How a New Focus for Learning Analytics Could Transform the Relationship Between Learning and Employment

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How a New Focus for Learning Analytics Could Transform the Relationship Between Learning and Employment

How can we use student data to provide insights that can improve the pipeline from higher education to students' future jobs?

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Abstract

Based on an NSF-funded workshop, we discuss learning analytics goals and research priorities for the coming decade. We report on a research agenda that would intensify the connection between learning analytics and recognition of learner competencies. This could have a transformative impact on the relationship between higher education and employment. This agenda is not a straightforward application of today's learning analytics, but requires investigation of entirely new analytic approaches. The agenda will generate significant new research questions leading to insights about learning and the data science techniques for analyzing learning.

Keywords

Learning analytics, post-secondary, people analytics, employment

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Introduction

Employers for most sectors of the economy hire university graduates but are disappointed with the usefulness of a college transcript for indicating what a graduate can do in a realistic work context. There is a need for more relevant credentials that support the pathway from higher education into the workforce. Although the existing university framework of courses and end-of-course grades are unlikely to change soon, students are increasingly engaging with educational technology for various formal and informal learning activities. When students utilize these platforms (e.g., learning management systems, online textbooks, groupware, etc.), they do work which results in data that is evidence for the skills and competencies they have. For example, students demonstrate how they can *lead a team* through the actions they take online while doing coursework. This data could be analyzed to produce additional credentials that a student could earn during their university coursework and which could dramatically increase their attractiveness to employers.

Learning analytics is a growing field which analyzes the data produced as students participate in an online course. However, to date, the main focus of learning analytics in higher education has been on predicting course dropout and on improving course performance. What is needed is a new research focus that connects the tools of learning analytics to the problem of recognizing students' competencies based on evidence generated as they learn.

A central goal of the workshop was to explore new ways to use the powerful tools in data science (machine learning, social network analysis, analytics and visualization of complex data, temporal, multi-scale and statistical models, integration of heterogeneous data, data scrubbing, wrangling and provenance tracking, data

privacy and cybersecurity) to strengthen our ability to define competence, to measure it, and to build it.

This research agenda would intensify the connection between learning analytics and competencies and could have a transformative impact on the relationship between higher education and employment. It is not an straightforward application of today's learning analytics, but requires investigation of entirely new analytic approaches -- and thus we foresee a significant new set of research questions arising and leading to new insights about learning and data science techniques for analyzing learning.

Skills and competence gained *outside* of formal classrooms are critical -- particularly

since people frequently change jobs during their careers. Many talented people fare poorly in traditional testing environments. Research in these areas is urgently needed so that institutions of higher education can become a more effective partner in creating productive career paths. Research is also essential because the dangers of using huge volumes of information about individuals creates unforeseen ways that it can impact their futures. Issues of privacy, the risk of embedding prejudices into algorithms, and many other hazards need careful and open discussion that only academic research can fully address.

Workshop attendees

 The workshop brought together individuals with expertise in a wide range of disciplines to define research priorities in learning analytics for the coming decade.

Increasing volumes of information about an individual's competence are available both from activities in educational institutions and in the workplace. These include both what the individual can do and the demonstrated competence in non-technical areas such as communicating and collaborating. There has been massive growth in the use of these tools in business recruitment in recent years, often called "people analytics," but most of the innovation and research has been conducted by private firms and much of the work remains proprietary.

To build a bridge between the academic scholars of learning with experts from the private and not-for-profit sectors, the invited participants had expertise in cognitive and behavioral sciences, instructional design, and expertise in specific disciplines. The participants also included data scientists who have made dramatic contributions in other parts of the economy, and people in business and not-for-profit organizations who have made major investments utilizing various data science methods for defining and measuring workplace competence.

Attendees were selected to include academic experts in a variety of disciplines (including education, information science, behavioral science, and academic administration), researchers working in companies helping employers define needed competencies and identify applications with needed skills, and individuals from NGOs doing work that provided perspective on state-of-the-art efforts to improve the way competence is defined and measured. The workshop was designed to facilitate communication between these research communities.

Workshop structure

The workshop, which was held on March 18-19, 2019, was one of a series of nine synthesis and design meetings that the National Science Foundation (NSF) funded to focus on issues essential to future learning environments.

The challenges of understanding how to define competence, measure it, and develop it are clear and merit close attention by employers and educational institutions. New technologies themselves bring some powerful new tools to the task. New sources of data and new tools for translating data into actionable insights may provide powerful new ways to define and measure needed competence and to evaluate new strategies for building competence.

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The workshop focused on using new sources of data and advanced analytics to address three key research questions:

1. How can we define the educational outcomes, competencies, and habits of mind that are goals for higher education?

2. How can these competencies be measured and communicated?
3. How can innovations in approaches to learning (technology and pedagogy) be Evaluated?

The first morning of the workshop featured public presentations from six invited speakers, with two speakers each addressing one of three topics. Topic 1 was **Defining Competence**, with presentations from Marie Cini (President and CEO, The Council for Adult and Experiential Learning) and David Blake (CEO, Degreed). Topic 2 was **Measuring Competence**, with presentations from Bror Saxberg (Vice President, Learning Science at Chan Zuckerberg Initiative) and Tammy Wang (Vice President of Data Science and Analytics at Riviera Partners). Topic 3 was **Evaluating New Approaches to Learning**, with presentations by Norman Bier (Director, Open Learning Initiative, DataLab, Carnegie Mellon) and Yun Jin Rho (Director, Efficacy Analytics and Studies, Pearson).

After the morning presentations, the 24 invited workshop participants spent the afternoon in a series of breakout discussion sessions. Participants rotated through the three topics during the afternoon, where they were invited to address each topic and provide input into how data science and

analytics might be applied to defining, measuring, and evaluating competence. To stimulate the discussions, a set of prompts were provided to the participants and note-takers captured the main points generated by the groups.

For research question 1, the prompts included:
- Can post-secondary institutions get access to data on employee activities and use it to gain insights into the competencies and expertise actually valued in the workforce?
- How can collaborations between academic research and corporate "people analytics" research best be managed?
- Can the tools of "people analytics" be expanded to help define the habits of thought and the problem solving skills of experts in academic disciplines (what does it mean to "think like an engineer"?)

For research question 2, the prompts included:
- What tools can be developed to learn from the increasingly rich set of data trails generated by students – including use of instructional technologies, online-discussions with colleagues and instructors – to understand their approach to desired levels of competence.
- Can this include both subject area competence and skills such as critical thinking, team participation, and communication?
- Can the tools of "people analytics" be applied to capture a richer measure

of each student's approach to meeting achievement goals?

For research question 3, the prompts included:
- Can tools such as adaptive rapid experimental design be used to evaluate the impact of innovations in instructional design?
- How can individual student data be used to guide instruction tailored to each student and provide individualized advice, and counseling?
- What data should be collected about each student (demographics, fine grained indicators of mastery and deficiencies, skills in online and other interactions including team performance and ability to communicate, English language skills, other measures)?
- Can this portfolio be built and curated like personal medical records (e.g. distinct access and consent rules for instructors, instructional software, and researchers)?

Susan Singer (Vice President for Student Affairs and Provost, Rollins College) wrapped up the day with remarks about how learning analytics can be a driver for competency-based learning.
The workshop participants continued discussion in the morning of the second day to further refine ideas generated during the prior day. The program concluded with the invited speakers reflecting on the group discussions and the research priorities generated during the workshop.

Key issues

Most of the workshop discussion explored the link between education and employment. This is not to deny that the core goal of education will always be enriching each individual's life …. But the current problems in defining and measuring competence is being driven by an increasing percentage of people needing access to higher education for employment, and the growing need to refresh skills and learn new ones throughout a career. The insights gained in the workshop regarding the current and potential future use of data and advanced analytics for defining, measuring and communicating competencies are presented below.

Reimagine higher education outcomes and skills

Defining the competencies needed by employers is increasingly difficult. Studies of job requirements show a steady increase in the level of "substantive complexity" of jobs (cognitive demand, analytical reasoning, and synthetic reasoning) and an increasing demand for "interactive skills" (negotiating, instructing, persuading, speaking, taking instructions).

· Technology, trade, and other forces are continuously reshaping the workplace and the role that humans play. About half of the increases in skill requirements that resulted came from changes in industry structure and half from changes in demand for different skill levels within each industry groupings.

· Since the specific skills needed for employment are almost certain to change over the course of a person's career, there is also a clear need to define lifelong learning.

· Private employers are attempting to improve their definitions of competency using new sources of data and new analytic methods to better understand the characteristics of most effective employees.

· The rapidly growing field of "People Analytics" is attempting to use advanced data analytic techniques to develop a variety of strategies for both understanding the characteristics of highly successful performers and to trying to identify these competencies in job applicants.

Develop new ways to measure and communicate competencies

There are two central challenges for measuring and communicating competencies: (1) measures gathered in a formal learning environment that have a strong correlation with competence in future jobs or courses, and (2) ways to evaluate and credential competence gained outside of a formal learning environment.

- Measuring competence requires both a clear definition of the desired competency, a theory about how a person can acquire and demonstrate the competency, and a rich set of information about the way each individual learns.

- There is a growing interest in a portfolio of credentials that

demonstrate specific areas of competence. It is possible that for all but the most elite institutions, degrees will be replaced with a set of "unbundled" credentials (representing competencies) that are constantly being refreshed.

Two thirds of employers did not ask recent college graduates for their transcripts.

Evaluate innovative approaches to learning

Most business sectors have seen market forces transform their business models to make full use of new information technologies, but markets in education are dramatically different. The complex mixture of public and private investments in education, and their unique mix of public and private benefits, has created a dramatically different dynamic.

- Even if there were clear metrics of educational success, few post-secondary institutions have the resources needed to make full use of the new technologies needed for measurement.

- A number of groups are developing programs that use the extensive information developed by learning technology systems to continuously improve the methods of instruction as well as tracking student progress.

- The tools used to assess an individual's approach to a desired level of competence can also be useful in measuring an individual's emotional state, motivation, or other factors that would be useful to the people (and software) involved in instruction and counseling (Pardo et al., 2015). Tools are being developed to understand how existing data from

students can tailor instruction to increase the likelihood of success for the widest range of students.

· The medical profession has also made extensive use of simulation and invested in some sophisticated assessments. A major statistical analysis conducted by the National Council of State Boards of Nursing which concluded that there is

"...substantial evidence that substituting high-quality simulation experiences for up to half of traditional clinical hours produces comparable end-of-program educational outcomes and new graduates that are ready for clinical practice" (Hayden et al., 2014).

Recommendations for future work

Post-secondary education is increasingly important for prospering in a modern economy and for the economy itself. Technical changes and globalization change the competencies needed, and the rate of change is likely to accelerate. However, the pace of change has far outstripped the ability of the research community to understand and support innovation, to explore the impact and utility of new data sources and analytic methods, and to prepare for potential liabilities in data privacy.

In the **near term,** design an aggressive research program that draws on the expertise of many different academic disciplines including education research, data science and analytics, and subject matter experts, including technical fields, social sciences, and the humanities. This research would be centered around how new tools – including the power of new ways to gather and analyze data – make it possible to redesign higher education so that more students can achieve the education they want, when they want it, where they want it, and in a form tailored to their individual needs and those of the workforce..

In the **longer term**, research should consider how to support potentially dramatic changes in the way education and work are connected. The model of 12-20+ years accumulating knowledge before a career and then coasting on this knowledge for a lifetime is unlikely to survive.

Priorities include:

● **Strong partnerships**: The research should draw on multiple disciplines and close the gap separating public and private research work.
● **Explore competencies demonstrated in educational and**

non-educational settings.
Define the skills actually needed in different occupations and help convert competence gained at work to academic credentials.
- **Validated credentials**: Need to validate credentials.
- **Privacy and security**: Privacy and security of personal information must be core in research; participants must know how data will be used.
- **Careful use of artificial intelligence** Machine learning will play a key role in defining, measuring, and building competence but care must be taken to avoid its dark side: the very real possibility that data used to train the system is burdened by historic biases that could be incorporated in new tools or their applications.

A research program capable of meeting these ambitious goals will not be easy to design or implement. But It is hard to find any set of research issues that are more important as we hurdle into a world where continuous learning is essential to individual and national prosperity.

For further information about this workshop, our discussion, and citations for statistics and quotes, please read the full white paper.

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