APPLYING LEARNING SCIENCE AND MACHINE LEARNING TO CLOSE EQUITY GAPS AND IMPROVE CAREER READINESS

From University of Texas Arlington

Marilee Bresciani Ludvik

Kimshi Hickman

Catherine Robert

Amanda Olsen

Pete Smith

Elizabeth Powers

Henry Anderson

Farhan Fahim

Ashley Purgason

Denisse Avila

Mitch Strahlman

Danielle Klein

From SDSU:

Stephen Schellenberg

Sandra Kahn

Nina Potter

Lisa Gates

From UT Health Sciences Center:

Shiming Zhang

What drew you To this session?

How is your institution applying
* learning science
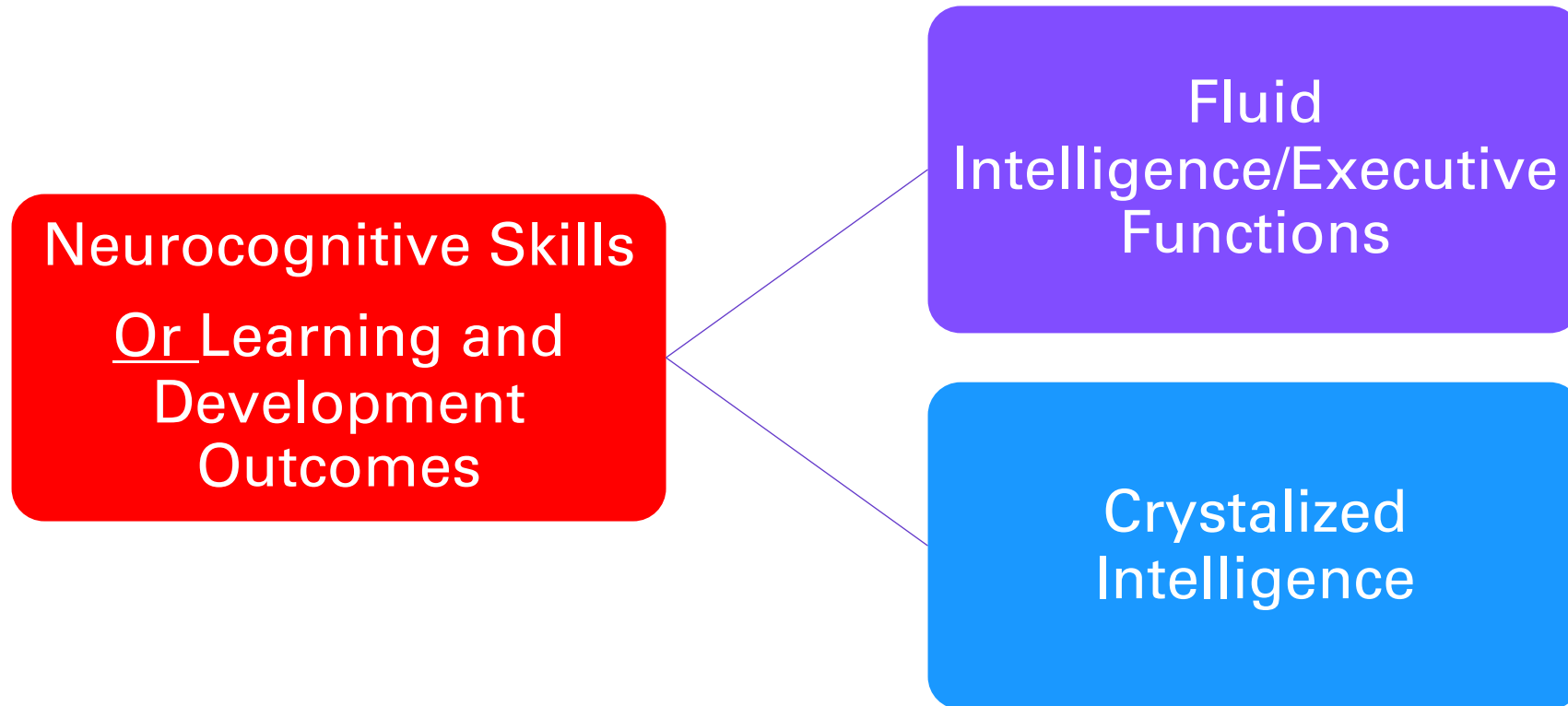*** machine learning**
to close equity gaps?
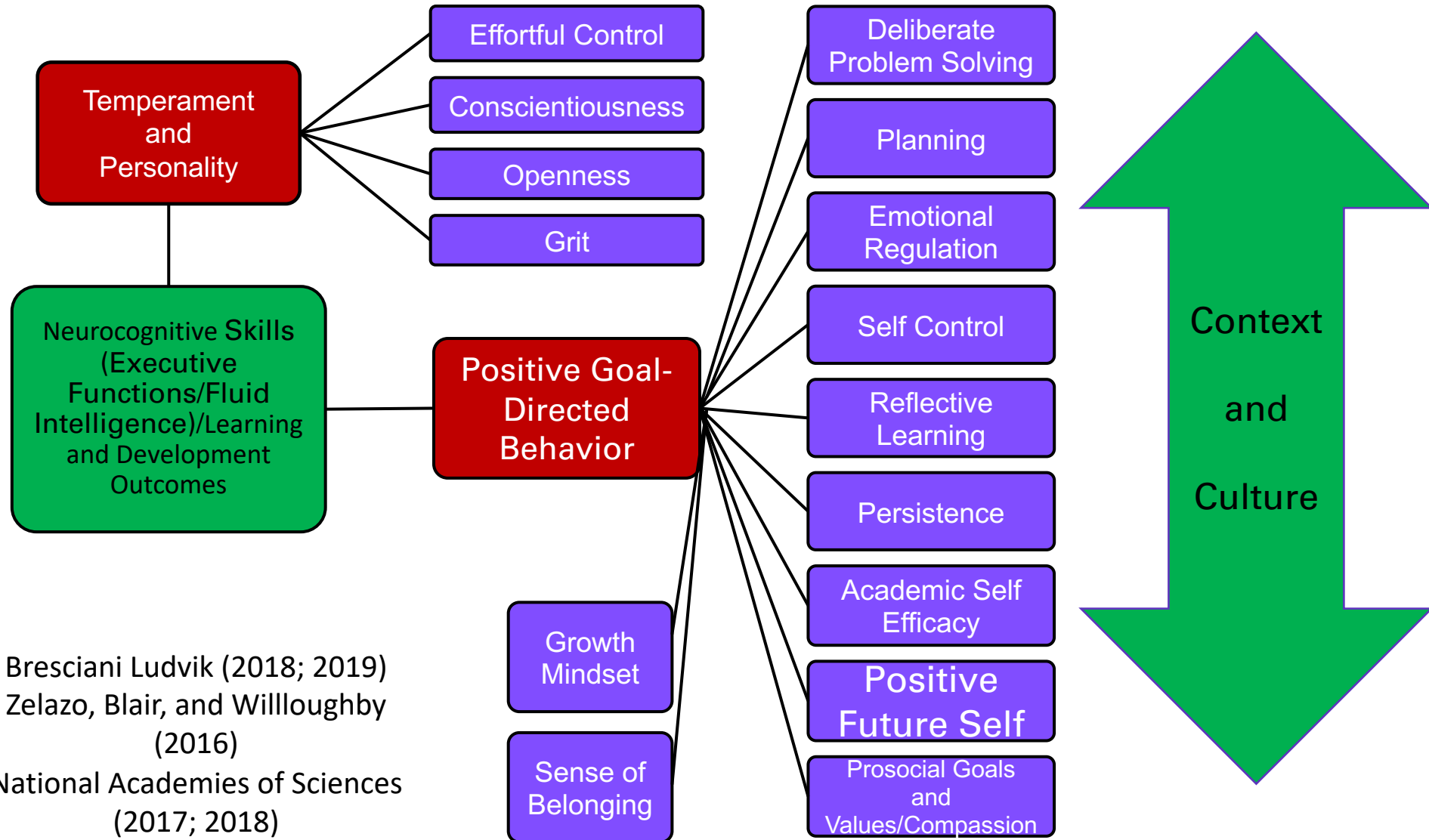
CONTEXT SETTING:

LEARNING SCIENCE as NEURODIVERSITY

- Learning and Development are inextricably intertwined
- Student Learning Imperative, 1996

Learning and Development as
Neurocognitive Skills
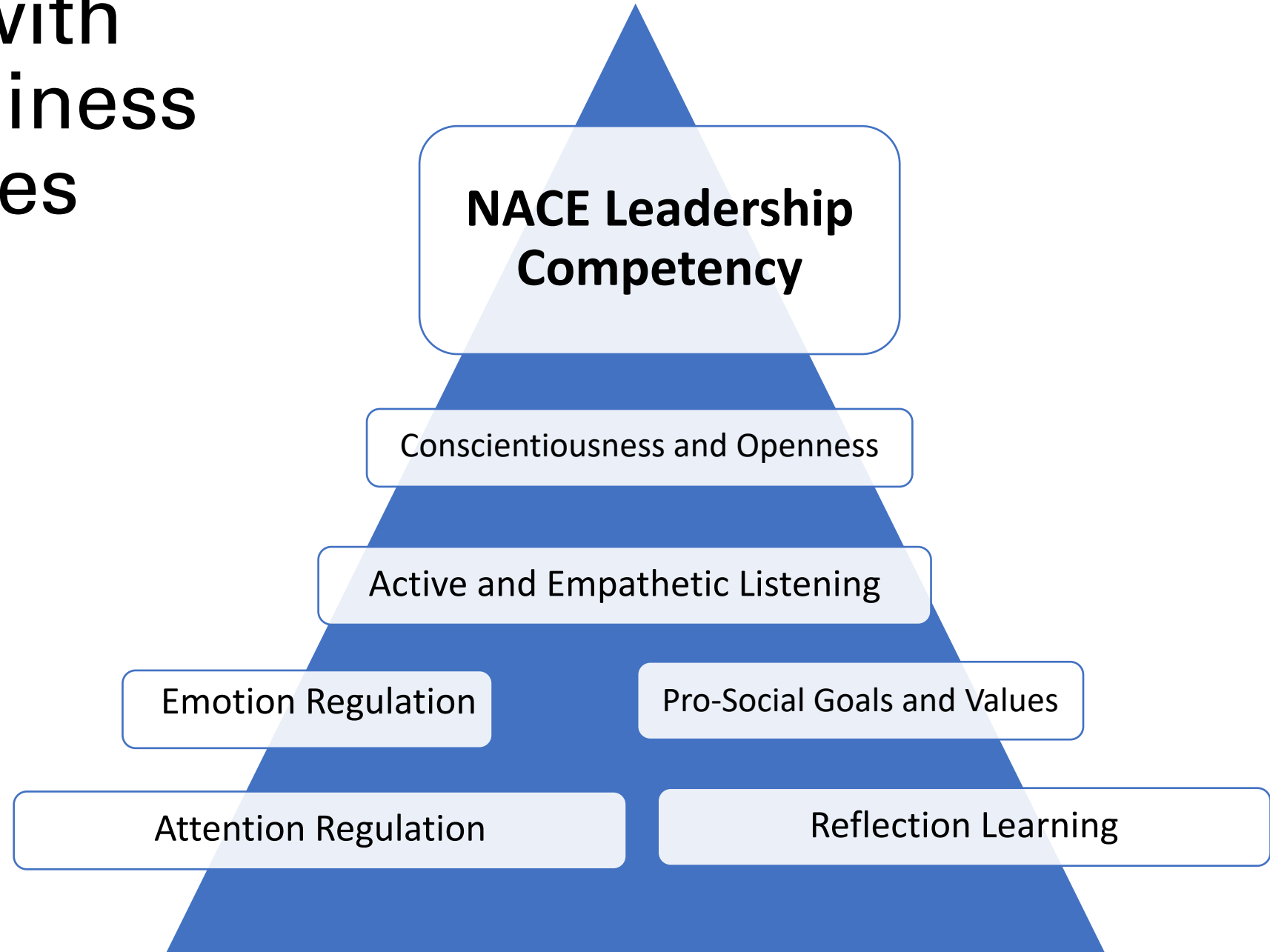(Bresciani Ludvik, 2018; Zelazo, Blair, and Willloughby, 2016)

Neurocognitive Skills

Or Learning and Development Outcomes

Fluid Intelligence/Executive Functions

Crystalized Intelligence

Map of Fluid Intelligence/Executive Functions to Specific Learning and Development Outcomes

Temperament and Personality
- Effortful Control
- Conscientiousness
- Openness
- Grit

Neurocognitive Skills (Executive Functions/Fluid Intelligence)/Learning and Development Outcomes

Positive Goal-Directed Behavior
- Deliberate Problem Solving
- Planning
- Emotional Regulation
- Self Control
- Reflective Learning
- Persistence
- Academic Self Efficacy
- Positive Future Self
- Prosocial Goals and Values/Compassion
- Growth Mindset
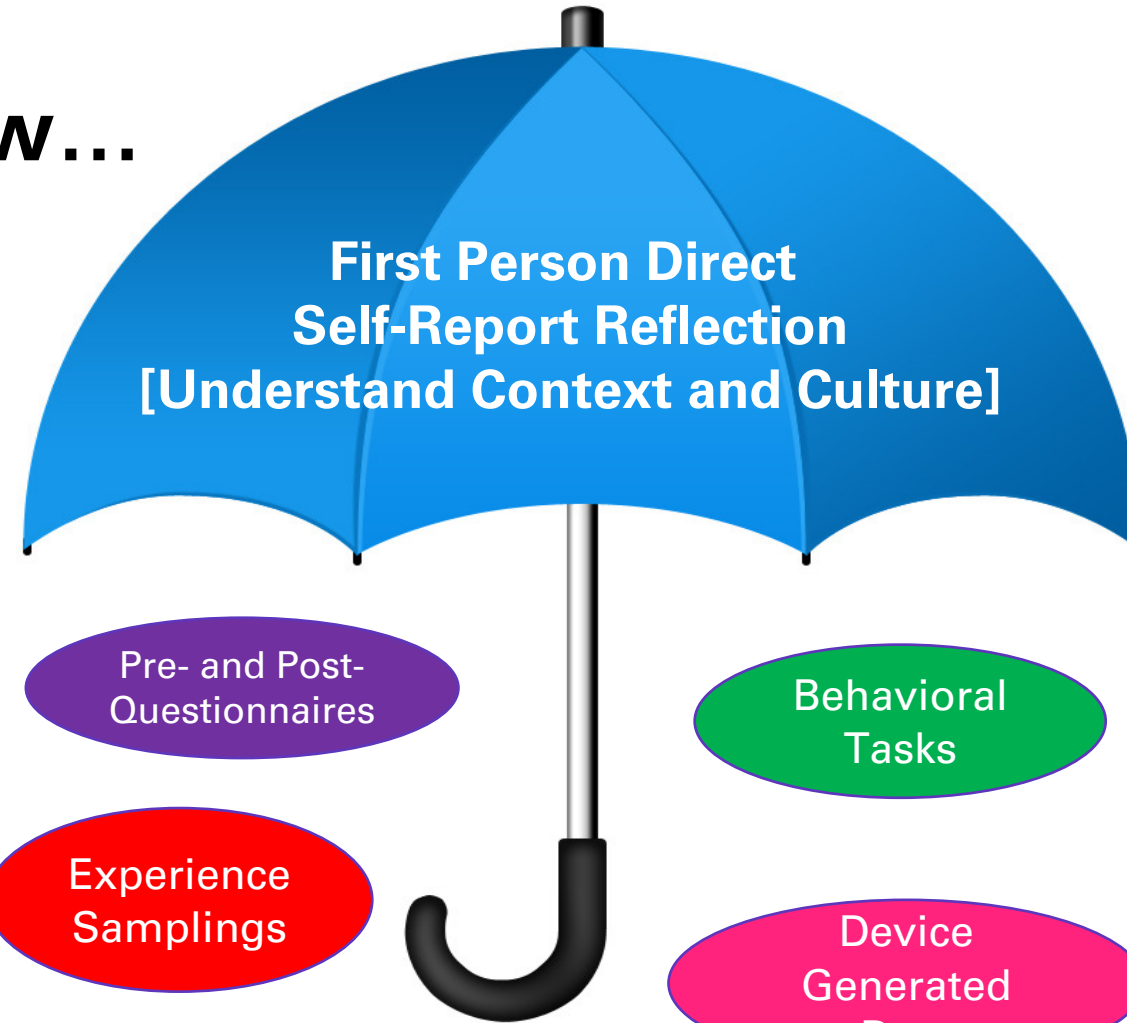- Sense of Belonging

Context and Culture

Bresciani Ludvik (2018; 2019)
Zelazo, Blair, and Willloughby (2016)
National Academies of Sciences (2017; 2018)

Alignment with Career Readiness Competencies

See Table 1 for
More Details

How Do We Know…

**First Person Direct
Self-Report Reflection
[Understand Context and Culture]**

Examples include:
BAI; PSS; FFMQ;
MDCS, etc

Pre- and Post-
Questionnaires

Behavioral
Tasks

Assessed
activity/assignment
where behaviour
can be observed
either
<u>within</u> the designed
 "intervention" or
outside of

Experience
Samplings

Device
Generated
Data

Reflective Practice - Describe in detail where
emotion regulation was experienced –
<u>within</u> or outside the designed "intervention" and 360
observations

Not Applicable Here

(Bresciani Ludvik 2020)
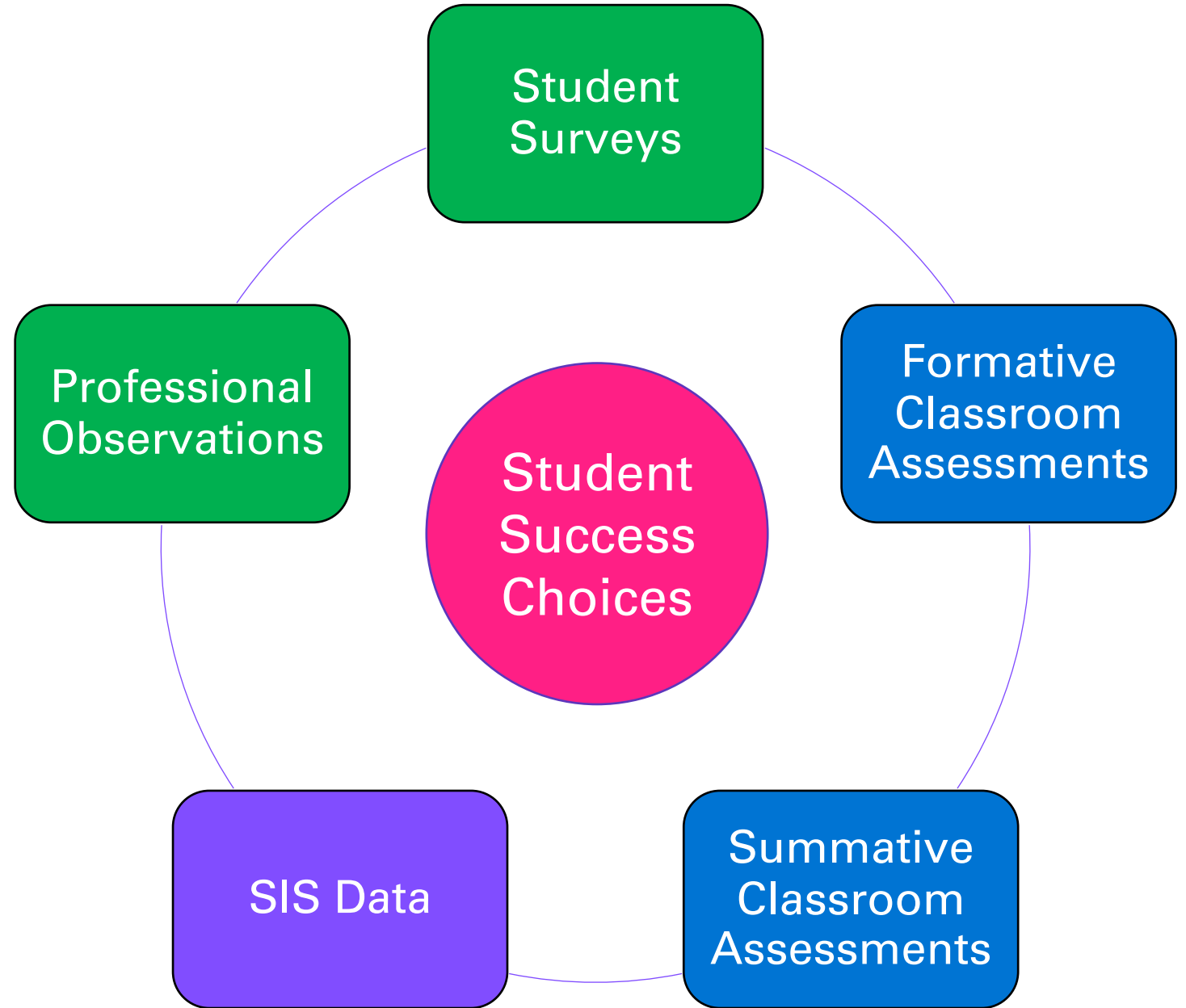
Learning Analytics

- Using and analyzing data about learners and their contexts, to understand and improve learning and learning environments.

- Highly interdisciplinary: educational research, data mining, machine learning, statistics, software design, domain expertise…

https://www.solaresearch.org/about/what-is-learning-analytics/
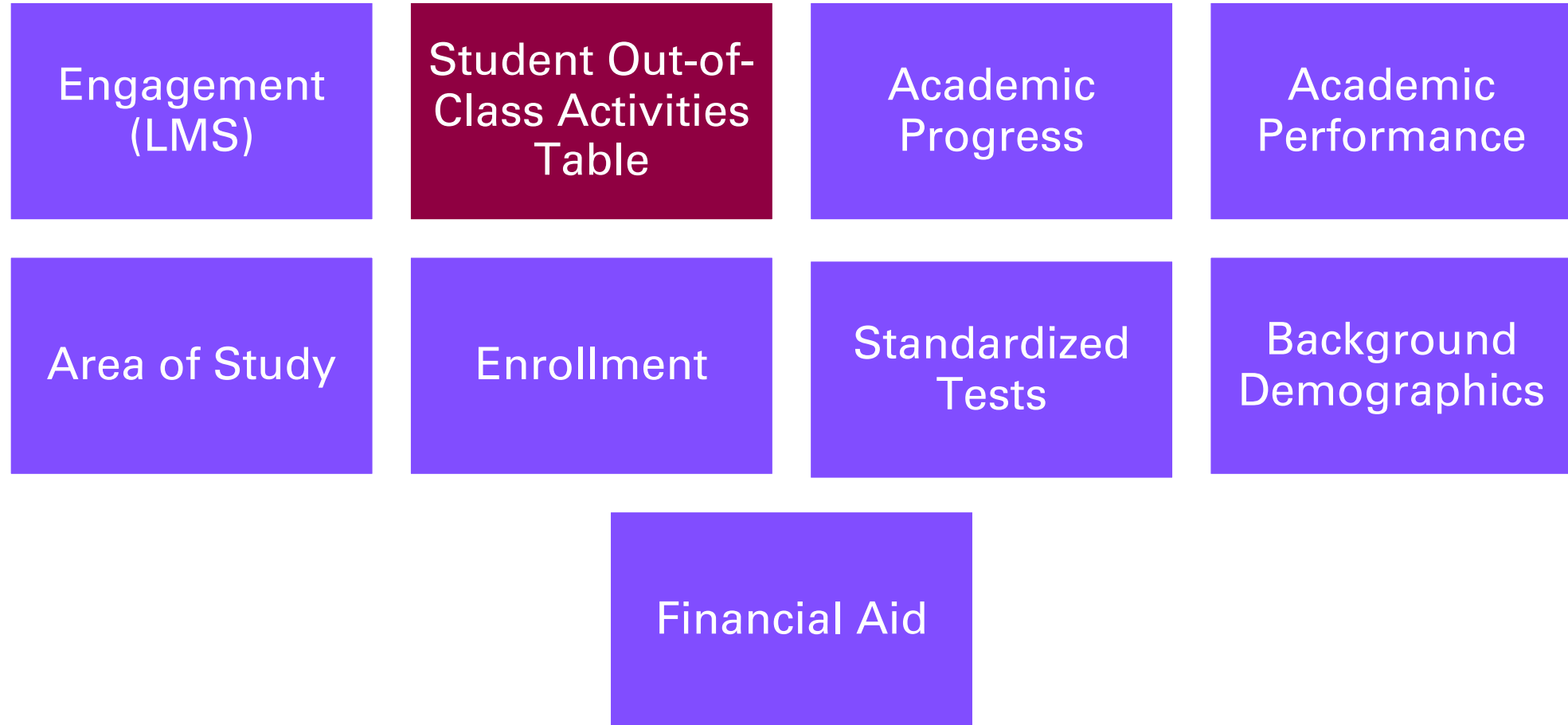
Current Data-Driven Process to Advance Student Success

(Bresciani Ludvik, 2021)

Civitas Learning Analytic Data Example

Engagement (LMS)

Student Out-of-Class Activities Table

Academic Progress

Academic Performance

Area of Study

Enrollment

Standardized Tests

Background Demographics

Financial Aid

Challenges we are Giving Ourselves

How do we bring more first-person direct student voice to the learning analytic modeling?

How do we bring in- and out-of-class professional observations to the learning analytic modeling?
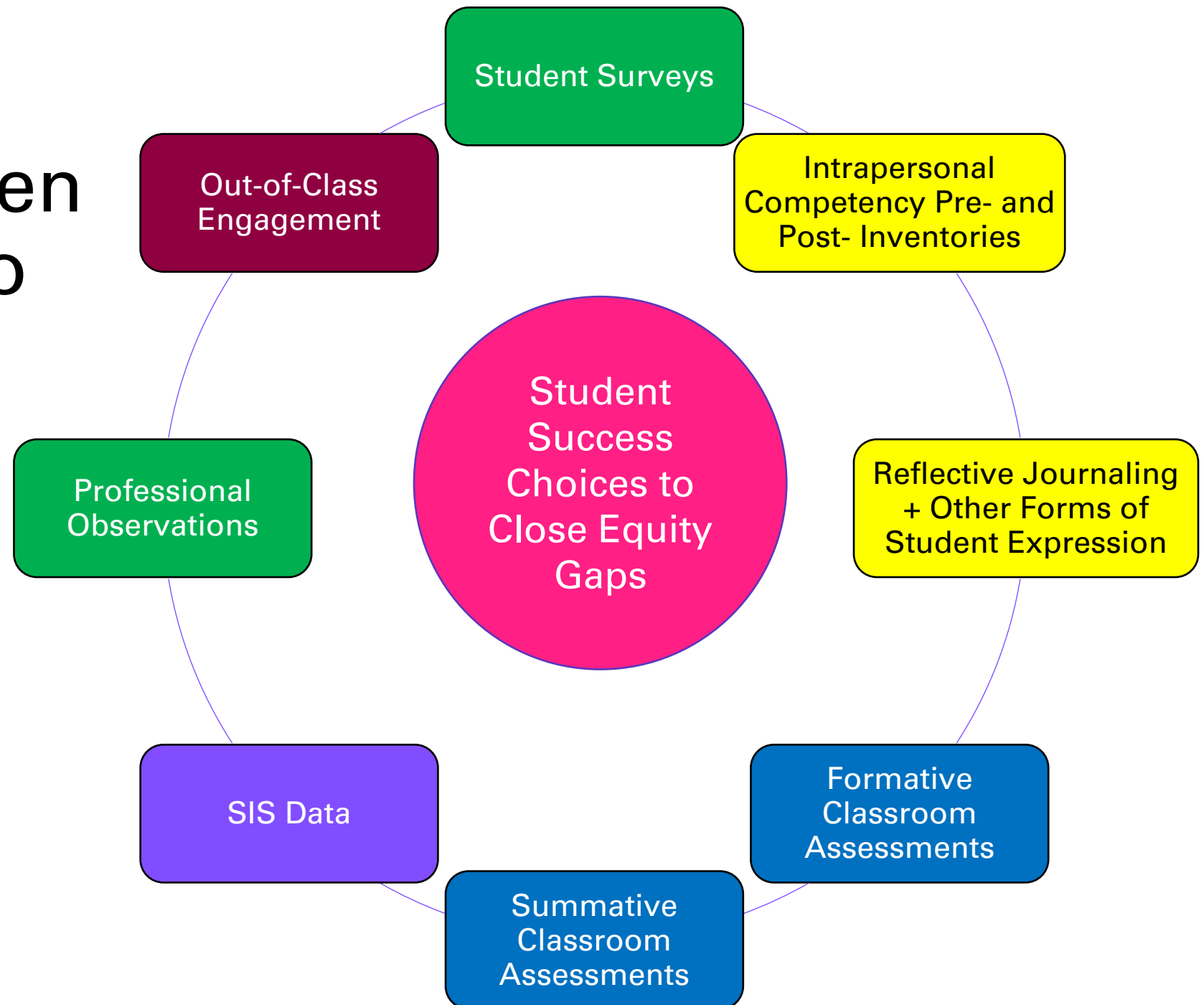
How do we bring out-of-class engagement experiences to the learning analytic modeling?

How do we ensure that our work is ethical, respects students' privacy, and does no harm?

Proposed Data-Driven Process to Advance Student Success

(Bresciani Ludvik, 2021)

Student Surveys

Out-of-Class Engagement

Intrapersonal Competency Pre- and Post- Inventories

Professional Observations

Student Success Choices to Close Equity Gaps

Reflective Journaling + Other Forms of Student Expression

SIS Data

Summative Classroom Assessments

Formative Classroom Assessments

Adding Out-of-Class Engagement and Professional Observations to Learning Analytics

Type of Out-of-Class Student Engagement/Activity	Frequency of Out-Class Student Engagement Activity	Type of HIP	Frequency of HIP

Type of Advising Appointment/Student Success Coaching Appointment	Frequency of Advising Appointment/Student Success Coaching Appointment	Outcomes of Advising Appointment/Student Success Coaching Appointment
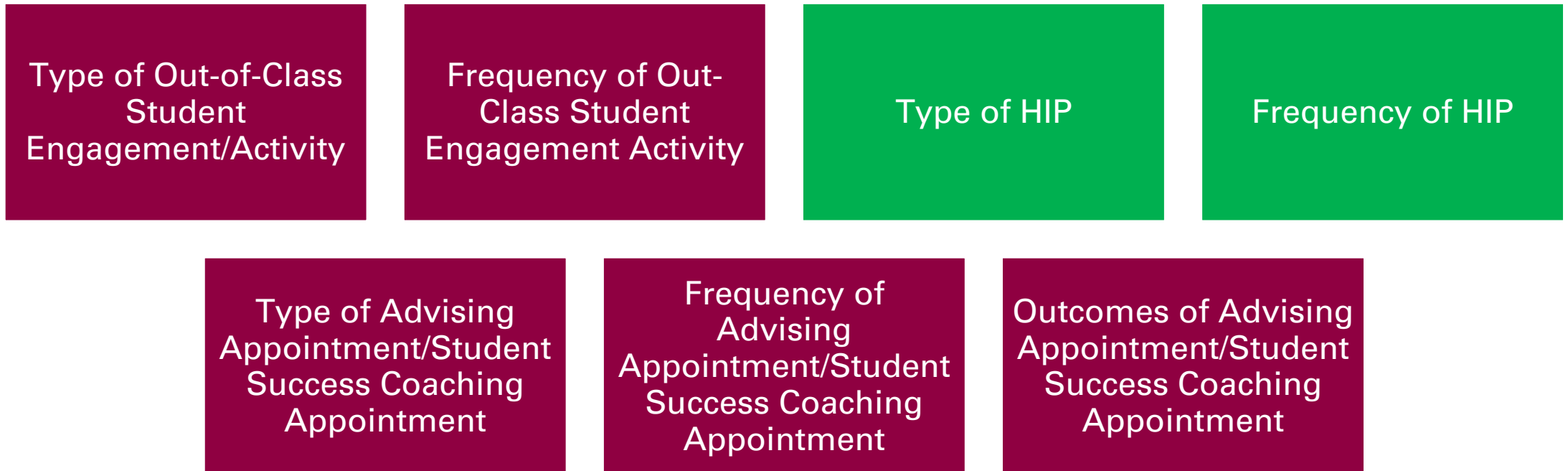
Adding Emotive Student Voice to Learning Analytics via NLP

Pre- and Post-Intrapersonal Competency Inventory Scores

Weekly Reflective Journal Prompts about the Provided Experience

Open-Ended Survey Question Responses

Various Analytical Approaches
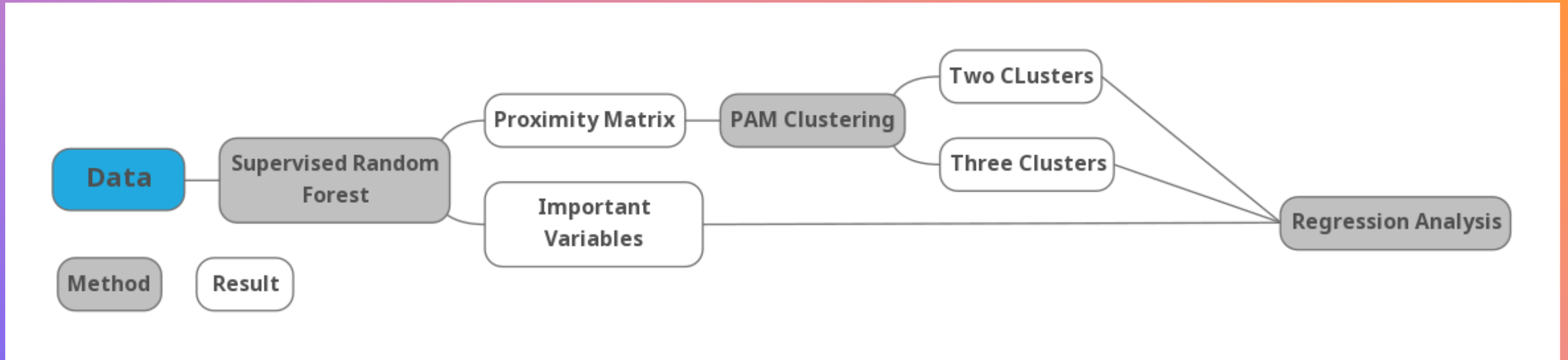
(Bresciani Ludvik, et al, Under Review)

Disagragate the Student Outcome Data	→	Exploratory Analysis	→	Random Forest	→	Clustering	→	Inferential

MANOVA	SEM	MLM with Interactions	Psychometric Analysis on Inventories	NLP

(ZHANG, ET AL, UNDER REVIEW)

Types of Decisions this Process has Informed

Improved Professional Development for Instructors

Improved First-Year Student Course Design

Improved Summer-Bridge Design

Improved in-between term communications with and support systems for students

Improved communication across the colleges and divisions to change policy and practice to promote success

Improved assessments and linkage of those to Insttuitional Performance indicators

Remember to Have the Process Conversation

- Invite in the team members
  - Diverse skill sets (instructional designers, assessment scholars, institutional researchers, data scientists, research methodologists, faculty, student success experts and the people who can say YES to getting you the data)
  - Embodied commitment to social justice
  - Commitment to data integrity and "do no harm"
- Leverage Volunteers to get started
- Use the Evidence while stating what is not known
- Build in the Systemic Commitment
  - With course buy-outs, stipends, re-worked workload and responsibilities, professional development

Limitation and Concluding Thoughts

- Computers are the only way to process the volume of data we want to work with. But, we can't boil a whole student down to "just some math."

- We need to always keep humans in the loop, to bring more nuance, contextual knowledge, and domain expertise to the modeling.

- We always need to be *very* aware of the ethical implications of our work and its applications.

- Remember that even small margins are meaningful. If we only help 2% of our students, we have to remember that we have still made a meaningful difference in their lives.
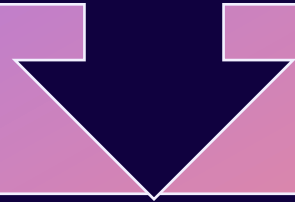
Questions and Comments

Marilee.Ludvik@uta.edu   **SaSchellenberg@sdsu.edu**   **shiming.zhang@uth.tmc.edu**

Intrapersonal Competency Cultivation Research Team
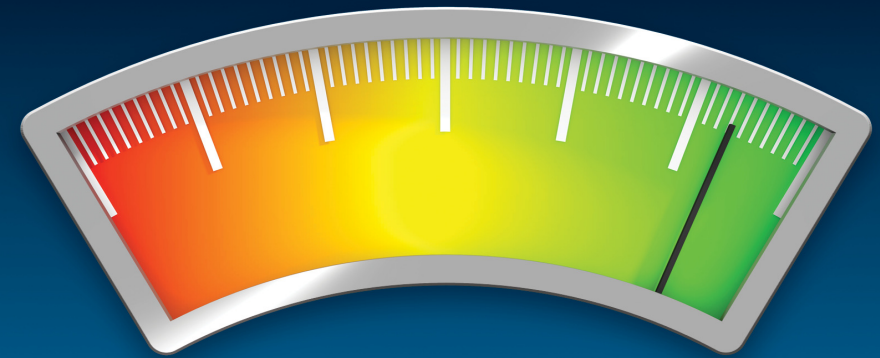
https://competencycultivation.uta.edu

DEEP THANK YOU TO:
STEPHEN SCHELLENBERG,
RANDY TIMM, NINA POTTER,
SANDY KAHN, ROGELIO BECERRA
SONGOLO, SHIMING ZHANG,
ROBYN SAIKI, REY MONZON
(MAY HE REST IN PEACE), CARYL
MONTERO ADAMS, KARA BAUER,
LISA GATES, REBECKA
HARMATA, JEANNE STRONACH,
ANNA JOST, AND MANY, MANY
MORE…
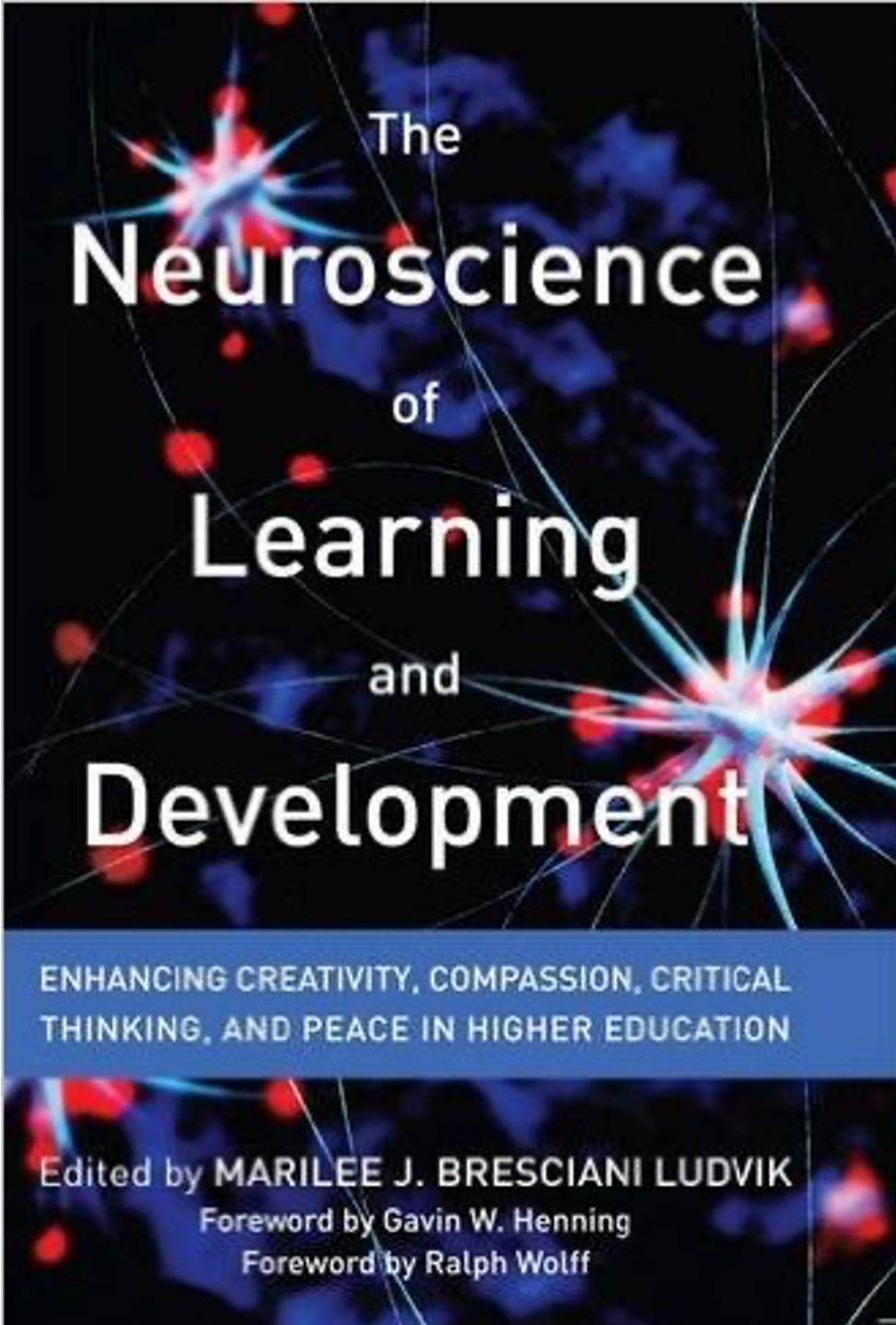
EQUITY-DRIVEN, HIGH ACHIEVEMENT

Assessment of Student Learning and Development

Marilee Bresciani Ludvik

With contributions from Marjorie Dorimé-Williams, Lara Evans, Mari Guillermo, Brianna Lynn Kuhn, Valerie Nye, Bill Sayre, Caren Sax, Charlene Teters, Andrea Vonny Lee, Stephen Wall, and Felix Wao

◆NASPA® | Student Affairs Administrators in Higher Education

The Neuroscience of Learning and Development

ENHANCING CREATIVITY, COMPASSION, CRITICAL THINKING, AND PEACE IN HIGHER EDUCATION

Edited by MARILEE J. BRESCIANI LUDVIK
Foreword by Gavin W. Henning
Foreword by Ralph Wolff

OUTCOMES-

CLOSING ACHIEVEMENT GAPS IN- AND OUTSIDE

BASED

THE CLASSROOM WITH ALIGNMENT TO

PROGRAM

PREDICTIVE ANALYTICS AND PERFORMANCE METRICS

REVIEW

MARILEE BRESCIANI LUDVIK
Foreword by Ralph Wolff

Second Edition of *Outcomes-Based Academic and Co-Curricular Program Review*

Change: The Magazine of Higher Learning

Looking Below the Surface to Close Achievement Gaps and Improve Career Readiness Skills

Marilee Bresciani Ludvik

Published online: 03 Dec 2019.

Submit your article to this journal ☍

View related articles ☍

View Crossmark data ☍

Looking Below the Surface
to Close Achievement Gaps and Improve Career Readiness Skills

SUCCESS

By
Marilee Bresciani Ludvik

Marilee Bresciani Ludvik serves as a Professor of postsecondary educational leadership at San Diego State University. She is also a Faculty Fellow within the Offices of Educational Effectiveness and Analytical Studies and Institutional Research.

In Short

- Achievement gaps still remain even though many institutions have invested in efforts to close them.
- Some institutions have benefited from the use of data analytics, yet may be unaware of whether they are reinforcing institutional and social behavior that may be increasing or maintaining achievement gaps.
- Focusing efforts on cultivating learning dispositions shown by neuroscientists to be malleable may prove beneficial in closing achievement gaps while ensuring career readiness skills.
- In order to close achievement gaps by focusing on the cultivation of learning dispositions, specific institutional inquiry processes need to be explored or refined.
- Discovering what various groupings of students need to be successful and then planning and delivering those various opportunities while also assessing their effectiveness takes an investment in development professionals, time, and planning materials.

There has been a great deal of emphasis on using data analytics to close achievement gaps in terms of persistence, graduation rates, and time-to-degree among varying and intersecting identity groups. For some institutions, applying just-in-time academic and student support initiatives predicted as necessary by data analytics has been fruitful. For other institutions, this approach may be less welcomed, as it may not account for institutional leaders' desire to understand individual students' needs or to critically examine how well the institution is avoiding a deficit mindset. Indeed, both of these may occur simultaneously.

Using predictive analytics that are in essence based on historical institutional processes without an understanding of how those analytics intersect with students' attainment of desired career readiness skills could potentially increase rather than decrease achievement gaps. With increasing emphasis on preparing career readiness competencies, such as social emotional intelligence, self-awareness, global citizenship, compassion, pro-social behavior, and lifelong learning skills and abilities, this article seeks to offer an additional lens through which to collect data in order to close achievement gaps while also ensuring optimal career readiness preparation.

"**Given that neurodiversity exists and its presence may not be easily identifiable by social groupings, how might we consider malleable learning dispositions (e.g., desired career readiness skills) that could be culturally constructed in order to honor each students' lived experience and cultural wealth while also ensuring the closing of achievement gaps and optimizing career readiness learning and development skills?**

CAREER READINESS AND DEVELOPMENTAL COMPETENCIES

In 2016 and 2017, a synthesis of learning and development research was published by the Institute of Educational Sciences (Zelazo, Blair, & Willoughby, 2016) and the National Academies of Sciences (NAS, 2017), respectively. In 2018, NAS released another synthesis of research, *How People Learn II: The Science and Practice of Learning.* Within these manuscripts and this book, decades of research reported how malleable, desired career readiness skills are and subsequently provided some ways in which they could be cultivated and assessed within in- and out-of-class educational settings.

What was also made clear in the 2018 NAS publication is that culture and context play an important role in understanding how people learn. "Learning does not happen in the same way for all people because cultural influences pervade development from the beginning of life" (p. 22). And while many scholars have been exploring the influence of internal and external persuasions on learning within specific contexts, the research is still in a nascent stage.

While there is no question that sociocultural groupings of students and their intersection are significant in describing achievement gaps across the country, there are many complications to identifying ways to improve learning and development based on sociocultural groupings and associated predictive metrics. As *How People Learn II* (NAS, 2018) pointed out,

> Research on genetic differences among population groups has established that there are not scientifically meaningful genetic differences among groups commonly identified as belonging to different races (Smedley and Smedley, 2005). It has long been recognized by social scientists that race is a social construction and that criteria for inclusion in a racial category or definition of particular groups as racial ones have varied over time (see, e.g., Figueroa, 1991; Kemmelmeier and Chavez, 2014; Lopez, 2006). (p. 24)

Adding to the complexity of interpreting the influence of social construction of identities on learning, perspectives on what constitutes culture and how it relates to learning and development have changed over time, further complicating data analytics. For example, while there are genetic differences within gender classification (Penn State, 2005), understanding those differences when it comes to designing and assessing postsecondary education student learning and development also has cultural and contextual challenges, particularly due again to social constructs encompassing gender identity.

That said, there are a number of studies that illustrate how culture plays a role in basic cognitive processes that help learners understand and organize the world, such as attention, memory, and perception of self and others, as well as the cognitive processes that shape learning (Chua, Boland, & Nisbett, 2005; Cole, 1995; Gelfand et al., 2011; Kitayama

& Cohen, 2007; Kronenfeld, Bennardo, de Munck, & Fischer, 2011; Markus & Kitayama, 1991; Medin & Bang, 2014; Nisbett, Peng, Choi, & Norenzayan, 2001; Rogoff & Chavajay, 1995; Segall, Campbell, & Herskovits, 1966). Furthermore, students' environmental experiences and personal choices can change certain portions of their brains necessary for learning and development (Bresciani Ludvik, 2016). And since there is clear evidence that human beings have a wide variety of diverse environmental experiences and personal choices and that not all human beings have the same opportunities to learn and develop, neurodiversity is a fact that educators must contend with simply based on the variety of lived experiences each student has had prior to college.

Given that neurodiversity exists and its presence may not be easily identifiable by social groupings, how might we consider malleable learning dispositions (e.g., desired career readiness skills) that could be culturally constructed in order to honor each students' lived experience and cultural wealth while also ensuring the closing of achievement gaps and optimizing career readiness learning and development skills?

In order to address this, institutional leaders should first examine their easy-to-identify performance indicators by social groupings and intersections of them. Such performance indicators include persistence rates, time-to-degree, cumulative grade point averages within specific majors, and graduation rates, to name a few. In addition, performance on standardized exams disaggregated by social grouping and their intersections would also include easy-to-identify information.

However, gathering this type of data is not new; this is how we identify achievement gaps. In order to discern the full range of ways to close these achievement gaps, educators need to intentionally shift their focus to cultivating career readiness skills, also known as learning dispositions (NAS, 2017). So, how do we design opportunities for students to cultivate learning dispositions and measure them in a way that informs the closing of achievement gaps?

Below the Tip of the Iceberg

To address this question, consider the iceberg analogy of learning dispositions introduced in Kuh, Gambino, Bresciani Ludvik, and O'Donnell (2018) and adapted here. In Figure 1, several learning dispositions are listed underneath the surface of the water, which researchers have suggested significantly correlate with degree completion or in some cases predict degree completion. The understanding from cognitive, social, and emotional neuroscientists is that these dispositions are indeed malleable, and the assumption is that it is our responsibility to cultivate these toward positive, goal-oriented behaviors, such as persistence, higher grade point averages, and ultimately degree attainment.

Figure 1. Iceberg Analogy of Learning Dispositions

Performance Metrics such as graduation rates, persistence rates, time to degree, matriculation into graduate school, and job placement

Easily Identified Learning through test scores and standardized exams

Application of skills such as:
- Attention Regulation,
- Emotion Regulation,
- Active Listening,
- Empathetic Listening,
- Growth Mindset,
- Resilience,
- Prosocial Behavior,
- Implicit Bias Regulation,
- Implicit Stereotype Threat,
- Empathy,
- Openness,
- Reflective Learning,
- Conscientiousness,
- Effortful Control,
- Academic Self-Efficacy, and
- Deliberate Problem Solving

Figure 2. Otto Scharmer's Iceberg Model

Awareness of the Iceberg

THE ICEBERG MODEL

Use this tool to help you think more systemically!

EVENTS
What is happening?

PATTERNS OF BEHAVIOR
What trends are there over time?

SYSTEMS STRUCTURE
How are the parts related?
What influences the patterns?

MENTAL MODELS
What values, assumptions, + beliefs shape the system?

Increasing Leverage
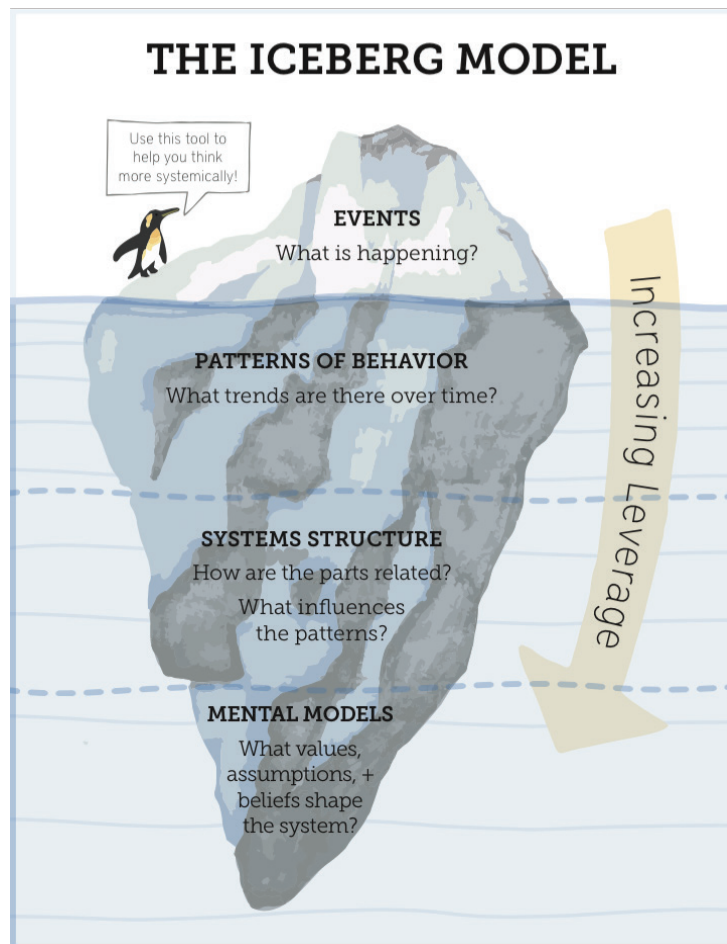
Furthermore, many of these learning dispositions map directly onto career-readiness skills desired by employers.

Figure 1 illustrates that many of our efforts to identify achievement gaps within our institutions rely in large part on the measurements of indicators listed above the water line. Measurement tools such as tests, standardized exams, time-to-degree, and persistence are easy-to-gather measures. And many current data analytic practices are seeking to understand students' behavior as it correlates with or predicts these indicators, specifically as they are grouped by social identities. This kind of data may be useful to many institutional decision-makers; however, it neglects to account for a great deal of underlying conditions, such as context and culture, that involve learning dispositions that are known to contribute to academic success (NAS, 2017). These learning dispositions also tightly aligned with employer-desired career readiness skills (Bresciani Ludvik, in press).

How do we get at a better understanding of those, particularly given neurodiversity? And how do we assess and respond institutionally to these dispositions?

Figure 1 is similar to Otto Scharmer's (2009) organizational behavior change "Theory U." In Scharmer's organizational behavior change theory, leaders must conduct their own deep dive, "below the tip. . .," to understand why their

performance metrics are the way they are and how they might be improved (p. 305). The deep dive process, illustrated in Figure 2, requires an understanding of patterns of past institutional as well as past students' behavior, which data analytics may be able to shed light upon.

Understanding past patterns of behavior is not simply gathering data to identify a pattern. Rather, according to Scharmer, the intention is to unearth the identification of deep-seated beliefs, values, mental models, and systemic structures to explain what informs the creation of those identified patterns of behavior. Analyzing the systemic structures that contribute to the patterns of behavior involves awareness of the values, assumptions, and mental models that have shaped these behavior patterns. This also includes being able to respond to the discomfort that often arises when organizational leaders realize that the very ways they have been doing business may be systematically contributing to the continuance of achievement gaps.

As you can see in this model, this requires refraining from acting on the easy-to-identify performance indicator data. Instead, leaders would leverage their increasing awareness through specific intentional collaborative reflection to examine ways of being and doing that have caused their organizations' past failures. It is an exploration of the systems

of belief, values, and attitudes that have informed policies, practices, and behavioral expectations that reside underneath the obvious question as to why the performance indicators might look the way they do. In other words, it requires gathering the kind of data that contributes to understanding how institutional practice and policies, intentionally or unintentionally, are or are not closing achievement gaps in cultivating malleable learning dispositions, such as pro-social goals and values, reflective learning, emotion regulation, and conscientiousness.

The reflection in Figure 2 can in turn prompt the deeper dive suggested in Figure 1, which includes a more thorough examination of students' learning dispositions and how institutional behavior is influencing the cultivation of these learning dispositions that correlate, and in some cases predict, timely degree completion. Thus, organizational leaders must begin collecting data on how known malleable learning dispositions are intentionally cultivated within their institutions via outcomes-based methodology. They can then compare those strategies within and across groupings and subgroupings of individuals using pre- and post-assessment measures along with first-person direct self-report experience data. When this type of inquiry is implemented, we can better understand how organizational and individual context and culture influence easy-to-identify "above-the-surface" data. This in turn can inform current institutional improvement strategy, which may explain the inability to close achievement gaps.

Engaging in this kind of inquiry requires an investment of time to collaborate, design, and pilot evidence-based strategies known to cultivate learning dispositions. It seeks to ascertain the influence of culture and context on student learning and development. Therefore, it also requires evidence that can be meaningfully compared across identity groups. Thoughtfully administered pre- and post-assessment measures across varying learning and development opportunities along with gathering individual students' voices of their learning experience, analyzed by various groupings and subgroupings of students, can signal to leaders what is working for whom, under what conditions, and why.

There are a number of free, valid, and reliable pre- and post-learning disposition/career readiness questionnaires and measures available to assess desired skills (Bresciani Ludvik, 2018). For example, institutional leaders can utilize the Growth Mindset Intelligence Scale (Dweck, 1999) to measure the extent growth mindset is being cultivated. There is also a multidimensional compassion scale (Jazaieri et al., 2014) to identify readiness to act with empathy or engage in pro-social behavior and a Self-Regulation Scale (Schwarzer, Diehl, & Schmitz, 1999) to measure attentional control in the pursuit of positive goals.

These learning disposition measures could be administered as pre-assessments for students; then, these measures could be administered as post-assessments at the end of the term to ascertain whether certain learning opportunities within the semester contributed to significant improvements or declines. If other first-person direct self-report data are collected, institutional leaders would then also know how the learning opportunities were experienced and can begin to explain how institutional culture and context may be influencing intended gains or unintended declines.

Use of these pre- and post-learning disposition scales could also be seen as providing indicators for equity. These are malleable skills but initially we do not know how individual students' experiences may have already cultivated them (or not) prior to students' entry into our institutions, and we thus do not know whether these dispositions need to be cultivated within their higher education experience. What we do know is that they are related to desired career-readiness skills and students' ability to demonstrate what they do

> "Use of these pre- and post-learning disposition scales could also be seen as providing indicators for equity. These are malleable skills but initially we do not know how individual students' experiences may have already cultivated them (or not) prior to students' entry into our institutions, and we do not know whether these dispositions need to be cultivated within their higher education experience.

know and have learned. And we of course want to see these skills developed in an equitable way with equitable results, thus improving the possibility of closing existing achievement gaps.

Probably the most time-consuming portion of this underneath-the-surface inquiry process would be gathering meaningful student voices and collaboratively interpreting it in a way that allows the institution to understand how its behavior influenced student experience. This is imperative to understanding the role of institutional and students' culture and context in student learning and development. Embedded reflective journal prompts, digital narratives, 360-degree evaluations, and thoughtfully constructed reflective student portfolios provide a wealth of data about students' internal processes of meaning-making. While this type of inquiry is time-consuming, without organizational leaders gaining a deeper understanding of what is working well for whom via the use of pre- and post-learning disposition measures (equity evaluation using these measures) and through listening to student voices, we cannot know where to allocate the precious resource of time to whom and when in order to close achievement gaps.

Gathering pre- and post-learning disposition data along with first-person self-direct report of experience could ground dialog for priority decisions around who needs something different than what we have been providing in order to succeed. Furthermore, it lets us know who is already coming in with high levels of specific learning dispositions, which then can highlight who is demonstrating cultural wealth in which dispositions. This systematic analysis is one actionable way to define and pursue evidence-based equity decisions.

> **Discovering what various groupings of students need to be successful and then planning and delivering those various opportunities while also assessing their effectiveness takes an investment of time, planning material, and the expertise of learning and development professionals.**

CHANGING ORGANIZATIONAL BEHAVIOR WITH BELOW-THE-SURFACE INQUIRY

This kind of probing is likely not possible for many institutions under current one size fits all assumptions. In other words, institutions need to be resourced in a manner where they can be responsive to varying needs of varying students. They need to engage in meaningful assessment of those experiences to determine whether what they are providing as equitable opportunities are actually working as expected. Given the oft-expressed skepticism about assessing students' learning and development, this may be an uphill battle for some institutional leaders seeking to collect meaningful evidence.

It also may simply not be possible unless organizational leaders are really willing to think critically about how educational opportunities are designed and delivered, especially how those who contribute to expected learning and development are hired, on-boarded, and provided with professional development to adopt and adapt learning science design and evaluation. It also requires that equitable student learning and development work be resourced fully, recognized, and evaluated in accordance with employment contracts and position descriptions. Discovering what various groupings of students need to be successful and then planning and delivering those various opportunities while also assessing their effectiveness takes an investment of time, planning material, and the expertise of learning and development professionals.
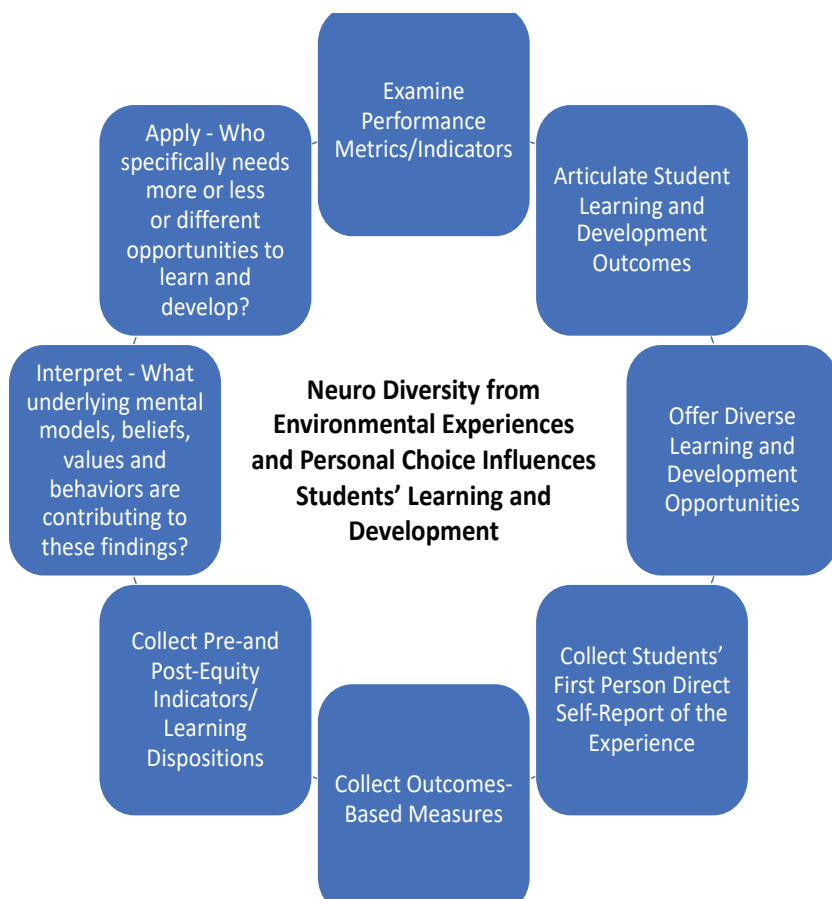
Figure 3 summarizes the context of blending the above- and below-surface inquiry methodologies. In this figure, moving clockwise from the top, the investigative process begins with examining above-the-surface institutional performance indicators to determine where inequities reside. This of course assumes that the institution is already disaggregating its data by identity groups and intersecting of identity groups. Many responsible and well-educated institutional researchers are reluctant to do this because of what they know to be true about small subpopulation sizes and statistical error. Nonetheless, we need the descriptive data story; we need to see the trendlines. So, we must first examine the performance indicator trends descriptively.

Also, we cannot close achievement gaps by ignoring our students' experiences just because there are not enough of them within our institutions to calculate statistical significance. As one of my colleagues puts it, "underrepresented students don't feel marginalized for no reason." At San Diego State University (SDSU), we had plenty of historic descriptive performance indicator data to show how we were under-serving our commuting population, which were predominately Pell eligible, first generation, and LatinX. Discovering this historical trend gave us an opportunity to dive deeper into exploring how we, as an institution, could repair the inequity of underserving this population by offering specific learning and development opportunities to these students.

Once educators examine their institutional performance indicators by identity groups and their intersections, they can then select the career readiness student learning and

FIGURE 3. EDUCATIONAL CONTEXT FOR EQUITY

Educational Context for Equity-Driven High Achievement Assessment

Examine Performance Metrics/Indicators

Apply - Who specifically needs more or less or different opportunities to learn and develop?

Articulate Student Learning and Development Outcomes

Interpret - What underlying mental models, beliefs, values and behaviors are contributing to these findings?

Neuro Diversity from Environmental Experiences and Personal Choice Influences Students' Learning and Development

Offer Diverse Learning and Development Opportunities

Collect Pre-and Post-Equity Indicators/ Learning Dispositions

Collect Students' First Person Direct Self-Report of the Experience

Collect Outcomes-Based Measures

development outcomes/learning dispositions about which they care. Within our SDSU Commuter Life pilot project, we had a deep conversation about learning dispositions and wrote them into our semester one-unit credit-bearing course as learning and development outcomes. Informed by learning and development science research, the discussion included almost all stakeholders, from SDSU faculty researchers and students, to alumni and employers, and the professionals in direct service to our students.

The next step was re-designing the course to ensure that these outcomes and the ways in which we would systematically cultivate these skill sets for various identity groups were clearly outlined week by week. We have one set of core practices that cut across various course sections, but then other material is added for other groups of students with other shared identities, which includes science, technology, engineering, and math pre-majors, those self-selecting to cultivate their leadership skills, those who are undecided in their major, and those who want more support with transitioning, to name a few. The placement of the students into the course sections is intentional, as is the assignment of the instructor to the course section.

Following the collection of data that is intended to inform re-design decisions, including first-person direct self-report evidence and pre- and post-learning disposition data using our preselected measures, leaders interpreted the findings,

asking questions that probe at underlying causes. We found significant gains for some students and significant declines in some subscale measures for other students. Without the collection of first-person direct self-report data, we would not have known where to focus our efforts on improving the design of the student and instructor experience. All of these data informed an intentional re-design of the course for the following year. As can be seen, the process concludes with refining provided opportunities for specific populations, keeping in mind that not every student needs every learning and development opportunity to succeed.

This inquiry process, represented in Figure 3, requires institutions to move from only making decisions based on above-the-surface data collection or predictive analytics, to investing resources in a more thorough process. Following the abbreviated inquiry model in Figure 3 provides institutional leaders with evidence to inform how the performance indicators can be moved and how achievement gaps can be closed. For instance, from our SDSU pilot data, we examined how shifts in pre- and post-learning disposition data significantly correlated with shifts in performance indicators such as desired decreases in academic probation, increases in term-to-term persistence data, and increases in cumulative grade point averages as well as number of hours toward specific degree completion. This kind of correlation analysis, coupled with first-person direct self-report data, gave us

> **We found significant gains for some students and significant declines in some subscale measures for other students. Without the collection of first-person direct self-report data, we would not have known where to focus our efforts on improving the design of the experience. All of these data informed an intentional re-design of the course for the following year.**
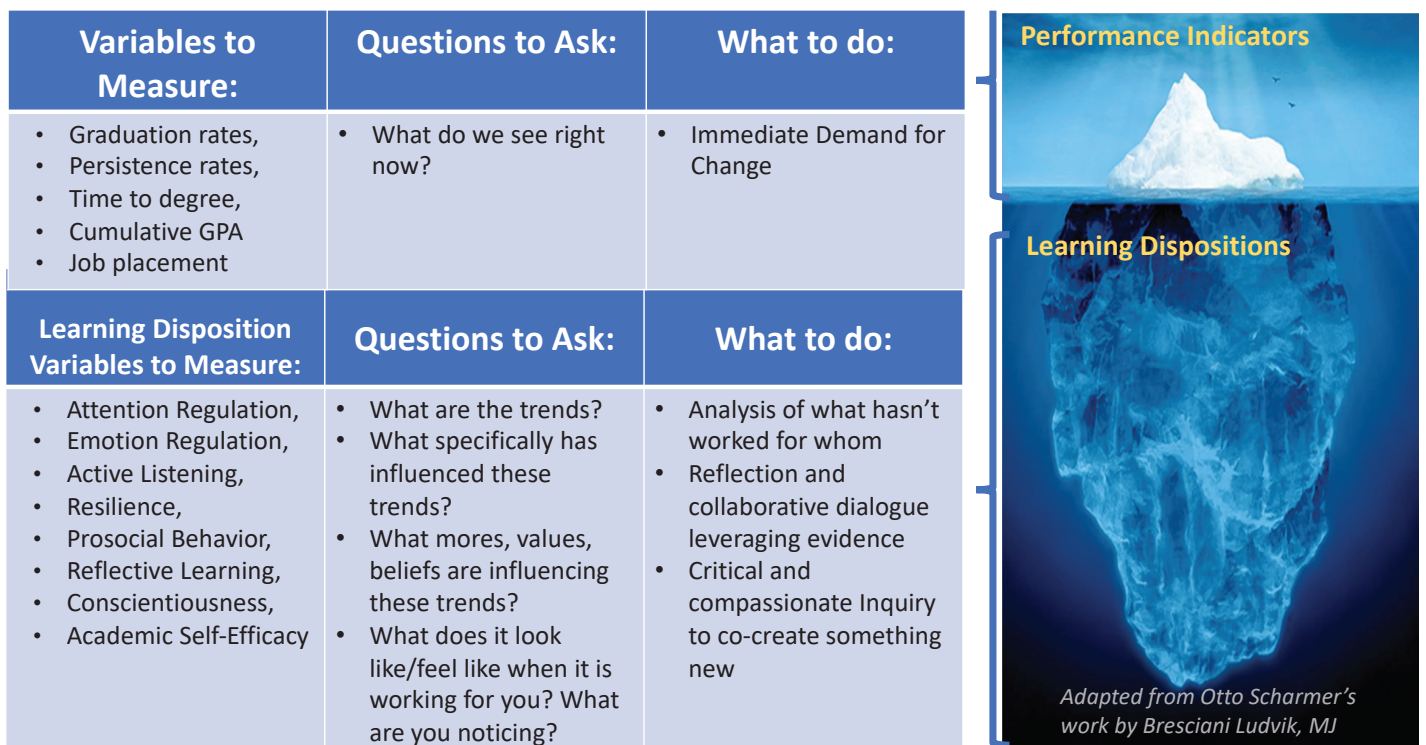
deeper insight into what to change for whom and when. It also informed some additional data collection practices that we are implementing this fall as we expand our pilot project and include more variations in the design for additional identity groupings.

In responding to the beneath-the-surface process in Figure 3, institutional leaders will explore an expanded set of variables, questions, and possible courses of action, as illustrated in Figure 4. Figure 4 exemplifies the movement from above-the-surface decision making, which demands changes based on easy-to-identify institutional performance indicators to decisions informed by evidence collected on learning disposition variables.

If institutional leaders seek to ensure they are not perpetuating achievement gaps or inadvertently increasing them, and they also seek to assure the cultivation of malleable learning dispositions that ensure career readiness, then they need to respond to the following questions:

1. What malleable learning dispositions does our institution value?
2. How well do our valued learning dispositions map to our employers' desired career readiness skills?
3. Where are we providing opportunities for these skills to be cultivated, how, and to whom specifically?
4. How are we gathering first-person direct self-report evidence of these learning experiences from the students?

FIGURE 4. ORGANIZATIONAL CHANGE INQUIRY

Variables to Measure:	Questions to Ask:	What to do:	
• Graduation rates, • Persistence rates, • Time to degree, • Cumulative GPA • Job placement	• What do we see right now?	• Immediate Demand for Change	*Performance Indicators*
Learning Disposition Variables to Measure:	**Questions to Ask:**	**What to do:**	
• Attention Regulation, • Emotion Regulation, • Active Listening, • Resilience, • Prosocial Behavior, • Reflective Learning, • Conscientiousness, • Academic Self-Efficacy	• What are the trends? • What specifically has influenced these trends? • What mores, values, beliefs are influencing these trends? • What does it look like/feel like when it is working for you? What are you noticing?	• Analysis of what hasn't worked for whom • Reflection and collaborative dialogue leveraging evidence • Critical and compassionate Inquiry to co-create something new	*Learning Dispositions* *Adapted from Otto Scharmer's work by Bresciani Ludvik, MJ*

5. How are we collecting evidence that the desired learning disposition/career readiness skills were acquired?
6. How are we comparing this evidence (pre- and post-scores) gathered across social grouping and subgroupings to identify how well the cultivation of these skills is allowing certain groupings and subgroupings of students opportunities to achieve (as is often measured by institutional performance indicators)?
7. How is what we are learning from this evidence providing us with opportunities to re-think our mental models, beliefs, values, and behaviors around previously conceived notions for how all students succeed?
8. How well are we using these data and dialog to refine specific experiences so that all students have an opportunity to achieve at high levels?

Neurodiversity exists; while there are some very real genetic and epigenetic differences in some students influencing their ability to learn and develop in expected ways, it remains a fact that not every human being is experiencing the same thing externally or internally in any given moment. Internal capacity and choices and perceptions, as well as external resources and experiences, are shaping each person's ability to learn and develop even when the same opportunity for learning and development is provided. Engaging in the deep dive below the surface to address the above questions may take more time, and will require compassionate dialog and active listening, but it also may dramatically improve career readiness skills that employers are seeking in our graduates while also closing achievement gaps. ⓒ

References

■ Bresciani Ludvik, M. J. (Ed.). (2016). *The neuroscience of learning and development: Enhancing creativity, compassion, critical thinking, and peace in higher education.* Sterling, VA: Stylus.

■ Bresciani Ludvik, M. J. (2018). *Outcomes-based program review: Closing achievement gaps in and outside the classroom with alignment to predictive analytics and performance metrics* (2nd ed.). Sterling, VA: Stylus.

■ Bresciani Ludvik, M. J. (in press). A new era of accountability. In J. P. Freeman, C. Keller, & R. Cambiano (Eds.), *Higher education's response to exponential societal shifts*. Hershey, PA: IGI Global.

■ Chua, H. F., Boland, J. E., & Nisbett, R. E. (2005). Cultural variation in eye movements during scene perception. *Proceedings of the National Academy of Sciences of the United States of America, 102*(35), 12629–12633.

■ Cole, M. (1995). Culture and cognitive development: From cross-cultural research to creating systems of cultural mediation. *Culture & Psychology, 1*, 25–54.

■ Dweck, C. S. (1999). *Self-theories: Their role in motivation, personality and development.* Philadelphia, PA: Taylor & Francis/Psychology Press.

■ Figueroa, P. (1991). *Education and the social construction of "race."* New York, NY: Routledge.

■ Gelfand, M. J., Raver, J. L., Nishii, L., Leslie, L. M., Lun, J., Lim, B. C., … Yamaguchi, S. (2011). Differences between tight and loose cultures: A 33-nation study. *Science, 332*(6033), 1100–1104. doi:10.1126/science.1197754

■ Jazaieri, H., McGonigal, K., Jinpa, T., Doty, J. R., Gross, J. J., & Goldin, P. R. (2014). A randomized controlled trial of compassion cultivation training: Effects on mindfulness, affect, and emotion regulation. *Motivation and Emotion, 38*(1), 23–35.

■ Kemmelmeier, M., & Chavez, H. L. (2014). Biases in the perception of Barack Obama's skin tone. *Analyses of Social Issues and Public Policy, 14*, 137–161. doi:10.1111/asap.12061

■ Kitayama, S., & Cohen, D. (2007). *Handbook of cultural psychology.* New York, NY: Guilford.

■ Kronenfeld, D. B., Bennardo, G., de Munck, V. C., & Fischer, M. D. (Eds.). (2011). *A companion to cognitive anthropology.* Hoboken, NJ: Blackwell.

■ Kuh, G. D., Gambino, L. M., Bresciani Ludvik, M., & O'Donnell, K. (2018, February). *Using ePortfolio to document and deepen the impact of HIPs on learning dispositions* (Occasional Paper No. 32). Urbana, IL: University of Illinois and Indiana University, National Institute for Learning Outcomes Assessment. Retrieved from http://learningoutcomesassessment.org/occasionalpaperthirtytwo.html

(continued)

References (cont'd)

■ Lopez, I. H. (2006). *White by law.* New York, NY: New York University Press.

■ Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224–253. doi:10.1037/0033-295X.98.2.224

■ Medin, D. L., & Bang, M. (2014). *Who's asking? Native science, Western science, and science education.* Cambridge, MA: MIT Press.

■ National Academies of Sciences, Engineering, and Medicine. (2017). *Supporting students' college success: The role of assessment of intrapersonal and interpersonal competencies.* Washington, DC: The National Academies Press. doi:10.17226/24697

■ National Academies of Sciences, Engineering, and Medicine. (2018). *How people learn II: Learners, contexts, and cultures.* Washington, DC: The National Academies Press. doi:https://doi.org/10.17226/24783

■ Nisbett, R. E., Peng, K., Choi, I., & Norenzayan, A. (2001). Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review, 108*(2), 291–310.

■ Penn State. (2005, March 23). Men and women: The differences are in the genes. *ScienceDaily*. Retrieved from www.sciencedaily.com/releases/2005/03/050323124659.htm

■ Penn State. (2005, March 23). Men and women: The differences are in the genes. *ScienceDaily*. Retrieved from www.sciencedaily.com/releases/2005/03/050323124659.htm

■ Rogoff, B., & Chavajay, P. (1995). What's become of research on the cultural basis of cognitive development. *American Psychologist*, *50*(10), 859–877.

■ Scharmer, O. (2009). *Theory U: Leading from the future as it is emerging.* Oakland, CA: Berrett-Koehler.

■ Schwarzer, R., Diehl, M., & Schmitz, G. S. (1999). *Self-regulation scale*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442651/#R32

■ Segall, M. H., Campbell, D. T., & Herskovits, M. J. (1966). *The influence of culture on visual perception.* Indianapolis, IN: Bobbs-Merrill.

■ Smedley, A., & Smedley, B. D. (2005). Race as biology is fiction, racism as a social problem is real: Anthropological and historical perspectives on the social construction of race. *American Psychologist*, *60*(1), 16–26.

■ Zelazo, P. D., Blair, C. B., & Willoughby, M. T. (2016). *Executive function: Implications for education (NCER 2017-2000)*. Washington, DC: National Center for Education Research, Institute of Education Sciences, U.S. Department of Education.