largest High School has an obligation to recognize and support its diverse student body, non-native English speakers included.

Precedents for Accommodating Diversity of Language

In the United States, the history of language rights for minority groups has been a mixed bag of official and unofficial policy, but since the 1960s there has generally been a heightened concern for civil rights and education for all (Wiley, 2007). A general precedent was set in 1974 when the Supreme Court established the illegality of excluding minority language students from the education system. In

Lau v. Nichols (1974), Chinese-American parents brought suit against the San Francisco Unified School District, claiming that its English-only policy effectively excluded Chinese students from meaningful education. According to Justice Douglas, who delivered the court's opinion:

there is no equality of treatment merely by providing students with the same facilities, textbooks, teachers, and curriculum; for students who do not understand English are effectively foreclosed from any meaningful education ... We know that those who do not understand English are certain to find their classroom experiences wholly incomprehensible and in no way meaningful. (*Lau v. Nichols*, 1974.)

The connection between language and meaningful education that *Lau v. Nichols* (1974) highlights is also applicable to adults who aspire to get their GED. Requiring candidates to take the exam in a language other than their own makes it more difficult for them to connect with the complex content of the exam. This risk is particularly high for test-takers who not only speak a different language, but also come from a different writing system. Given that readers from non-alphabetic backgrounds are shown as less efficient in processing English words than those from an alphabetic background, a Chinese GED candidate, for example, would likely be further alienated from the content of the exam than those from alphabetic systems (Akamatsu, 2003). Even the vast diversity within alphabetic systems (Arabic, Cyrillic, Latin, etc.) would imply that readers would process English text differently. However, despite the variation of languages and scripts among GED candidates and

a mandate for differential consideration from *Lau v. Nichols* (1974), GED Testing Service holds many non-native English-speaking candidates to the same standards as their native peers.

In the 1990s, a new era of standards and accountability coincided with a significant increase in the immigrant population, raising questions about test reliability for English language learners (ELLs) (Center for Public Education, 2007). In 2001, the No Child Left Behind Act (NCLB) highlighted the need to help ELLs perform well on academic measures. Under Title I of NCLB, states must include ELLs in their assessments of academic achievement and provide them with appropriate accommodations to yield accurate data on what they know and can do (U.S. Department of Education, 2007). Since then, more attention has focused on examining research and policy related to ELLs, increasing resources for supporting them and establishing accommodations for tests and alternative forms of assessment (Center for Public Education, 2007).

More recently, the rigorous language standards of the Common Core State Standards (CCSS) initiative have further called into question the support of ELLs in American schools. As stated by the two organizations leading the initiative, the National Governors Association and the Council of Chief State School Officers (2010), “these students may require additional time, appropriate instructional support, and aligned assessments as they acquire both English language proficiency and content area knowledge” (para. 1). Beyond this general statement of support, the developers of the CCSS left questions of implementation of the standards to individual states to decide. Since then, demands from the states for more federal assistance in supporting ELLs have prompted Stanford University to launch

the Understanding Language Project. Rejecting the traditional focus of grammar and vocabulary in the instruction of ELLs, the project advocates for more emphasis on discourse, complex texts, explanation, argumentation, purpose and structure of text (TESOL, 2013). As to the role of assessments in the CCSS, Kenji Hakuta, project co-chair, cautions against tests that are insensitive to ELLs or overly focused on language rather than content (Scope, 2011).

In addition to the growing support for language accommodation in education at both federal and state levels, there is GED Testing Service’s own precedent of language accommodation. The Spanish language version of the test that was developed for GED test-takers in Puerto Rico is authorized for use by Spanish speakers in the United States. A French version of the exam, originally designed for use in Canada, is also available. Excepting speakers of Spanish or French, other minority language groups are obligated to take the exam in English, creating a double standard within the program. Granted, the logistics of offering test versions in all languages may not be feasible, but accommodations to put test-takers on more equal footing are well within reason.

Accommodations for the 2014 GED

When faced with a large-scale test in English, such as the GED exam, an ELL test-taker must direct more cognitive resources to processing the language of the test compared to a candidate who is fully proficient in English. Consequently, the ELL will have fewer resources available to attend to the actual content of the test in math, science, social studies, etc. (Francis, Rivera, Lesaux, Keiffer, & Rivera, 2006). To provide an equal assessment opportunity for all, non-native English speaking test-takers must be provided

with support in areas where the English language is not the target of assessment. These supports are usually provided in the form of “accommodations” which alter the standard test procedure to make the content more accessible and meaningful to the test-taker (Abedi & Levine, 2013). Accommodations for the English version of the GED would ideally reduce the linguistic burden necessary to access the content of the test and address the linguistic and sociocultural needs of the test-taker without comprising the points being assessed (Acosta, Rivera, & Shafer Willner, 2008).

The Center for Equity and Education at George Washington University has identified 40 different accommodations that provide direct and indirect support for ELLs. Francis et al. (2006) caution that accommodations, whether used individually or in combination, should be selected carefully based on the specific needs of individual test-takers. Highlighting several specific accommodations demonstrates the breadth of the options. The provision of bilingual dictionaries or glossaries, for example, has proven an effective accommodation for some test-takers, provided they are literate in both their native language and in English. However, as native language literacy must not be assumed, more information about the test-taker is necessary to determine the appropriateness of bilingual reference materials (Francis et al., 2006). Moreover, accommodations for testing should also be consistent with the instruction and preparation leading up to the test. As an example, Francis et al. (2006) note that bilingual dictionaries were not found effective for students who had no experience using them while preparing for the test. Finally, accommodations may also vary depending on the content area of the test. The bilingual dictionary may help a test-taker access

a math word problem without compromising the content, but it would give an unfair advantage on a test item targeting vocabulary (Francis et al., 2006). The implication for GED Testing Service would be to avoid a one-size-fits-all approach to accommodations by accounting for the specific needs of an individual test-taker as well as the context of the accommodation (Abedi, Mirocha, Leon, & Goldberg, 2005).

While bilingual reference materials may support some test-takers on some parts of the GED test, extended time limits are another accommodation that would certainly benefit others. As a stand-alone accommodation, providing candidates with extra time allows for slower processing speeds in English (Acosta et al., 2008). Extended time limits are also important in combination with other accommodations that require additional time to use, such as a bilingual dictionary (Acosta et al., 2008).

Another accommodation that has proven helpful to ELLs is a “plain English” version of a test. As explained by Acosta et al. (2008), “plain English” consists of test items and/or directions for which linguistic complexity has been reduced while maintaining the level of difficulty of the test item. In other words, through language structure and vocabulary that avoid ambiguity, colloquialisms, or multiple meanings, test items become more meaningful and accessible to ELLs. Particularly for the math and science portions of the GED, which do not target language ability, plain English would seem appropriate.

Acosta et al. (2008) also point out a number of oral accommodations that could support GED candidates. Scripted oral English is an accommodation in which test items or instructions are read aloud from a script or through an audio recording while the test-taker has access to the written text. Clarification in English

provides unscripted, on-the-fly, oral explanations of text considered potentially difficult for ELLs to access, offering reformulated input that is more manageable. Other accommodations allow test-takers to answer test items orally rather than in writing. Given that the new 2014 GED involves more extended written responses, potentially requiring a test-taker to focus more on the English language than the actual content of the exam, oral accommodations may better demonstrate one's knowledge.

These accommodations, among others outlined by Acosta et al. (2008), could compensate for language barriers on the English version of the GED exam and allow test-takers to better reflect their depth of knowledge. Moreover, as research shows that linguistically challenging assessments yield the largest performance gaps between ELLs and native English speakers, these accommodations are a way to "level the playing field" (Abedi, 2004). Finally, given that the linguistic complexity of test items may threaten the validity of a test and the reliability of its results, accommodations would help to ensure the integrity of the new GED test (Abedi, 2004). That is, appropriate accommodations ensure that the language background of students does not add another dimension to the assessment outcome that may be a source of measurement error for ELLs taking the GED in English (Abedi, 2002).

Conclusion

Abedi (2004) emphasizes that language and performance are confounded. Solving math problems and answering science and social studies questions in English pose a double challenge for learners of minority language groups. Accommodations for language have been shown to be an effective, valid way to support these learners. Carefully selected

accommodations are effective because they reduce the performance gap between native and non-native English speakers. They are valid because they do not compromise the content of the exam.

GED Testing Service's lack of support for non-native English speakers is at odds with precedent and with research on language accommodations in education. These GED candidates are disadvantaged by the current one-size-fits-all approach and have much to gain from language accommodations. Effective accommodations would allow test-takers to focus on the target content rather than the language barriers. They would give test-takers a chance to better demonstrate their knowledge, and they would put all candidates on more equal footing.

GED Testing Service would also benefit from addressing the needs of this group of candidates. The higher standards of the new 2014 GED make it probable that fewer candidates will pass the test. Competition from the HiSET and TASC exams will also contribute to the program's dwindling numbers. From a programmatic standpoint, these reasons should motivate GED Testing Service to reevaluate its position on language accommodations. To better attract and retain potential candidates, it must acknowledge and accommodate the diversity among its target population. As the program now transitions into its upgraded version of the test, it is an opportune moment to revisit language policies and make adjustments.

These adjustments would not only respond to shifts within the GED program, but also within larger national trends. The GED program may be America's Largest High School, but of the 39 million adults in the United States without a high school diploma, only a fraction takes the test. As the GED is a bridge to further education and employment, the success of the

program has implications for the nation's economic well-being. The numbers show an overwhelming need for programs that serve this segment of the population, but GED Testing Service must find better ways to reach its market.

In the years ahead, minority groups will account for a larger part of this population. According to the National Education Association (2009), the number of ELLs in public schools has doubled over the last 15 years and two-thirds come from low-income families. Most significant—and troubling—is that these students' academic performance is lower than their peers. ELLs also have higher dropout rates (NEA, 2009). Support for these students in K-12 systems have become commonplace, in part through language accommodations, but GED Testing Service has yet to catch on. The need is great and the timing is right to make the 2014 GED more accessible and meaningful to minority language groups. ❖

Laurel Anderson works at the Carlos Rosario International Public Charter School in Washington, DC, which provides adult immigrant students with ESL instruction, GED preparation, and workforce training. Over the years, her work with the school has included teaching ESL, planning professional development for the faculty and developing curriculum.

References

- Abedi, J. (2002). Standardized achievement tests and English language learners: Psychometrics issues. *Educational Assessment, 8*(3), 231–257.
- Abedi, J. (2004). Will you explain the question? *Principal Leadership, 4*(7), 27–31.
- Abedi, J., & Levine, H. (2013). Fairness in assessment of English learners. *Leadership, 43*(3), 27–38.
- Abedi, J., Courtney, M., Mirocha, J., Leon, S., & Goldberg, J. (2005). *Language accommodations for English language learners in large-scale assessments: Bilingual dictionaries and linguistic modification* (CSE Report 666). Los Angeles, CA: National Center for Research on Evaluation, Standards, and Student Testing, University of California. Retrieved from <http://www.cse.ucla.edu/products/rsearch.asp>
- Acosta, B., Rivera, C., & Shafer Willner, L. (2008). *Best practices in the accommodation of English language learners: A Delphi study*. Prepared for the LEP Partnership, U.S. Department of Education. Arlington, VA: The George Washington University Center for Equity and Excellence in Education. Retrieved from <http://files.eric.ed.gov/fulltext/ED539759.pdf>
- Akamatsu, N. (2003). The Effects of first language orthographic features on second language reading in text. *Language Learning, 53*(2), 207–231.
- Cardoza, K. (2013, October 8). The GED test is about to get much harder, and much more expensive. *The Atlantic*. Retrieved from <http://www.theatlantic.com/education/archive/2013/10/the-ged-test-is-about-to-get-much-harder-and-much-more-expensive/280281/>
- Center for Equity and Excellence in Education (2014). *ELL accommodations online toolkit and database*. Retrieved from <http://ells.ceee.gwu.edu/default.aspx>
- Center for Public Education (2007). *Research review: What research says about preparing English language learners for academic success*. Retrieved from https://www.shastacoe.org/uploaded/Dept/is/general/Teacher_Section/EnglishLanguageLearners.pdf
- Crissey, S. R., & Bauman, K. J. (2012). *Measurement of high school equivalency credentials in census bureau surveys* (SEHSD Working Paper No. 2012-3). Retrieved from http://www.census.gov/hhes/socdemo/education/data/cps/GED_wp2012-3.pdf
- Francis, D.J., Rivera, M., Lesaux, M., Keiffer, M., & Rivera, H. (2006). *Practical guidelines for the education of English language learners: Recommendations for the use of accommodations on large-scale assessments*. Portsmouth, NH: Center for Instruction. Retrieved from <https://www2.ed.gov/about/inits/ed/lep-partnership/assessments.pdf>
- GED Testing Service (GEDTS). (2015). Issues. Retrieved from <http://www.gedtestingservice.com/educators/cost>
- GED Testing Service (GEDTS) (2013). *2012 annual statistical report on the GED® Test*. Washington, DC: Author. Retrieved from <http://www.gedtestingservice.com/uploads/files/8d4558324628dfcf1011dc738acca6eb.pdf>
- Guison-Dowdy, A., & Patterson, M.B. (2011). *Journeys through college: Postsecondary transitions and outcomes of GED test passers*. Washington, DC: American Council on Education.
- Lau v. Nichols, 414 U.S. 563 (1974).
- Montagne, R. (Narrator). (2015, January 9). A “sizable decrease” in those passing the GED [Radio broadcast episode]. *Morning Edition*. Washington, DC: National Public Radio. Retrieved from <http://www.npr.org/blogs/ed/2015/01/09/375440666/a-sizable-decrease-in-those-passing-the-ged>
- National Governors Association Center for Best Practices & Council of Chief State School Officers (2010). *Application of the common core state standards for English language learners*. Retrieved from <http://www.corestandards.org/assets/application-for-english-learners.pdf>
- NEA Education Policy and Practice Department (2009). *English language learners face unique challenges* [Policy brief]. Retrieved from [http://www.nea.org/assets/docs/HE/ELL_Policy_Brief_Fall_08_\(2\).pdf](http://www.nea.org/assets/docs/HE/ELL_Policy_Brief_Fall_08_(2).pdf)
- [Scope]. (2011, November 22). *Kenji Hakuta on ELLs and the common core standards* [Video file]. Retrieved from <http://www.youtube.com/watch?v=PY2fhP8Q0OY>
- Smith, A. (2014, May 9). Tougher GED tests mean fewer take the exam. *USA Today*. Retrieved from <http://www.usatoday.com/story/news/nation/2014/05/08/fewer-ged-test-takers/8847163/>
- TESOL International Association. (2013). *Overview of the common core state standards initiatives for ELLs*. Alexandria, VA: Author. Retrieved from <http://www.tesol.org/docs/advocacy/overview-of-common-core-state-standards-initiatives-for-ells-a-tesol-issue-brief-march-2013.pdf?sfvrsn=4>
- U.S. Department of Education, Office of Elementary and Secondary Education. (2007). *Assessment and accountability for recently arrived and former limited English proficient (LEP) students*.
- Wiley, T. (2007). Accessing language rights in education: A brief history of the U.S. context. In C. Baker & O. Garcia (Eds.), *Bilingual Education: An Introductory Reader* (pp. 89–96). United Kingdom: Multilingual Matters.

There is now neurological evidence that phonics is superior to the whole word approach to teaching reading.

During the word verification task, participants' brain activity was measured with EEGs.

does not. The authors further explain, however, that skilled reading of exception words (words not easily sounded out using phonics) requires fluent switching back and forth between small grain and large grain mapping.

Methodology

The purpose of the experiment described in the article was to measure neurological activity associated with sublexical grapheme-phoneme mapping (phonics) and whole word mapping. This was accomplished by developing a new written alphabet that consisted of created symbols that the participants had never seen before and then teaching them to read using the new alphabet. Sixteen literate adults participated in the study.

The participants were taught to read by both small grain and large grain mapping. Participants were trained to read two different scripts that were created for this experiment. The first script, grapheme-phoneme (GP), was designed to simulate phonics. This script consisted of symbols that mapped each grapheme (written symbol) to a single phoneme (sound). In the second, whole-word (WW) script, more complex graphemes were mapped with corresponding phonemes. The mapped associations in the GP script were consistent, thus they were generalizable. When a participant had mapped a specific phoneme with a specific grapheme, that mapping could then be applied to other, unfamiliar words in the GP script. In the WW script, the mapped associations were not consistent so that the participants could not employ phonics to learn the words, they had to rely on memorization.

Each participant received training in decoding both scripts over two days. After training, participants were tested on their knowledge in a word verification task. In this task participants were presented with the scripts followed by the researcher saying the word. The participants then had to state whether the spoken words matched the scripts. This procedure was repeated for three conditions: GP words, WW words, and transfer words. The transfer words were new words on which the participants had not receive training, but were decodable given the grapheme-phoneme associations already learned in the GP script.

During the word verification task, participants' brain activity was measured with EEGs. The process for recording and measuring the EEGs was very complex. Essentially, however, time intervals between the presentation of the stimuli (script and spoken word) and participants' responses (correct or incorrect) were measured and averaged for participants for each condition (GP, WW, and transfer words). In addition, the amount and location of

neurological activity in participants' brains was also measured by the EEGs. A sophisticated form of data analysis using MANOVA was employed to determine differences in time measured by the EEGs. TANOVA analysis was employed to determine statistical differences in amount of neurological activity.

Findings

Interestingly, time and accuracy findings for the WW script were better than for those for the GP script. In other words, with the WW script, participants recognized whether the words and scripts were correct or incorrect faster and with fewer errors than with the GP script. These differences are explained by the authors as being due to the difficulty of the tasks performed. Since the sublexical decoding required for the GP task is more difficult, the time it takes to correctly identify the spoken words and the error rate in doing so increases. On the other hand, accuracy for transfer words was greater than expected, indicating that participants were sensitive to sublexical unit organization when reading trained words in the GP script as well as the transfer words.

More to the point, however, the EEGs showed that there were statistically significant differences in measured left-lateralization brain activity between using the GP script and the WW script. This indicates that the GP script generated significantly more left-brain activity than the WW script. In addition, there were also statistically significant differences in measured left-lateralization brain activity between the GP script and the transfer words. This shows that decoding the transfer words generated significantly more left brain activity than just reading the trained words from the GP script.

Discussion

The authors conclude that learning the grapheme-phoneme mappings in training “drastically biased behavior” (p. 29). In other words, learning the GP script induced changes in brain circuitry which enhanced left-brain activity. The changed brain circuitry was also evident when decoding the transfer words. This indicates that phonics generates more left-brain activity which enables participants to be more effective in decoding unfamiliar words because the way the brain works has been changed by learning phonics. It should also be noted that learning WW words increased right-lateralized topography which indicates that the whole word approach does not engage the left-lateralized linguistic processes to a significant degree.

Most reading teachers know that phonics works as a method of instruction. This research goes a step further, however, and provides a connection between

Interestingly, time and accuracy findings for the whole-word script were better than for those for the grapheme-phoneme script.

The grapheme-phoneme script generated significantly more left-brain activity than the whole-word script.

Learning to read with phonics does in fact change the brain which makes the application of phonics to learn unfamiliar words possible.

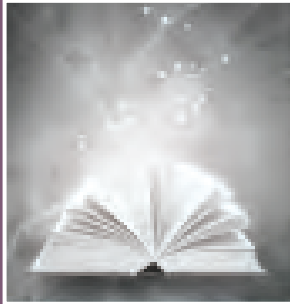
This is a first step in the direction of basing teaching practice on neurological evidence of learning.

methods of instruction and neurological brain activity. An important finding from the study is that not only does learning the GP script generate significantly more left-lateralized neurological activity than learning the WW script, but that the transfer words generated significantly more left-lateralized neurological activity than learning the GP script itself. The authors found the increased left hemisphere activity acquired from learning phonics results in actual changes in the way the brain circuitry functions and these changes are carried over to future learning situations. It can be concluded that learning to read with phonics does in fact change the brain which makes the application of phonics to learn unfamiliar words possible.

Teachers select teaching methods for a variety of reasons including personal preferences, past experience, global assessment of their value, and, more recently, by evidence-based assessments of learning outcomes. This research moves us beyond these teacher-centric and behavioral observation approaches to connecting teaching methods with the brain activity of learners. The significance is that for the first time there is actual evidence linking teaching methods to what is happening in a learner's brain. This is a first step in the direction of basing teaching practice on neurological evidence of learning.

Gary Dean is Professor and Chair in the Department of Adult and Community Education at Indiana University of Pennsylvania.

BOOK REVIEW



Reviewed by

Iris Feinberg

*Georgia State
University*

Building Health Literate Organizations: A Guidebook to Achieving Organizational Change By Mary Ann Abrams, Sabrina Kurtz-Rossi, Audrey Riddenburgh, and Barbara Savage

2014; UnityPoint Health, West Des Moines, IA
Available for free download at <http://www.HealthLiterateOrganization.org>. Website registration is not required.

Building Health Literate Organizations: A Guidebook to Achieving Organizational Change is a compilation of concepts, ideas, suggestions, stories, and examples designed to help healthcare organizations identify health literacy challenges and create adaptive implementations to increase organizational and patient level health literacy. This resource provides a clearly laid out roadmap for considering what health literacy is, how it impacts both an organization and the people it serves, and why an enhanced level of health literacy is important for patients, providers, and organizations. The authors rely on the Institute of Medicine's Roundtable on Health Literacy's *Ten Attributes of Health Literate Health Care Organizations* (Brach et al., 2012) to define what a health literate organization is; these tenets also provide structure within which the authors present real-world examples and suggestions for adaptation in real-world settings. The authors also support many of their ideas with recognized and accepted health literacy research, citing the *National Action Plan to Improve Literacy* (U.S. Department of Health and Human Services, 2010) and the *Health Literacy Precaution Toolkit* (DeWalt et al., 2010), among many others.

The guidebook is structured into nine chapters; whether read online or downloaded and printed, the pages and sections are well formatted with easy-to-read sections, consistency in formatting between sections and chapters, and a good use of action-oriented language. Each chapter (after the Introduction) also includes one or more real-life stories that strengthen the ideas presented in that chapter. The idea for the book

This resource provides a clearly laid out roadmap for considering what health literacy is.

Each chapter also includes one or more real-life stories that strengthen the ideas presented in that chapter.

came from ongoing work at UnityPoint Health (formerly the Iowa Health System) by Abrams and Savage; the authors share their own experiences in implementing health literacy initiatives. This approach should be helpful for those who work in healthcare settings and who are charged with developing a health literacy program for their organization.

This resource contains many different strategies and suggestions, and is meant as a guide, not a step-by-step manual. The authors point out, however, that these are not the only strategies to try and that adaptation and flexibility in developing and implementing initiatives is important to success. Chapter 1 is a brief introduction to what health literacy is and how to best use the guidebook to build organizational change. Chapter 2, entitled “Background,” provides a good overview of health literacy, and should be read first by those who are not familiar with the topic. This section also includes a detailed description of a tool called “Model for Improvement” that UnityPoint Health uses, and that can help organizations organize and implement changes in real-world settings. Chapters 3-8 are topic chapters; each subject relates back to one or more of the attributes of a health literate organization that are laid out in the “Introduction” (Chapter 1). The attributes chosen are (in chapter order) “Engaging Leadership,” “Preparing the Workforce,” “The Care Environment,” “Involving Populations Served,” “Verbal Communication,” and “Reader-Friendly Materials.” When appropriate, chapters also include resources for the reader; for example, in Chapter 3, “Engaging Leadership,” specific resources and tools are listed along with a helpful description of what each resource provides. The resources are further divided into subject areas such as “Data, Reports,” “Making the Business and Quality Case,” and “Toolkits.” Chapter 9, “Case Study,” details the process from initiation through implementation that UnityPoint Health followed to change their Informed Consent for Surgery form into a reader-friendly format.

Chapters 4 and 5, “Preparing the Workforce” and “The Care Environment,” could be considered sequential; they involve working with the healthcare organization’s staff and then within the health care environment. The authors note that not all of an organization’s staff may have high levels of general literacy and/or health literacy; however there is little guidance as to how to include those affected in developing interventions. These two chapters lead the reader directly to development and implementation of interventions for the workforce (mostly oral interventions) and the workplace (a combination of written and oral interventions). The authors provide coaching tips, techniques, and ideas for those who will be implementing oral interventions and suggested approaches for collecting and assessing data in the workplace.

The authors encourage inclusion of patient and family input in development and evaluation of health literacy interventions in Chapter 6, “Involving

Populations Served.” This chapter provides ideas and methodologies that organizers can use to involve the populations they serve; however, there is no mention of any potential ethical or legal issues such as ensuring there are no HIPPA violations, requiring confidentiality, recruiting patients without bias, or other protections of human subjects in research. A section encouraging that these issues be evaluated within appropriate sources in an organization prior to engaging patients and their families could address this issue.

The guidebook is not meant to be a step-by-step manual; however, I am unclear as to why Chapters 7 and 8, “Verbal Communication” and “Reader-Friendly Materials,” are placed where they are since they describe tools that should be used to accomplish the interventions discussed in prior chapters. Perhaps these sections could be in an appendix that delineates them as tools rather than leaving them as independent chapters. The information contained therein is very useful and practical; however, leaving them to the end of the guide without indicating that they are tools to be used in developing implementations that were discussed earlier could be confusing for readers.

Overall, I highly recommend *Building Health Literate Organizations: A Guidebook to Achieving Organizational Change*. Providing practical and useful guidance to healthcare organizations that want to become more health literate is a challenging task; the authors have succeeded in presenting concrete and suitable guidance supported by up to date research, a collaboration of contributors, and personal experience. The guidelines developed throughout this resource could be used by any healthcare organization regardless of size, location, or patient population served. This is a useful resource for people who want to improve the quality of clear communication with patients, providers, and health systems and enhance safe, high quality, and equitable health care.

This resource contains many different strategies and suggestions, and is meant as a guide, not a step-by-step manual.

Iris Feinberg is the Assistant Director of the Adult Literacy Research Center at Georgia State University.

References

- Brach, C., Keller, D., Hernandez, L. M., Baur, C., Dreyer, B., Schyve, P., ... & Schillinger, D. (2012). *Ten attributes of a health literate health care organization*. Institute of Medicine Roundtable on Health Literacy. Washington DC: National Academies of Science.
- DeWalt, D.A., Callahan, L.F., Hawk, V.H., Broucksou, K.A., Hink, A., Rudd, R., & Brach, C. (2010). *Health literacy universal precautions toolkit* (AHRQ Publication No. 10-0046-EF). Rockville, MD: Agency for Healthcare Research and Quality.
- U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion. (2010). *National action plan to improve health literacy*. Washington, DC: Author. Retrieved from: <http://www.health.gov/communication/HLActionPlan>

WEB SCAN



*Reviewed by
David J. Rosen*

*Newsome
Associates*

Surveying Adult Learners' Technology Skills: What Digital Literacy Skills Do Your Students Have—or Need?

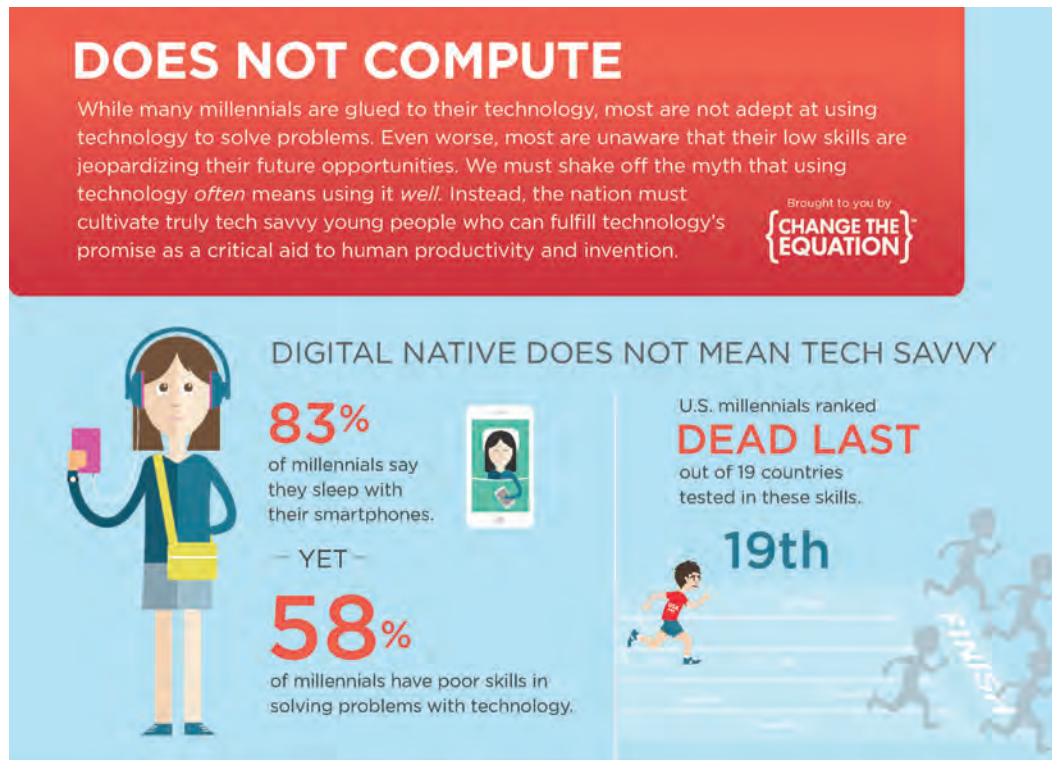
In the past couple of years, several new web-based resources have emerged for adult basic education programs, teachers, and adult learners to survey and assess adult learners' technology and/or digital literacy skills. These include international surveys, national assessments designed specifically for adult learners, at least one large-scale adult learner state survey, and a few open educational resource informal surveys that teachers can use as is or adapt to use with their students. They can be used to assess students' technology, digital literacy, or digital literacy and problem solving skills. Some are free; others are relatively inexpensive. While this is not a comprehensive list of these surveys and assessments, it includes several of the most recent and best-known ones, as well as some made by adult basic education practitioners.

National and State Surveys

1. The PIAAC Survey of Adult Skills Assessment of Problem Solving in Technology-Rich Environments (PST-RE)

This is an International Organisation for Economic Co-operation and Development assessment used by many advanced countries that are members of the OECD, the United States among them. PST-RE is one of three domains assessed, along with literacy and numeracy. The results of the PST-RE assessment, worldwide, will be found in this free publication at <http://bit.ly/1hGcSIH>. The U.S. results for the PIAAC SAS will be

found at <http://nces.ed.gov/surveys/piaac/results/summary.aspx>. The PST-RE is available for use by adult basic skills programs and other organizations in the U.S. and is called Education and Skills Online. A free demo version will be found at <http://www.oecd.org/skills/ESonline-assessment/>. The full version is available for a cost of under \$12.50 per test-taker, depending on the quantity and which assessments are chosen. Information about it can be found at <http://www.oecd.org/skills/ESonline-assessment/assessmentadministration/purchasing/>.



Results of U.S. Millennials on the PIAAC Survey of Adult Skills
<http://piaacgateway.com/infographics/>

2. California Adult Education Online Application and Reporting

<https://adulthood.otan.us/info.cfm?fuseaction=studentResults>

OTAN, in California, has been doing a large-scale survey of adult basic education and ESL students' Internet access, smartphone access, and how they use computers, feature phones, smartphones, and the Internet.

Surveys You Can Use with Your Students

3. Northstar Digital Literacy Assessment

<http://www.digitalliteracyassessment.org/>

This free assessment of basic skills needed to perform tasks on computers and online employs online, self-guided modules in eight areas: Basic Computer Use, Internet, Windows Operating System, Mac OS,

Email, Microsoft Word, Social Media, and Microsoft Excel. It is also possible, for a reasonable fee, for an organization to become a sponsor, receive training, and then have the authority to award Northstar Digital Literacy Certificates, a credential for employment.

4. Student Internet and Computer Skills Survey

<http://tinyurl.com/ovntxsv>

Using this open education resource classroom survey of basic digital literacy skills, web access and e-mail, you can survey your students (orally or in writing) and remix, tweak, or build upon it for non-commercial purposes.

5. Survey of Cell Phone Use Skills

<http://tinyurl.com/yjzqxy6>

Survey your students specifically about their cell phone use with this open education resource survey originally developed by Santa Anna College ESL Professor, Susan Gaer and adapted by David J. Rosen.

6. Mobile Devices Survey

<http://bit.ly/1Wwogan>

This student cell phone Survey by Susan Gaer includes ways to use cell phones for English Language Learning Instruction.

David J. Rosen is an education consultant in the areas of adult education, distance education and technology.



BIGGER & BETTER IN TEXAS!

DALLAS APRIL 10-13, 2016

Collaborate with your colleagues from around the country in the Lone Star State!

Learn about new best practices and receive targeted training from national level speakers. Twelve strands--comprised of more than 200 sessions--will be offered, providing valuable, state-of-the-art training that you will be able to bring back to your adult ed program! Join more than 1,400 conferees and enjoy numerous networking opportunities with your peers in adult education from around the country!



National Conference Strands

Adult Basic Education • Administration • Community Ed • Continuing Higher Education • Corrections • Digital Literacy • Distance Education ESL/ELL • Family Literacy • GED/Post Secondary Credential Learning Difficulties/Disabilities • Literacy • Numeracy • Professional Development • Public Policy/Advocacy • Technology • Testing Preparation • Transitions/Pathways

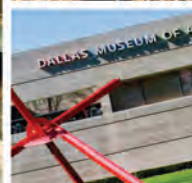
*Visit us on the **COABE APP** or online at **COABE.ORG** for complete conference details and updates!*



Scan this QR code to download the COABE app!



Make a weekend out of it and take time to enjoy some of what Dallas has to offer!



Enjoy shopping, horseback riding with your family, or a romantic getaway with your significant other in one of the country's most beautiful states!



Presented in partnership by:
The Commission on Adult Basic Education (COABE) and The Texas Association for Literacy and Adult Education (TALAE)
Contact: COABE Conference 2016
E-mail: info@coabe.org Fax: 866-941-5129
Phone: 888-44-COABE





RUTGERS

Graduate School of Education

Online Master's Degree in Adult Education

Learn to Lead Adult Learning

Learning is a lifelong process. It doesn't end with the completion of high school or college. Each year, millions of adults return to the classroom to acquire new skills. That's why now is the time to earn your master's in adult education from an institution U.S. News & World Report has named one of the nation's best graduate schools of education.

- Complete coursework 100% online
- Study cutting-edge adult learning theory and best practices
- Choose from four optional specializations
- Enjoy small class sizes and personal instruction

Specialize in:

- Adult Literacy and ESL
- Educational Technology
- Human Resources Development
- Higher Education Teaching

Apply today to engage in stimulating study led by top education professionals right from your home computer.

Visit online.rutgers.edu to learn more.

Why a Master's Degree in Adult and Continuing Education?

A master's degree in adult in continuing education is a versatile degree that prepares you to help adults learn and meet their goals in a variety of contexts including business and industry, professional associations, higher education, health care, non-profit and community-based organizations, even school districts. This 30-credit degree program can prepare you for job opportunities in a range of employment settings.

Why Rutgers?

- The Graduate School of Education is a top-ranked Graduate Schools of Education by US News and World Report.
- Top notch faculty create stimulating and meaningful learning experiences.
- Classes are hands-on, interactive, and collaborative and assignments are practical and applied.
- The program of study is flexible. Students have the option to specialize in one of 4 areas or do course work across any combination of these.

COMMON
CORE
BASICS

SPANISH / EDITIONS

NEW!

Grade level equivalency 6–8 test preparation is now available in all five subject areas for native Spanish speakers.

- ▶ Reading
- ▶ Writing
- ▶ Math
- ▶ Science
- ▶ Social Studies

Built Upon the College and Career Readiness Standards



Pre-2014 GED® Test • Pre-TASC™ Test • Pre-HiSET® Exam

Test Ready. Future Prepared.

Learn more at commoncoreachieve.com/spanish

TASC Test Assessing Secondary Completion and Bookmark Standard Setting Procedure are trademarks of Data Recognition Corporation. Data Recognition Corporation is not affiliated with The After-School Corporation, which is known as TASC. The After-School Corporation has no affiliation with the Test Assessing Secondary Completion ("TASC test") offered by Data Recognition Corporation, and has not authorized, sponsored or otherwise approved of any of Data Recognition Corporation's products and services, including TASC test. HiSET® is a registered trademark of Educational Testing Service (ETS). This product is not endorsed or approved by ETS. GED® is a registered trademark of the American Council on Education (ACE) and administered exclusively by GED Testing Service LLC under license. This material [or content] is not endorsed or approved by ACE or GED Testing Service.



“COABE Members save \$30 off an individual subscription to the Journal. Contact info@coabe.org to renew your membership today!”

COABE
PO Box 620
Syracuse, NY 13206
CHANGE SERVICE REQUESTED

Presorted
Non-Profit Org.
U.S. Postage
PAID
Syracuse, NY
Permit No. 1920

LEARNING Upfront, Close and Personal

Essential Education's Adaptive Learning System

gives the student the right lesson at the right time to provide a truly personalized learning experience. Students learn faster and retain more because they know exactly where they are and where they need to go to maximize their success. Teachers have the one-on-one tools they need to guide and motivate their students to success. Success... one student at a time.



Visit our website to learn more
www.essentialled.com | info@essentialled.com
(800) 931 - 8069

