Expanding Skills in
HIGHER EDUCATION

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RESEARCH REPORT

Continuing a Culture of Evidence: Expanding Skills in Higher Education

María Elena Oliveri & Ross Markle

Educational Testing Service, Princeton, NJ

From 2006 to 2008, Educational Testing Service (ETS) produced a series of reports titled *A Culture of Evidence*, designed to capture a changing climate in higher education assessment. A decade later, colleges and universities face a new set of challenges resulting from societal, technological, and other influences, leading to a need to augment the skills expected of college graduates. This report is one of a new series of reports by ETS describing current issues and trends in higher education with a focus on assessment. In this report, we discuss shifts in cognitive and noncognitive skills expected of college graduates in response to new educational and occupational demands. In particular, we describe these demands, the factors influencing them, and the impact of these factors on the instruction and assessment of skills needed for success in higher education and the workforce.

Keywords assessment; student learning outcomes; higher education; noncognitive skills; 21st century skills

> [As a country,] simply providing more education may not be the answer. There needs to be a greater focus on skills — not just educational attainment — or we are likely to experience adverse consequences that could undermine the fabric of our democracy and community. (Educational Testing Service, 2016, p. 5)

At a time when educational quality and the value of a college degree are highly scrutinized, the need to examine what is learned is imperative. In the novel, *Hard Times*, Charles Dickens's (1854) character Thomas Gradgrind instructs his children's teachers: "Teach these boys and girls nothing but Facts … nothing else will ever be of any service to them" (p. 1). Today, almost everyone would agree that an education focusing solely on content would hinder rather than adequately prepare college graduates to be productive members of society. In fact, Coley, Goodman, and Sands (2015) stated that the consequences of not reacting and adapting quickly to changing educational climates may adversely impact our nation's ability to stay competitive, with negative effects on employability and economic prosperity.

Determining exactly which skills are expected of modern college graduates, however, is not straightforward. We must determine not only key student learning outcomes (SLOs) but also effective methods of instruction and assessment to capture them. To this end, our report's objectives are twofold. First, we provide an overview of the national and international influences precipitating changes in higher education, examples of which include (a) an increasingly global economy, (b) an elevated use of technology, and (c) changes in the types of industries dominating the U.S. and global economies. These influences place pressures on higher education institutions (HEIs) and their stakeholders to produce skilled and competitive graduates. They also place pressures on students to learn and gain useful and relevant skills in preparation to either continue studying or enter the workforce successfully. Second, we discuss efforts to identify, conceptualize, and assess the skills necessary to produce competitive graduates and/or graduates who can meet workforce demands. Last, we make suggestions relevant to HEIs, test developers, researchers, and policy makers to inform these efforts further.

Changes in the Higher Education Landscape

In *The World Is Flat*, Thomas Friedman (2006) highlighted concerns for the American economy amid increased globalization rates and world competitiveness. Results of international large-scale surveys since then have supported these concerns, indicating that the United States could no longer take for granted its high standing in international higher

Corresponding author: R. Markle, E-mail: rmarkle@ets.org

education, as it was being surpassed by other countries (Coley et al., 2015; U.S. Department of Education, 2006). A U.S. Department of Education (2006) report foreshadowed this decreasing performance:

> At a time when we need to be increasing the quality of learning outcomes and the economic value of a college education, there are disturbing signs that suggest we are moving in the opposite direction. As a result, the continued ability of American postsecondary institutions to produce informed and skilled citizens who are able to lead and compete in the 21st-century global marketplace may soon be in question. (p. 12)

Consistently, evidence has shown that the international standing of the United States is at an alarmingly low point. Coley et al. (2015) compared results from the Program for the International Assessment of Adult Competencies (PIAAC; also referred to as the Survey of Adult Skills) for the United States and 21 other participating countries. PIAAC assesses the proficiency of adults in key-information processing skills (literacy, numeracy, and advanced problem solving in technology-rich environments) deemed centrally important to financial success in modern economies (Levy, 2010).

Coley et al. (2015) found that American millennials (i.e., adults born after 1980), despite having the highest educational attainment rates of any previous generation of adults surveyed by PIAAC, ranked among the lowest worldwide in all three skills. What is more, US millennials with at least a bachelor's degree also performed poorly when compared with similarly credentialed peers from other nations, demonstrating poor performance across the educational spectrum. This points to an increasing need to implement educational changes to remain globally competitive.

In addition to the PIAAC results, there has been consistent evidence from the workforce sector to suggest that degree holders are not graduating with the relevant skills needed for successful employment, leading to calls for enhanced preparation of college students in the acquisition of the skills needed for the workplace. In 1990, then Secretary of Labor Lynn Martin formed the Secretary's Commission on Achieving Necessary Skills (1991; SCANS). The commission's charge was to examine the extent to which the US educational system met employers' needs. The members reported that educators needed to better prepare students for a more complex, modern work environment. This objective required supplementing the mastery and acquisition of content knowledge with additional skills including creative thinking, decision-making, problem-solving, and critical and innovative knowledge application as well as "personal qualities," including responsibility, self-esteem, and integrity. The SCANS report was a watershed moment in defining what higher education students should know and be able to do.

Identifying Skills That Graduates Need to Meet Workforce Demands

More recent surveys of employers have suggested a mismatch between the skills cultivated in HEIs and those required by the workforce. Findings from a 2010 survey of more than 300 employers showed that only 28% of respondents felt that 4-year colleges and universities adequately prepared students for the workforce (Hart Research Associates, 2010). Another survey that sampled more than 2,000 employers revealed that companies had difficulty finding qualified applicants possessing the problem-solving and communication skills necessary to fulfill workplace demands (Manyika et al., 2011). Survey findings suggested that employers felt graduates were insufficiently prepared to meet workforce demands, and they urged for student preparation to include the acquisition of additional skills. A study put forth by the Conference Board and the Society for Human Resource Management more specifically identified the skills desired by employers. The skills of oral and written communication, teamwork/collaboration, professionalism/work ethic, and critical thinking/problem-solving were each deemed as important for college graduates by more than 90% of respondents (Casner-Lotto & Benner, 2006).

Perhaps the results from such research reports and surveys can be framed by understanding the changing nature of employment. As an example, consider the tasks performed by an accountant today as compared to several decades ago. Whereas balancing sheets and forecasting projections required lengthy computation time before the age of computers, many tasks now are automated, saving valuable time and affording accountants additional opportunities to critically evaluate, interpret, and visualize their results in client reports. Because automation shifted the distribution of accountants' work to be less on the creation of data and more on their use of, automation increased the need for accountants to possess other skills, such as problem-solving, interpreting data, collaborating with clients in identifying the types of data to include in the reports, and the coordination of tasks across departments.

Autor, Levy, and Murnane (2003) explained that an increased degree of complexity and diversity of work tasks required a more diversely skilled workforce to meet such demands (also see Levy & Murnane, 2004). This complexity increased

due to the elevated use of technology and changes in the types of industries dominating the US economy, which involved a reduction in manufacturing jobs and an increase in service-oriented fields (Kirsch, Braun, Yamamoto, & Sum, 2007). In addition, globalization led to increased worldwide collaborations with diverse clients and customers (Friedman, 2006).

To address the need to expand the skill set and maintain connectivity with the workforce, several associations wrote reports that identified the skills needed in this new environment. Examples include reports by the Association of American Colleges and Universities (2007) titled *College Learning for the New Global Century*, the *Degree Qualifications Profile* by the Lumina Foundation (Adelman, Ewell, Gaston, & Geary Schneider, 2014), the Council for the Advancement of Standards in Higher Education (Strayhorn, 2006), and the Assessment and Teaching of 21st Century Skills (2012). These organizations led notable efforts to redefine what graduates should know and be able to do.

Markle, Brenneman, Jackson, Burrus, and Robbins (2013) sought to advance the conversation beyond the identification of skills to the assessment thereof. Thus, they reviewed seven high-profile frameworks used in higher education and the workforce, seeking to identify a common set of skills that could then be used in an assessment framework. The focus was on the expectations of a college graduate rather than those of a new employee, emphasizing educational outputs more than workforce needs. They found the following skills to be common across frameworks: creativity, critical thinking, teamwork, effective communication, digital and information literacy, citizenship, and life skills (e.g., time management, goal setting, and adaptability).

Burrus, Jackson, Xi, and Steinberg (2013) conducted a second integrative review from a workforce-oriented perspective. The authors examined the Occupational Information Network (O*NET) database, which indexes job requirements across a large number of occupations requiring college degrees and beyond. Using cluster analyses to identify common skills across positions, they found similarity in the complex skills commonly required of new employees and those listed by Markle et al. (2013), with teamwork, creativity, communication, and critical thinking/problem-solving emerging in both efforts.

Oswald, Schmitt, Kim, Ramsay, and Gillespie (2004), in their review of multiple HEIs' SLOs and mission statements, also highlighted similar skills, including leadership, adaptability, and cultural awareness. Further support for this skill set is provided by the National Research Council (2011, 2012) and the National Academy of Sciences (Pellegrino & Hilton, 2013). Similarly, the first *A Culture of Evidence* report (Dwyer, Millett, & Payne, 2006) described a central set of skills that would comprise the authors' proposed comprehensive national system for assessment in higher education.

Collectively, these findings have suggested a significant overlap in the skills emphasized by HEIs and those sought by employers. If this is the case, why is it that employers perceive such a significant skills gap? One possible explanation is that a college degree does not sufficiently articulate the skills acquired by college graduates. For example, the acquisition of a college degree has traditionally indicated notable learning, perseverance, effort, and a host of other skills and behaviors (Burning Glass, 2014; Spence, 1973; Weiss, 1995). However, as bachelor's degrees have become both more common among job applicants and increasingly required among job openings, the degree has become less effective in providing unique information that articulates the acquisition of particular skills (Burning Glass, 2014). As Rampell (2014) stated in a *Washington Post* article, "[B]achelor's degrees are probably seen less as a gold star for those who have them than as a red flag for those who don't" (para. 10).

Using Assessment to Provide Evidence of Expanded Skills

As the expectations of college graduates grow and change, assessment can play a key role in improving the teaching and learning of these key skills. From the perspective of colleges and universities, assessments can help understand the extent to which these skills exist in their students and graduates. Resulting data can be used to demonstrate effectiveness where they do exist or to spark discussions about innovative pedagogical, curricular, or co-curricular experiences where they do not. Assessment can be a guide for institutional change and improvement, as shown increasingly in recent years.

From the individual perspective, assessments can also help college graduates to communicate the key skills they have obtained. Research from the Economic Policy Institute, a nonprofit, nonpartisan think tank, showed higher rates of unemployment and underemployment for recent college graduates, despite recent improvements in the economy (Davis, Kimball, & Gould, 2015). Thus, assessments of key skills could provide additional evidence of career readiness as these graduates compete — both among themselves and with existing workers — for new jobs and careers. Similarly, as employers look to detect those key skills in job applicants, assessment could play an important role.

Although assessment can help guide improvements in student learning, workforce preparation, and degree completion by monitoring, informing, and enhancing the teaching and learning of key skills, there are persistent challenges with regard to assessment design, implementation, score analysis, and reporting. In the final section of this report, we provide suggestions to HEIs, researchers, test developers, and policy makers to help inform efforts to address assessment-related issues. These recommendations will feature the work of various organizations and HEIs already under way, including next-generation models.

The Implications for Higher Education Institutions

We make two suggestions to help address a new and expanded set of skills, each with pedagogical, curricular, and assessment-related implications: first, that HEIs more explicitly acknowledge these skills through articulated SLOs, and second, that HEIs integrate the expanded skill set into pedagogy, curricula, and assessment.

In relation to the curriculum, many HEIs have already begun transitioning to more active learning opportunities, such as collaborative group projects and hands-on experience in research, experimentation, or problem-based learning, which hold promise in developing these more complex skills (Association of American Colleges and Universities, 2007). To illustrate, consider an example relating to teamwork and collaboration, which were identified as highly desirable and relevant skills for both workforce and higher education success across fields of study (Baepler, Walker, & Driessen, 2014; Chen, Donahue, & Klimoski, 2004; Laursen, 2013).

Peterson and Miller (2004) compared the learning of undergraduate educational psychology students during cooperative learning versus large-group instruction and found that cooperative learning yielded gains in student engagement, thinking about the tasks, and working at optimal levels of challenge and skill. In macroeconomics, Johnston, James, and Lye (2000) reported increased learning of the course content when instructors included collaborative activities in the classroom. Such boosts extended to online learning through multimedia, including online media platforms, discussion boards, and virtual group work (Hmelo-Silver, Chernobilsky, & Jordan, 2008), which suggested specific benefits related to emphasizing domain-general skills that do not rely solely on specialized knowledge (Aguado, Rico, Sanchez-Manzanares, & Salas, 2014; Stevens & Campion, 1994, 1999).

Moreover, HEIs can also explicitly integrate the expanded skill set into curricular revisions. An example from the engineering field illustrates the implementation of curricular changes to include additional skills in the requirements for certification. In 2015, the Accreditation Board for Engineering and Technology changed the requirements of the engineering certification council curriculum to include an expanded skill set (Flaherty, 2015, para. 10). Charles N. Haas, a professor of environmental engineering and chair of civil, architectural, and environmental engineering at Drexel University, stated,

> Engineers can no longer afford to be the guys with pocket protectors and slide rules … . They need to be able to *interact* with people from *diverse communities* and understand and *meet their needs* and *communicate* with different constituencies as much as possible. (Flaherty, 2015, para. 3, emphasis added)

These examples illustrate skills that are generalizable across contexts and connected to authentic work-related contexts that, when taught and assessed, might lead to improvements in workplace performance (Association of American Colleges and Universities, 2007).

Implications of Expanding the Skill Set for Researchers and Assessment Developers

Kuh and Ikenberry (2009) suggested integrating broader skills not only in instruction but also in assessment practices, given the benefits of this inclusion for improving student learning (Ewell, 2009). Thus, in addition to the work done within HEIs, addressing and assessing these new skills has implications for those who work with colleges and universities, such as researchers and test developers. Such individuals can support pedagogical efforts by providing formative assessments — those that are administered to inform learning allow for frequent corrective feedback to point out students' mistakes and clear up misconceptions as students learn the course content.

Two examples illustrate these issues: Encouraging Positive Social Interaction while Learning ON-line (EPSILON) and Interactive Multi-Media Exercises (IMMEX), which combine advanced psychometric modeling (the use of

mixture models and latent classes) to inform assessment practices (Soller & Stevens, 2008). A combination of feedback-giving mechanisms, adaptive learning, and advanced psychometric models served to track and monitor students' online learning and information sharing while solving scientific problems. Findings indicated that existing technologies can assist instructors to mediate online student interactions, monitor student progress while learning, and provide feedback to guide student learning and inform students of the specific areas with which they are struggling.

Although assessment can help enhance teaching and learning of the expanded skill set, several challenges remain for future research and collaborations. One theme relates to improving our understanding of the types of mind-sets, skills, and behaviors gathered under overarching terms such as problem solving or collaboration. Ongoing research on these issues is important to continue to inform learning and the assessment of the expanded skill set. A second area of research is related to examining the types of items (scenario-based, simulations, situational judgments) that might be most suitable to assess the expanded skill set authentically. Typically, exemplars of the skills have been assessed using self-report items, which may be unable to capture students' actual skills but instead reflect the responses they think the evaluators are looking for. Other shortcomings and criticisms are provided by Markle, Wang, Sullivan, and Russell (2015) as well as Kyllonen and Bertling (2013) with a discussion on ways to devise more direct or "authentic" measures of the expanded skill set, particularly in relation to assessing culturally, linguistically, and ethnically diverse learners (Oliveri, Lawless, & Mislevy, 2016).

These types of challenges suggest the need to apply the principled assessment design process described in previous *A Culture of Evidence* reports, namely, evidence-centered design (ECD; Mislevy, Steinberg, & Almond, 2003), to those advanced skills discussed here (Oliveri et al., 2016). Promising assessment examples based on ECD models directed to the assessment of the expanded set of skills are the *HEIghten*® outcomes assessment suite. Among other skills, they assess critical thinking (Liu, Frankel, & Roohr, 2014), quantitative literacy (Roohr, Graf, & Liu, 2014), written communication (Sparks, Song, Brantley, & Liu, 2014), and civic competency and engagement (Torney-Purta, Cabrera, Crotts Roohr, Liu, & Rios, 2015). These are computer-delivered, modular, next-generation assessments that can support HEIs' goals by identifying areas for program and/or curricular improvement, identifying gaps in student SLOs, and gauging institutional performance. They can also help students understand their own strengths and challenges in the expanded skill set and demonstrate them to employers.

Implications for Public Policy

At the policy level, there are multiple ways that educational systems, state governments, and federal bodies can promote the teaching and learning of expanded skills in higher education. Many of these mechanisms likely involve supporting opportunities for students to acquire such skills in engaged learning activities. One example is the promotion of apprenticeships and work-study programs. A recent cost–benefit analysis of the use of apprenticeships revealed that the inclusion of assessments could greatly increase the utility of the apprenticeship model (Muehlemann & Wolter, 2014). The goals would be to identify ways in which to standardize the training received through apprenticeships as a way to provide apprentices with standardized and nationally recognized credentials for their efforts. To this end, active collaboration is needed from policy makers, the educational system, training regulations, and labor market institutions to address such issues. Such assessments may come before and after the apprenticeship to provide adequate, actionable data to help guide public policy.

Moreover, from an assessment perspective, the most likely action for policy makers is to include these skills in the systems that are used to evaluate or reward HEIs. For example, performance funding provided by the state of Tennessee includes metrics of student learning in general education (see Tennessee Higher Education Commission, 2010). Models such as this could be adapted to emphasize expanded skills and thus encourage institutions to make them a priority. In some instances, state educational systems and legislative bodies can influence the areas of learning on which HEIs focus, which has implications for the ways of articulating what students should know and be able to do. For example, the Collaborative for Academic, Social, and Emotional Learning (CASEL) has worked to expand states' K–12 curricula to include social and emotional learning outcomes in addition to more traditional academic ones (see Dusenbury, Weissberg, Goren, & Domitrovich, 2014). These types of initiatives can be helpful in ensuring that the learning and assessment of the expanded set of skills starts early and continues throughout one's education.

Conclusion

Throughout this report, we discussed the importance of expanding the skills upon which HEIs should focus. Committing to the skills that are common among the goals of higher education and the needs of the workforce can help enhance both college success and workforce preparation. As discussed, these skills include complex and integrative skills. Although the identification of the importance of such skills has been ongoing, their implementation in higher education still needs attention. These efforts can be guided through collaboration with researchers, test developers, employers, and other stakeholders.

We hope the suggestions provided here will enhance test development work in this area, providing tasks that clearly demonstrate skill acquisition. We suggested following ECD approaches to develop better measures of these skills (i.e., those that decrease threats to validity through response manipulation; cf. National Research Council, 2011) and engage in collaborations with HEIs to understand and obtain a comprehensive view of the effectiveness and usability of assessment data to meet key institutional, individual, and societal needs. These recommendations are not entirely novel, and in many cases, they reflect ongoing efforts at colleges and universities across the country. However, it is important that this work continues and grows. Higher education is notoriously slow to change, while simultaneously, it is a hub of innovation and intellectual capital. Through understanding the challenges it faces and the future ahead, colleges, universities, and their stakeholders can collaborate to meet the demands of a new environment and continue to serve as a pillar of our society.

References

Adelman, C., Ewell, P., Gaston, P., & Geary Schneider, C. (2014). *The degree qualifications profile*. Washington, DC: Lumina Foundation.

Aguado, D., Rico, R., Sanchez-Manzanares, M., & Salas, E. (2014). Teamwork Competency Test (TWCT): A step forward on measuring teamwork competencies. *Group Dynamics: Theory, Research, and Practice*, *18*, 101–121.

Assessment and Teaching of 21st Century Skills. (2012). *Our global team*. Retrieved from http://www.cisco.com/c/dam/en_us/about/citizenship/socio-economic/docs/ATC21S_Exec_Summary.pdf

Association of American Colleges and Universities. (2007). *College learning for the new global century: A report from the National Leadership Council for Liberal Education and America's promise*. Washington, DC: Author. Retrieved from https://www.aacu.org/sites/default/files/files/LEAP/GlobalCentury_final.pdf

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The skill content of recent technological change: An empirical exploration. *Quarterly Journal of Economics*, *118*, 1279–1334.

Baepler, P., Walker, J. D., & Driessen, M. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers & Education*, *78*, 227–236.

Burning Glass. (2014). *Moving the goalposts: How demand for a bachelor's degree is reshaping the workforce*. Boston, MA: Author. Retrieved from http://burning-glass.com/wp-content/uploads/Moving_the_Goalposts.pdf

Burrus, J., Jackson, T., Xi, N., & Steinberg, J. (2013). *Identifying the most important 21st century workforce competencies: An analysis of the occupational information network (O*NET)* (Research Report No. RR-13-21). Princeton, NJ: Educational Testing Service. 10.1002/j.2333-8504.2013.tb02328.x

Casner-Lotto, J., & Benner, L. (2006). *Are they really ready to work?* Washington, DC: Partnership for 21st Century Skills.

Chen, G., Donahue, L. M., & Klimoski R. J. (2004). Training undergraduates to work in organizational teams. *Academy of Management Learning & Education*, *3*, 27–40.

Coley, R. J., Goodman, M. J., & Sands, A. M. (2015). *America's skills challenge: Millennials and the future*. Princeton, NJ: Educational Testing Service. Retrieved from http://www.ets.org/s/research/30079/asc-millennials-and-the-future.pdf

Davis, A., Kimball, W., & Gould, E. (2015). *The class of 2015*. Washington, DC: Economic Policy Institute. Retrieved from http://www.epi.org/files/2015/the-class-of-2015-revised.pdf

Dickens, C. (1854). *Hard times – For these times*. London, England: Bradbury & Evans.

Dusenbury, L., Weissberg, R., Goren, P., & Domitrovich, C. (2014). *State standards to advance social and emotional learning*. Chicago, IL: Collaborative for Academic, Social, and Emotional Learning. Retrieved from http://www.casel.org/wp-content/uploads/2016/06/casel-brief-on-state-standards-january-2014.pdf

Dwyer, C. A., Millett, C. M., & Payne, D. G. (2006). *A culture of evidence: Postsecondary assessment and learning outcomes*. Princeton, NJ: Educational Testing Service.

Educational Testing Service. (2016). *America's skills challenge: Millennials and the future*. Retrieved from https://www.ets.org/s/research/29836/

Ewell, P. T. (2009). *Assessment, accountability, and improvement: Revisiting the tension* (National Institute of Learning Outcomes Assessment Occasional Paper No. 1). Retrieved from http://www.learningoutcomesassessment.org/documents/PeterEwell_005.pdf

Flaherty, C. (2015, June 26). Watered-down gen ed for engineers? *Inside Higher Education*. Retrieved from https://www.insidehighered .com/news/2015/06/26/faculty-members-criticize-proposed-changes-gen-ed-accreditation-standards-engineers

Friedman, T. L. (2006). *The world is flat: A brief history of the twenty-first century* (updated and expanded ed.). New York, NY: Macmillan.

Hart Research Associates. (2010). *Raising the bar: Employers' views on college learning in the wake of the economic downturn*. Washington, DC: Association of American Colleges and Universities.

Hmelo-Silver, C. E., Chernobilsky, E., & Jordan, R. (2008). Understanding collaborative learning processes in new learning environments. *Instructional Science*, *36*, 409–430. doi: 10.1007/s11251-008-9063-8

Johnston, C. G., James, R. H., & Lye, J. N. (2000). An evaluation of collaborative problem solving for learning economics. *Journal of Economic Education*, *31*(1), 13–29. doi: 10.1080/00220480009596758

Kirsch, I., Braun, H., Yamamoto, K., & Sum, A. (2007). *America's perfect storm: Three forces changing our nation's future*. Princeton, NJ: Educational Testing Service.

Kuh, G., & Ikenberry, S. (2009). *More than you think, less than we need: Learning outcomes assessment in American higher education*. Retrieved from http://www.learningoutcomeassessment.org/documents/niloafullreportfinal2.pdf

Kyllonen, P. C., & Bertling, J. P. (2013). Innovative questionnaire assessment methods to increase cross-country comparability. In L. Rutkowski, M. von Davier, & D. Rutkowski, (Eds.), *Handbook of international large-scale assessment: Background, technical issues, and methods of data analysis* (pp. 277–285). Boca Raton, FL: CRC Press.

Laursen, S. L. (2013, November). *From innovation to implementation: Multi-institution pedagogical reform in undergraduate mathematics*. Paper presented at Lighthouse Delta 2013: The 9th Delta Conference on Teaching and Learning of Undergraduate Statistics, Kiama, Australia.

Levy, F. (2010). *How technology changes demands for human skills* (OECD Education Working Paper No. 45). Retrieved from http://www.oecd.org/edu/skills-beyond-school/45052661.pdf

Levy, F., & Murnane, R. J. (2004). *The new division of labor: How computers are creating the next job market*. Princeton, NJ: Princeton University Press.

Liu, O. L., Frankel, L., & Roohr, K. C. (2014). *Assessing critical thinking in higher education: Current state and directions for next-generation assessment* (Research Report No. RR-14-10). Princeton, NJ: Educational Testing Service. 10.1002/ets2.12009

Manyika, J., Lund, S., Auguste, B., Mendonca, L., Welsh, T., & Ramaswamy, S. (2011). *An economy that works: Job creation and America's future*. Retrieved from http://www.mckinsey.com/~/media/McKinsey/Global%20Themes/Employment%20and%20Growth/An%20economy%20that%20works%20for%20US%20job%20creation/MGI_US_job_creation_full_report.ashx

Markle, R., Brenneman, M., Jackson, T., Burrus, J., & Robbins, S. (2013). *Synthesizing frameworks of higher education student learning outcomes* (Research Report No. RR-13-22). Princeton, NJ: Educational Testing Service. 10.1002/j.2333-8504.2013.tb02329.x

Markle, R. E., Wang, Z., Sullivan, T., & Russell, J. A. (2015, April). *Myths and realities: Effort and response distortion in low-stakes, self-report assessments of noncognitive skills*. Paper presented at the meeting of the American Educational Research Association, Chicago, IL.

Mislevy, R. J., Steinberg, L. S., & Almond, R. G. (2003). Focus article: On the structure of educational assessments. *Measurement: Interdisciplinary Research and Perspectives*, *1*, 3–62.

Muehlemann, S., & Wolter, S. C. (2014). Return on investment of apprenticeship systems for enterprises: Evidence from cost-benefit analyses. *IZA Journal of Labor Policy*, *3*(1), 1–22.

National Research Council. (2011). *Assessing 21st century skills: Summary of a workshop*. Washington, DC: National Academies Press.

National Research Council. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Washington, DC: National Academies Press.

Oliveri, M. E., Lawless, R. R., & Mislevy, R. J. (2016, April). *A construct-centered approach to assessing collaborative problem solving*. Paper presented at Fairness Issues and Validation of Non-cognitive Skills Symposium conducted at the meeting of the National Council on Measurement in Education, Washington, DC.

Oswald, F. L., Schmitt, N., Kim, B. H., Ramsay, L. J., & Gillespie, M. A. (2004). Developing a biodata measure and situational judgment inventory as predictors of college student performance. *Journal of Applied Psychology*, *89*, 187–207.

Pellegrino, J. W., & Hilton, M. L. (2013). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Washington, DC: National Academies Press. Retrieved from http://www.p21.org/storage/documents/Presentations/NRC_Report_Executive_Summary.pdf

Peterson, S. E., & Miller, J. A. (2004). Comparing the quality of students' experiences during cooperative learning and large-group instruction. *Journal of Educational Research*, *97*(3), 123–134.

Rampell, C. (2014, September 9). The college degree has become the new high school degree. *Washington Post*. Retrieved from http://www.washingtonpost.com/

Roohr, K. C., Graf, E. A., & Liu, O. L. (2014). *Assessing quantitative literacy in higher education: An overview of existing research and assessments with recommendations for next-generation assessment* (Research Report No. RR-14-22). Princeton, NJ: Educational Testing Service. 10.1002/ets2.12024

Secretary's Commission on Achieving Necessary Skills. (1991). *What work requires of schools: A SCANS report for America 2000*. Washington, DC: U.S. Department of Labor.

Soller, A., & Stevens, R. (2008). Applications of stochastic analyses for collaborative learning and cognitive assessment. In G. R. Hancock & K. M. Samuelson (Eds.), *Advances in latent variable mixture models* (pp. 109–111). Charlotte, NC: Information Age.

Sparks, J. R., Song, Y., Brantley, W., & Liu, O. L. (2014). *Assessing written communication in higher education: Review and recommendations for next-generation assessment* (Research Report No. RR-14-37). Princeton, NJ: Educational Testing Service. 10.1002/ets2.12035

Spence, A. M. (1973). Job market signaling. *Quarterly Journal of Economics*, *87*, 355–374.

Stevens, M. J., & Campion, M. A. (1994). The knowledge, skills and ability requirements for teamwork: Implications for human resources management. *Journal of Management*, *20*, 502–528.

Stevens, M. J., & Campion, M. A. (1999). Staffing work teams: Development and validation of a selection test for teamwork settings. *Journal of Management*, *25*, 207–228.

Strayhorn, T. L. (2006). *Frameworks for assessing learning and development outcomes*. Washington, DC: Council for the Advancement of Standards in Higher Education.

Tennessee Higher Education Commission. (2010). *2010–2015 Performance funding quality assurance guidebook.* Retrieved from https://www.roanestate.edu/webfolders/wallaceda/oier/reports/performance-funding/2010-15_Cycle_Standards.pdf

Torney-Purta, J., Cabrera, J. C., Crotts Roohr, K., Liu, O. L., & Rios, J. A. (2015). *Assessing civic competency and engagement in higher education: Research background, frameworks, and directions for next-generation assessment* (Research Report No. RR-15-34). Princeton, NJ: Educational Testing Service. 10.1002/ets2.12081

U.S. Department of Education. (2006). *A test of leadership: Charting the future of U.S. higher education*. Washington, DC: Author.

Weiss, A. (1995). Human capital vs. signaling explanation of wages. *Journal of Economic Perspectives*, *9*(4), 133–154.