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How do We "Know" What Our Students "Know" They "Know"?

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With an emphasis on diversifying higher education, responding to the question of how we know that all of our students know what we need for them to know requires educators to include context and culture within our educational inquiry methodologies. A synthesis of literature shares a table of measures that are organized into seven inquiry approaches, all used to understand how students know. Ways to foster students' awareness of their knowing that incorporate considerations of context and culture are proposed as well as challenges of integrating the approaches or lenses through which we evaluate all students' ways of knowing.

Keywords: learning assessment, multiple methods, self-report, behavioural measures, contextual measures, content measures, knowing

Introduction

Discovering what our students know and are able to do is not only a good idea; it is a responsible way to design and deliver education, especially when the emphasis is on understanding how well what we are doing is working for whom. Furthermore, we are required by accreditation and quality assurance agencies and in some cases, state/province agencies, to provide evidence of what our students are able to know and do. In order to close achievement gaps, it is inherent that we understand how all of our students are able to know what we need them to know, so we can improve their experiences. While institutions invest a great deal in discovering how to improve the systems that design, deliver, and evaluate higher education, we continue to be criticized for the value of a degree and our inability to close achievement gaps. As such, this is as good a time as any to step back, reflect, and discern whether the questions we are asking about how and what students know and are able to learn are the ones that will equip us with combating the increasing challenges facing higher education today. This meta-synthesis describes the inquiry approaches we have historically used to discover what students know and are able to do and posits questions and inquiry methods to consider as we work to transform not only our educational design and delivery, but also the ways in which we discover what students know they know.

Background

In 2000, the National Research Council published an informative book about how we understand people learn. Within that book, there were several empirically informed ways to understand how students learn in order to improve learning environments, whether online or in person. The book organized content that

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influenced the learning design and improvement discussions into six primary areas: (a) the role of prior knowledge in learning; (b) plasticity and related issues of early experience upon brain development; (c) learning as an active process; (d) learning for understanding; (e) adaptive expertise; and (f) learning as a time-consuming endeavor (p. 233). The book editors also emphasized the “importance of (understanding) social and cultural contexts, transfer and the conditions for wide application of learning, subject matter uniqueness, assessment to support learning, and (at that time) the new educational technologies” (p. 233).

In 2005, the National Research Council applied many of the discoveries from the 2000 publication in a book that would focus on how students learn science in the classroom. In 2018, the National Research Council again produced a compendium of what we understand about how students learn and called on educators to engage in more explicit assessments that would include an understanding of context and culture. The authors encouraged educators to consider questions paraphrased here as, in order to account for culture and context and to leverage it in the design of learning and development opportunities, how can we invite students to become more transparent about their thinking? What is their process for making meaning? What motivates them to learn and apply that learning in culturally relevant and meaningful ways? How do students know that they know? And how can we learn from that to empower more students to learn? These paraphrased questions are intended to point educators in the direction of what we could be studying over the next decade. Doing so may not only close achievement gaps, it may also return value to a higher education degree.

While the National Academies of Sciences has invested a great deal in sharing what we know about how people learn, the author wanted to explore how that is translating to publish educational research. To say that most educators do not care about discovering the answers to these questions or have not invested themselves in trying to find the answers to these questions may be inaccurate. What is understood is that a simple search conducted in the summer of 2016 of the university library journals (using the search words “education journal”) elicited over 1,957 education journals and 713 books (note that some countries publish their educational journals in single annual reports that share common names, thus counting as an individual journal in this search). All of these journals were filled with research manuscripts seeking to discover what we know about what our students know they know. This would lead one to assume that many are invested in the study of understanding knowing. This peaked the author’s curiosity and intent to understand in what ways we have explored understanding how our students know and more specifically, how our students know they know.

Methodology

In order to explore how we know what our students know they know, a review of 100 randomly selected abstracts from the 1,957 education journals published from 2005-2015 was conducted. In addition, purposeful selection of 12 additional abstracts published in five cognitive neuroscience journals (of which there were 17 available) were reviewed in order to represent another perspective of knowing for educational researchers to investigate and integrate into their work.

To ascertain the inquiry approaches, each abstract and methodology section was examined to identify:

1. How “knowing” was contextualized;
2. How it was measured when those methods, as described in the abstract, were unclear.

These two categorizations were noted on index cards and later grouped them into categories by using the constant comparative method. Once, the draft table of groupings was completed, it was recorded that some commonly used assessment of learning and development measures were missing from these published journals.

So, the author completed two additional steps: First, the analysis six assessment of learning and development websites (listed in the references) that are regularly utilized were added. Second, the measures and contexts from these websites were compared and contrasted with the draft table, adding any additional methodologies that may not have been represented thus far. In addition, some measures being administered in the author’s and other colleagues’ piloted projects, which seek to understand culture and context were included.

Findings

Table 1 synthesizes the results of this analysis into measures that are organized into seven inquiry approaches; all used to understand how students know what they know: (a) biological/neurological/physiological measures that seek to understand how the body knows; (b) behavioral measures that aim to explore how knowing exhibits itself; (c) content measures that investigate evidence of knowledge content; (d) disposition and attitudinal measures that seek to explain students dispositions and motivation towards the process of knowing; (e) self-report measures to invite students’ perspectives of the process of knowing and what is known; (f) contextual measures which seek to explain the context for knowing and not knowing; and (g) process measures which explore the process of students’ awareness in their coming to know what they know. In Table 1, the name of specific instruments was avoided, with the exception of some of the biological, neurological, and physiological measures. Here, the technology was named in order to describe, with more specificity, what is being examined. As you can also see from reading Table 1, some types of measures are used more than once as they can be modified and applied to multiple lenses of inquiry.

Table 1

Types of Measures Grouped by Inquiry Approach

Biological/ Neurological/ Physiological measures	Behavioral measures	Content measures	Disposition/Attitudinal measures	Self-report measures	Contextual measures	Process measures that can be cultural specific
Blood flow in the brain using functional magnetic resonance imaging (fMRIs)	Observation (by instructors, peers, and site supervisors)	Tests (standardized and non-standardized)	Standardized inventories	Surveys	Interviews	Think aloud
Electrical activity in the brain using an electroencephalogram (EEG)	Academic transcript analysis	Quizzes (multiple choice and open-ended)	Role-playing	Questionnaires	Focus groups	Mind maps
Cardio-vascular measures (heart rate, blood pressure)	Scenarios using deception	Case studies	Scenario evaluation	One-minute questions	Environmental studies	Reflective journals/Essays
Skin-conductants	Behavioral adjustment plan	Role-playing	Journal/Essay reflections	Polling	Journal reflections	Reflective portfolios
Saliva swabs	Social media analysis	Situation-based/dilemma-based analysis	Surveys	Standardized inventories	Institutional descriptive data (including institutional type)	Inquiry-driven conversations (individually and in-class)
	External reviews/community partner critique	Class-based and capstone essays and projects (inquiry-based and applied)	Questionnaires		Demographic variable groupings/student descriptors	Interviews

(Table 1 to be continued)

	360 degree evaluations	Portfolios	Case studies		Cultural narratives	Observations
	Calendar categorization/time management calendar	Questionnaires	Students’ ability to make meaning of their learning		Phenomenology	Difficult factors assessment
	Detailed behavioral event interviews	Grades	Instructors’ ability to make meaning of what they are teaching and how they are evaluating students		Ethnography	Detailed behavioral event interviews
		Persistence rates*			Institutional performance indicators	Performance
		Job placement rate*			Student academic readiness data	Calendar categorization/time management calendar/daily planner usage
		Salary earnings*			Student non-cognitive assessed variables	Use of visuals/ images
		Time to degree*			Evaluations of classroom teachers	Vision boards
		Course pass rates			Institutional policies and practices	Inclusion of family or community members
		# of credit hours accumulated*			Promotion/review/& tenure policies/personnel evaluations	Learning journey mapping
		Degree or certificate attainment*			Needs assessment	
		Rubrics			Utilization of student support services	

Notes. The asterisk symbol (*) invites a conversation among educators as to whether these are content measures or contextual measures. While used as content measures in the literature analyzed, they may be more accurately categorized as contextual measures of learning and development.
Measures listed in italics were found in journals published after 2016 and used in pilot collaborative work to explore context and culture.
Note caution in the use of Table 1.

If the reader finds Table 1 to be useful in categorizing inquiry methods for understanding “How all of our students know”, please be sure to note this; you may not want to agree with the way researchers used all of these measures. For instance, how does time-to-degree relate to content learning, particularly in light of the 2018 National Research Council publication that invited us all to be aware that learning is a time-consuming endeavour and that we have a lot more to learn about how context and culture influence all students learning. As such, the author recommends that indicators such as time-to-degree and graduation rates be used as

contextual measures, as opposed to content measures. Nonetheless, Table 1 represents how the measures were used in the publications included in this analysis. In addition, the author recommends that we be very thoughtful about how we use measures and under which lens of inquiry we use them in order to optimize our improvement of the design, delivery, and evaluation of higher education for all students. For example, how does time-to-degree improve our understanding of how students know what they know. If it is lengthy, what does that indicate? If it is within the time-frame desired by many higher education funders, what does that indicate?

Limitations

There are several limitations to this synthesis. First, through random selection, the author may have missed some pertinent measures of knowing. Important measures that are building blocks of identifying ways of knowing may have been inadvertently excluded from the additional purposeful selection of cognitive neuroscience journals. There are other fields that may discuss ways of knowing that would be published in journals that are not identifiable using the limited search criteria that was used. Other researchers may categorize these measures differently based on how they interpreted the abstracts and methodology sections that were included in this synthesis.

This manuscript is missing the details of what we know about how identity groupings and intersecting of identity groupings know what they know. As a profession, we are in the nascent stages of this exploration. There is neurodiversity present within identities and their intersections (Bresciani-Ludvik, 2018). As such, furthering our understanding of knowing how all the students we serve know, so that we can learn how to better serve all students may not be fully reached without our further delving into context and culture. For example, because students who identify as Asian (with the exclusion of those students who identify as of East Asia and Pacific Islanders) are graduating at higher rates than any other social race category, this is not an indicator that these students know what they know and how they know it.

In essence, what you do not see in Table 1 is the answer to these questions, “What do we really know about what students know from the use of these measures and how does what we know influence the design, delivery, and evaluation of student learning and development for all of our students?” The simple answer is that there is not a simple answer. Synthesizing the results from investigating the complex process of learning and development of thousands of individuals into one meaningful performance indicator is extremely challenging. Rather than attempting to answer these questions here, the author recommends that we shift back to investigating the questions inspired by the National Research Council 2018 publication, how can we invite students to become more transparent about their thinking? What is their process for making meaning? What motivates them to learn and apply that learning in culturally relevant and meaningful ways? How do students know that they know? And how can we learn from that to empower more students to learn?

Discussion

If we want to focus on understanding how students know what they know, perhaps we begin by becoming cognizant of what “knowing” means. Merriam Webster’s dictionary defines “knowing” as “having or reflecting knowledge, information, or intelligence; shrewdly and keenly alert: astute (a ‘knowing’ observer); indicating possession of exclusive inside knowledge or information (a ‘knowing’ smile)” (Retrieved August 2, 2016, from http://www.merriam-webster.com/dictionary/knowing). This may explain why, when we examine the published

research on what students know, we discover the emphasis on identifying their ability to demonstrate what they know as defined by content acquisition. There are several content measures listed in Table 1. We also notice the extent that we are seeking to understand the context in which students learn and develop and how culture also plays a role. These approaches and these lines of inquiry make sense to continue to pursue, particularly as it relates to improving the ways in which we design opportunities for students’ learning and development.

There are also a few more measures that may be beneficial to our exploring the context of how students know. These are not new measures; they are simply categorized here as contextual measures. Of importance is:

1. Our ability to understand the implications our institutional policies and practices have on students;
2. The way we hire, review, promote, and reward instructors as well as administrators;
3. The connection of how students view instructors in evaluations compared to their demonstrated content learning;
4. The manner in which students report needing academic and student support services and how they actually use them.

What is being proposed is an intentional combining of all of these ways of inquiring into what students know in order to better understand what we can improve and how we can improve it for each and every student.

Connection Action to Learning and Development Theory

What is lacking in Table 1 is the emphasis on understanding the process of students’ coming to “know” and the process of they make meaning of their learning. Turning toward Shannon Nolan-Arañez and Bresciani-Ludvik’s (2018) interpretation of Marcia Baxter-Magolda’s self-authorship theory, “the internal capacity to construct meaning is related to what Baxter-Magolda (2009; 2014) calls self-authorship. Self-authorship is a form of meta-cognition (a process of) understanding one’s beliefs, relationships, and identity” (Karp & Bork, 2012; Duckworth, Akerman, MacGregor, Salter, & Vorhaus, 2009, p. 101). In self-authoring, students build on this evolving intra-personal perspective by comparing and contrasting what they are learning and making meaning out if it. Nolan-Arañez and Bresciani-Ludvik (2018) reported that the “final stage of self-authorship is interpersonal development which requires students understanding how they want to interact with others. And determine expectations for others in their lives. The cycle of self-authorship builds momentum with every crossroads experience (a point in time) where students decide if they want to move forward with others’ expectations or in a new direction informed by their internal voice … (the meaning making) can expand and contrast based on life’s” experiences and the human reaction to them” (pp. 103-104).

Using Baxter-Magolda’s self-authorship theory as a basis for the importance of connecting students meaning making with meta-cognition or students’ awareness of what they are discovering, we are still left with the question, “How do we know that students know they know?” Meta-cognition has been an expressed interest of some educational researchers. Defined as the “awareness or analysis of one’s own learning or thinking process” (Retrieved August 2, 2016, from http://www.merriam-webster.com/dictionary/metacognitionon), meta-cognition research may be what we are interested in delving further into if we are to significantly improve student learning and development.

In examining meta-cognitive research (Barton, 2004; Elbaz, 1989; Lucariello & Naff, 2016; Olson, Turmo, & Lie, 2001; Zohar & Nemet, 2002), the importance of connecting the content of what is being learned to the instructor’s and student’s ability to make meaning of it remains a resounding point of interest to the improvement of learning and development. Students’ ability to reflect upon and apply their knowledge and

skills is important in their meaning making process. In discovering the relevance of what they have learned as it relates to where they find value and identity means that students engage more fully as active participants of their learning (Astin, 1993; Schlossberg, 1989; Tinto, 1975). A likely result is that students will be considered an academic success, as measured by completion of a degree or certificate (performance indicator). Still, “How do we know they know what they know”, particularly when compared to the evidence of the knowledge that was assessed and the context in which it was provided and the culture in which the student finds meaning?

A more extensive synthesis of meta-cognition research is necessary. For now, the practice of intentionally dissecting meta-cognition allows one to influence the development of awareness in the classroom, particularly when students may be coming from environments where they are looking for just one answer that is “correct” or seeking to only satisfy a rubric analysis. In dissecting meta-cognition, we need to understand what awareness is. Merriam Webster defines the word “aware” as, “knowing that something (such as a situation, condition, or problem) exists**:** feeling, experiencing, or noticing something (such as a sound, sensation, or emotion): knowing and understanding a lot about what is happening in the world or around you” (Retrieved August 2, 2016, from http://www.merriam-webster.com/dictionary/awareness). When the author searched for educational research that investigated, “how aware are students of what they are learning?” It was much more difficult to find research and findings to summarize. What was discovering, however, was fascinating, and it led the author to completely re-design every course taught.

Re-Designing Educating and Evaluating of Learning and Development

Einstein is attributed as saying, “The same kind of thinking that created the problem is not the kind of thinking that can resolve it” (Retrieved September 14, 2010, from http://www.brainyquote.com/quotes/quotes/a/alberteins385842.html). If we keep focusing on evaluating what we think students know, we are not going to create anything different than what we already have discovered. Rather, we needed to shift your thinking away from, “How do I know students know to, how are students aware of what they are learning? How do they integrate what they are learning into what they value, who they are, and who they are becoming? How aware am I of what they need and how do I need to adapt what I know to be in service to what we are co-creating?”

In essence, the shift from “How do I know students know to how aware students of what they know are” places students in the driver seat of the co-creation of the design, delivery, and evaluation of their education. In this educator moves from the primary seat of responsibility for student learning to partnering and co-creating with students along their educational journey. Again to quote Einstein of “I never teach my pupils, I only attempt to provide the conditions in which they can learn” (Retrieved September 14, 2010, from http://www.goodreads.com/quotes/253933-i-never-teach-my-pupils-i-only-attempt-to-provide). If educators are to shift their focus of inquiry, it means breaking students’ “awareness” of their learning into four primary pieces: (a) attention regulation; (b) emotion regulation; (c) cognitive re-appraisal; and (d) self-regulation. Later, the author also discovered that adding compassion and self-compassion into this formula, but for now, we remain focused on meta-cognition skill building.

Within the meta-cognition skill building context, attention regulation (AR), became the first building block. As defined by Lutz, Slagter, Dunne, and Davidson (2008), AR refers to the student’s ability to focus and sustain attention on an intended object. Through attention regulation, an individual is trained to notice when one’s focus is directed to the intended object (e.g., their breath) and to notice when the focus has drifted away

from the intended object (e.g., to thoughts, bodily sensations, or sounds in the environment). Becoming aware of where attention resides is not only important to learning and development (Bresciani-Ludvik, 2016), but also it is important to the process of developing awareness (Goldin & Gross, 2010; Goldin, McRae, Ramel, & Gross, 2008).

Tang and colleagues (2007) compare attention training (such as a working memory training program) and attention state training (such as that designed into the courses in which I teach) and further delineate the differences between the two: “Attention training: (a) trains executive attention networks; (b) requires directed attention and effortful control; (c) targets non-autonomic control systems; (d) produces mental fatigue easily; and (e) training transfers to other cognitive abilities (p. 226). Whereas, “attention state training: (a) produces changes of body-mind state; (b) requires effort control (early stage) and effortless exercise (later); (c) involves the autonomic system; (d) aims at achieving a relaxed and balanced state, and (e) training transfers to cognition, emotion, and social behaviours” (p. 226). Being aware of what kind of attention training we are designing in education appears to be a primary component of fostering greater student success.

Next, came the building block of training emotion regulation (ER). ER as defined by Grolnick, Bridges, and Connell (1996) is the process of harnessing awareness of where attention resides and then initiating, maintaining, and modulating an emotional response. Emotion regulation builds upon attention regulation (Gross, 2002; Gross & Thompson, 2007). This is an important process to design within higher education because emotions play a role in regulating what gets stored and recalled from memory (Hutcherson, Goldin, Ramel, McRae, & Gross, 2008; Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996; Lang, 1995; Lazarus & Lanier, 1978) as well as play a role in decision-making and the prioritizing of decisions (Loewenstein & Lerner, 2003; Baer et al., 2004; Beilock, 2010; Bergen-Cico et al., 2013; Bravers, Reynolds, & Donaldson, 2003; Brown & Ryan, 2003; Buchheld, Gross-man, & Walach, 2001; Chadwick et al., 2016; Chiesa, Calati, & Serretti, 2011; Cotman & Berchtold, 2002; Cotman, Berchtold, & Christie, 2007; Damasio & Carvalho, 2013; Damasio, Damasio, & Tranel, 2013; Garland, Goldin, Ramel, & Gross, 2009; Hutcherson, Goldin, Ramel, McRae, & Gross, 2008). Furthermore, as Antonio Damasio and his colleagues’ research (Damasio & Carvalho, 2013; A. Damasio, H. Damasio, & Tranel, 2013) suggested, human beings will behave according to what their body wants to do, whether or not the human is aware of it. In essence, based on evolutionary tendencies of survival, the human body will react to environmental stimuli and behave in ways in which the mind is unaware (Habibi & Damasio, 2014). In times of stress, for instance, cognitive processes become known after the body has already acted. This research suggests the importance of training students’ awareness of their emotions, often expressed physiologically in the body, thus empowering students to integrate their emotions into their choices as opposed to being unaware of the role their emotions have in their behaviour.

Furthermore, we also understand that heightened emotion and in particular, stress, can be harmful to students. When students feel stressed (regardless of the reason), their bodies react to the situation they have perceived to be challenging and threatening, which consequently changes the way the brain functions (Lang, 1995). While the stress response has evolutionary benefit, it can also have deleterious effect on higher order thinking, and consequently, academic performance (Cassady, 2004; Kirschbaum, Wolf, May, Wippich, & Hellhammer, 1996; Lazarus & Launier, 1978; Lesch, 2007; Loewenstein & Lerner, 2003).

With emotion regulation training, individuals begin to notice their own emotions, specifically how emotions begin to develop (e.g., stress associated with a feeling of tension) and where emotions are located in one’s body (e.g., stress beginning with a feeling of tension in the abdomen and resonating toward the upper

chest) (Bresciani-Ludvik, 2016). Moreover, when training for emotion regulation, the participant is often instructed to simply pause, breathe, and observe the emotion, without judgment, which can allow an immediate physiological reaction in the body, down regulating the emotion, and up regulating cognitive processes (Bresciani-Ludvik, 2016). This process allows students to become aware of emotions and notice how they may be influencing decisions, the prioritizing of decisions, storage, and recall of memory, and behavior among other things. In this way, emotions are integrated into cognition, allowing for a different way of thinking than existed before; often referred to as cognitive reappraisal.

Cognitive regulation or more often referred to as reappraisal (CR) allows one to examine a situation for what it is, ask several questions about what is fact and interpretation and identify other possibilities (Bresciani-Ludvik, 2016). In CR training, students are invited to describe the sensations they are feeling as they become aware of emotions (Goldin, Ziv, Jazaieri, & Gross, 2012). In cognitive reappraisal, a person becomes aware of the unwelcomed emotion, for example, names the emotion, practices inquiry into it, and then chooses how to act upon that emotion.

Building on CR, we added additional inquiry practices. In essence, determining what is true for the individual and to acknowledge what is true for the individual may not be true for others or to the situation that elicited the emotion can immediately reduce stress and up-regulate analytical reasoning; it becomes more of an integration of emotion into the cognitive processes, rather than an avoiding or suppressing of emotion (Bresciani-Ludvik, 2016). That is, the participant can be with unwelcomed sensations without casting blame for those sensations on oneself or another. This allows the student to re-appraise the emotion in the moment, thus leveraging the usefulness of the emotion if it is helpful to task completion (such as knowing that experiencing stress when learning something new is normal) or determine the stress as a signal to seek appropriate and relevant assistance.

With attention (AR), emotion (ER), and cognitive re-appraisal (CR) regulation training, we posit that the student will move closer to becoming self-regulated. We like to think of this as a movement toward more empowered and consequence-aware choices. Self-regulation has been a challenging concept to define, cultivate, and evaluate (Geldhof, Little, & Hawley, 2012; Geldhof, Little, & Colombo, 2010; Gestsdottir, Urban, Bowers, Lerner, & Lerner, 2011; McClelland, Ponitz, Messersmith, & Tominey, 2010; Vohs & Ciarocco, 2004; Zuberi & Zuberi, 2012). There have been a variety of definitions of self-regulation (Baumeister & Vohs, 2004; Cole, Martin, & Dennis, 2004; Kochanska, Murray, & Harlan, 2000; Rueda, Posner, & Rothbart, 2005; Zelazo & Müller, 2002). For use in this work, the author has adopted McClelland et al.’s (2010) concept of self-regulation as “a multi-dimensional construct that includes the regulation of emotion, cognition, and behaviour” (p. 510).

In Table 2, you will see the design of the AR, ER, and CR curriculum—called “integrative inquiry” (INIQ)—and the usual ways in which it is evaluated. It has been shown to significantly reduce students’ stress and anxiety, increase AR, ER, and CR, as well as increase students’ self-awareness, resilience, compassion (when the compassion component was later added), and self-regulation (Bresciani-Ludvik, 2016).

With the foundation of INIQ training, we are beginning to discover the answers to these questions, “How are students aware of what they are learning?” and “How do they integrate what they are learning into what they value, who they are, and who they are becoming?” The applied evidence to reveal answers to these questions is currently being collected. Finally, the question that remains unanswered with this research is this, “How aware am I of what they need and how I need to adapt what I know to be in service to what we are

co-creating?” The short answer is to immerse oneself as a learner using the same meta-cognitive skill building process as the one the students are invited into. This is where the compassion and self-compassion pieces play an integral role.

Table 2

INIQ Structure, Outcomes, and Measures

Category	Goals	INIQ/OSRT practices	Outcomes	Assessment measures/tools
Attention regulation	Attention management/awareness; Awareness of awareness.	Focused breathing; Meta-attention; Open attention; Mindful meditation; Mindful listening.	Increased attention regulation	FFMQ; daily journaling; daily multiple choice check-in question; focus group interview; behavioral event interview.
Attention regulation; emotion regulation	Attention management/awareness; Emotional awareness; Compassion.	Focused breathing; Meta-attention; Open attention; Mindful meditation; Mindful listening; Empathic Listening Focused movement; Body scan; Movement in nature; Reflective journaling	Increased emotion regulation	FFMQ; BAI; PSS; daily Journaling; daily multiple choice check-in question; Beck; PSS; focus group interview; behavioral event interview.
Cognitive reappraisal	Attention management/awareness; Emotional awareness; Self-awareness; Compassion; Conscious choice-making.	Naming emotions; Cognitive reappraisal; Task-switching; Just Like Me; Unwelcomed Emotions Re-appraisal; Loving Kindness Meditation; Resilience training	Increased cognitive re-appraisal	FFMQ; Daily Journaling; Daily multiple choice check-in question; Beck; PSS; focus group interview; behavioral event interview.
Self-regulation	Attention management/awareness; Emotional awareness; Self-awareness; Conscious choice-making; Adaptable leadership.	Previous practices continued, while adding more reflective Journaling; Alignment of experience with personal and professional goals and values; Insight meditation; Creative expression; Well-being exploration	Increased self-regulation	Daily Journaling; daily multiple choice check-in question; focus group interview; pre-and post-exam assessment; final exam performance with cardiovascular measures; behavioral event interview.

Conclusions

This synthesis of literature began with exploring the National Research Council’s proposed questions for educational researchers. We examined ways we are measuring what students know and explored two areas where we may be able to improve our inquiry methodology. First, we can consider integrating the various lenses/approaches (see Table 1), in which we measure what students know, so as to get a more accurate picture of how students know what they know, and therefore, get a better understanding of how we can improve the design, delivery, and evaluation of higher education, so that all students can succeed. Second, we can strengthen the process measures that help us understand “How we know students know what they know”. To this end, a training methodology, called INIQ, was offered as one option in which students and instructors can begin to foster awareness of their thoughts, feelings, and actions.

In closing, we offer one more interview protocol (see Table 3), that may help improve our process and behavioural measures of knowing. In this protocol, it is important that the interviewer be trained as an astute observer and sensor of the student, so as to gauge the direction of the follow-up questions. We are currently piloting this interview protocol and it will likely go through several iterations. We welcome your letting us know what you discover in using it and also how you might improve it.

If we are to create something different (e.g., decolonization) in the next decade of postsecondary education, we must break apart conceptual language like “knowing” and “critical thinking” and see what we can discover about, “How our students are aware of what they are learning and how they integrate what they are learning into what they value, who they are, and who they are becoming” while in partnership (e.g., a co-creation) with the students we serve. We need to train students into awareness of their thoughts and actions as well as ourselves. And it is likely that we will need to use different measures of learning and development than the ones that are currently in high volume use or at the very least, use multiple measures representing a variety of inquiry approaches. Perhaps more importantly, it is time to actively and intentionally train and then invite students into their own evaluation of their learning and development and meaning-making journeys. They might help us discover whether four years enough for students to feel ready for the job market is. Then again, maybe they will help us discover that four years is more than enough. Either way, they will likely help us understand how time is a context variable in the measurement of learning and development and an important one at that.

Table 3

INIQ Behavioral Event Interview

1. What is motivating you to engage in the INIQ practices?
How do you know you are motivated to practice?
What do you feel in your body?
Describe the location of those sensations; the intensity; the qualities…
How do you know you are feeling what you are feeling?
Do you hear it, see it, and feel it? Can you describe it?
What emotions are you noticing when you notice these bodily sensations?
How do you know that you are feeling this?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the feeling.
What are you thinking when you notice these sensations?
How do you know what you are thinking?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the thought.
Do you see images or hear sounds associate with these thoughts? If so, can you describe the color, tone, qualities, and intensity of these sounds/images?
2. Are you noticing any resistance to engaging in the practices?
How do you know you are experiencing resistance?
What do you feel in your body?
Describe the location of those sensations; the intensity; the qualities …
How do you know you are feeling what you are feeling?
Do you hear it, see it, and feel it? Can you describe it?
What emotions are you noticing when you notice these bodily sensations?
How do you know that you are feeling this?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the feeling.
What are you thinking when you notice these sensations?
How do you know what you are thinking?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the thought.
Do you see images or hear sounds associate with these thoughts? If so, can you describe the color, tone, qualities, and intensity of these sounds/images?
What are you noticing about your stress-level after engaging in the INIQ practices?
How do you know this is your experience?
What do you feel in your body?
Describe the location of those sensations; the intensity; the qualities …
How do you know you are feeling what you are feeling?
Do you hear it, see it, and feel it? Can you describe it?

What emotions are you noticing when you notice these bodily sensations?
How do you know that you are feeling this?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the feeling.
What are you thinking when you notice these sensations?
How do you know what you are thinking?
Do you hear it, see it, and feel it?
Describe the qualities, intensity, and sensation of the thought.
Do you see images or hear sounds associate with these thoughts? If so, can you describe the color, tone, qualities, and intensity of these sounds/images?
What are you noticing about your options for choice around the stress?
How do you know these are options?
Do you hear it, see it, and feel it? Can you describe it
For example, are you noticing whether the stressor is true or is it a perception?
Are you noticing whether you can choose another way to perceive the stressor?
Are you noticing that you can ask for help to address the stressor?
If so, do you know what kind of help to ask for and where to go for help?
How do you know?
Do you hear it, see it, and feel it? Can you describe it?
What are you noticing about your own self-judgment or self-talk when stress arises?
How compassionate do you feel towards yourself or others when you notice stress arising?
What else would you like to share about using these INIQ practices or what you are discovering from them that I didn’t already ask you about?

References

Alderman, M. H., Ooi, W. L., & Cohen, H. (1990). Blood pressure reactivity predicts myocardial infarction among treated hypertensive patients. *Journal of Clin Epidemiol, 43*, 859-866.

Alvarez, J. A., & Emory, E. (2006). Executive function and the frontal lobes: A meta-analytic review. *Neuropsychology Review, 16*(1), 17-42.

Argyris, C. (1993). *On organizational learning.* Cambridge, MA: Blackwell.

Astin, A. (1993). *What matters in college?* San Francisco, CA: Jossey-Bass.

Baer, R. A., Hopkins, J., Krietemeyer, J., Smith, G. T., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*(1), 27-45.

Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., & Sauer, S. (2008). Construct validity of the five facet mindfulness questionnaire in meditating and non-meditating samples. *Assessment, 15*(3), 329-342.

Barton, K. S. (2004). *Research on students’ historical thinking and learning.* Retrieved August 2, 2016, from https://www.historians.org/publications-and-directories/perspectives-on-history/october-2004/research-on-students-historical-thinking-and-learning

Baxter-Magolda, M. B. (2003). Identity and learning: Student affairs’ role in transforming higher education. *Journal of College Student Development, 44*(2), 231-247.

Baxter-Magolda, M. (2009). *Authoring your life: Developing an internal voice to navigate life’s challenges.* Sterling, Virginia: Stylus.

Baxter-Magolda, M. B. (2014). Self‐Authorship. *New Directions for Higher Education, 2014*(166), 25-33.

Beck, A. T., Epstein, N., Brown, G., & Steer, R. A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *Journal of Consulting and Clinical Psychology, 56*(6), 893.

Beck, A. T., & Steer, R. A. (1990). *Manual for the Beck Anxiety Inventory.* San Antonio, TX: Psychological Corporation.

Beilock, S. (2010). *Choke: What the secrets of the brain reveal about getting it right when you have to*. New York, NY: Free Press.

Bennet, L. M., Gadlin, H., & Levine-Finley, S. (2012, August). *Collaboration and team science field guide*. Washington, DC: National Institutes of Health.

Bergen-Cico, D., & Cheon, S. (2014). Mediating role of mindfulness and self-compassion in reducing trait anxiety. *Mindfulness, 5*(5), 505-519.

Bjork, R., Dunlosky, J., & Kornell, N. (2013). Self-regulated learning: Beliefs, techniques, and illusions. *Annual Review of Psychology, 64*, 417-444.

Boyraz, G., Granda, R., Baker, C., Tidwell, L., & Waits, J. (2015). Posttraumatic stress, effort regulation, and academic outcomes among college students: A longitudinal study. *Journal of Counseling Psychology, 63*(4), 476-486.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Braver, T. S., Reynolds, J. R., & Donaldson, D. I. (2003). Neural mechanisms of transient and sustained cognitive control during task switching. *Neuron, 39*, 713-726.

Bresciani-Ludvik, M. J. (Ed.). (2016). *The neuroscience of learning and development.* Sterling, VA: Stylus Publishing.

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 Publishing.

Brown, K., & Ryan, R. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84*(4), 822-848.

Buchheld, N., Grossman, P., & Walach, H. (2001). Measuring mindfulness in insight meditation (Vipassana) and meditation-based psychotherapy: The development of the Freiburg Mindfulness Inventory (FMI). *Journal of Meditation and Meditation Research, 1*, 5-23. doi:10.2307/1411318

Bush, G., Luu, P., & Posner, M. I. (2000). Cognitive and emotional influences in anterior cingulate cortex. *Trends in Cognitive Sciences, 4*(6), 215-222.

Cassady, J. C. (2004). The influence of cognitive test anxiety across the learning-testing cycle. *Learning and Instruction, 14*(6), 569-592.

Chadwick, P., Strauss, C., Jones, A. M., Kingdon, D., Ellett, L., Dannahy, L., & Hayward, M. (2016). Group mindfulness-based intervention for distressing voices: A pragmatic randomised controlled trial. *Schizophrenia Research, 175*(1-3), 168-173. doi: 10.1016/j.schres.2016.04.001

Chan, R. C., Shum, D., Toulopoulou, T., & Chen, E. Y. (2008). Assessment of executive functions: Review of instruments and identification of critical issues. *Archives of Clinical Neuropsychology, 23*(2), 201-216.

Chang, H. (2016). The perceptions of temporal path analysis of learners’ self-regulation on learning stress and social relationships in junior high school. *Universal Journal of Educational Research, 4*(1), 30-35.

Chemers, M. M., Hu, L. T., & Garcia, B. F. (2001). Academic self-efficacy and first year college student performance and adjustment. *Journal of Educational Psychology, 93*(1), 55.

Chida, Y., & Steptoe, A. (2010). Greater cardiovascular responses to laboratory mental stress are associated with poor subsequent cardiovascular risk status: A meta-analysis of prospective evidence. *Hypertension, 55*, 1026-1032.

Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review, 31*(3), 449-464.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 385-396.

Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310.

Cooke, N. J., & Hilton, M. L. (2015). *Enhancing the effectiveness of team science.* Washington, DC: The National Academies Press.

Cotman, C. W., & Berchtold, N. C. (2002). Exercise: A behavioral intervention to enhance brain health and plasticity. *Trends Neurosci, 25*, 295-301. doi:10.1016/S0166-2236(02)02143-4

Cotman, C. W., Berchtold, N. C., & Christie, L. (2007). Exercise builds brain health: Key roles of growth factor cascades and inflammation. *Trends Neurosci, 30*, 464-472. doi:10.1016/j.tins.2007.06.011

Damasio, A., & Carvalho, G. (2013). The nature of feelings: Evolutionary and neurobiological origins. *Nature Reviews Neuroscience, 14*(2), 143-152.

Damasio, A., Damasio, H., & Tranel, D. (2013). Persistence of feelings and sentience after bilateral damage of the insula. *Cerebral Cortex, 23*(4), 833-846.

De Kloet, E. R., Joëls, M., & Holsboer, F. (2005). Stress and the brain: From adaptation to disease. *Nature Reviews Neuroscience, 6*(6), 463-475.

DelMas, R., Garfield, J., Ooms, A., & Chance, B. (2007). Assessing students’ conceptual understanding after a first course in statistics. *Statistics Education Research Journal, 6*(2), 28-58.

Donovan, M. S., & Bransford, J. D. (Eds.). (2005). *How students learn: Science in the classroom.* Washington, DC: National Academy Press.

Dubbelt, L., Demerouti, E., & Rispens, S. (2016). Self-regulation. *Zeitschrift Für Psychologie, 224*(1), 46-56.

Duckworth, K., Akerman, R., MacGregor, A., Salter, E., & Vorhaus, J. (2009). Self-regulated learning: A literature review. In *Wider Benefits of Learning Research Report No. 33*. Centre for Research on the Wider Benefits of Learning, Institute of Education, University of London.

Duschek, S., Muckenthaler, M., Werner, N., & del Paso, G. A. (2009). Relationships between features of autonomic cardiovascular control and cognitive performance. *Biological Psychology, 81*, 110-117.

Freema, E. (1989). *Teacher thinking: A study of practical knowledge.* New York, NY: Nichols Publishing Co.

Fujisawa, T. X., Jung, M., Kojima, M., Saito, D. N., Kosaka, H., & Tomoda, A. (2015). Neural basis of psychological growth following adverse experiences: A resting-state functional MRI study. *PloS One, 10*(8), e0136427.

Geldhof, G. J., Little, T. D., & Hawley, P. H. (2012). Two measures of self-regulation for young adults and late adolescents in the academic and social domains. *International Journal of Behavioral Development, 36*(6), 476-488.

Geldhof, G. J., Little, T. D., & Colombo, J. (2010). Self-regulation across the lifespan. In M. E. Lamb, A. M. Freund, and R. M. Lerner (Eds.), *Social and emotional development: The handbook of lifespan development* (Vol. 2, pp. 116-157). Hoboken, NJ: Wiley.

Gestsdottir, S., Urban, J. B., Bowers, E. P., Lerner, J. V., & Lerner, R. M. (2011). Intentional self-regulation, ecological assets, and thriving in adolescence: A developmental systems model. In R. M., Lerner, J. V., Lerner, E. P., Bowers, S., Lewin-Bizan, S., Gestsdottir, & J. B. Urban (Eds.), Thriving in childhood and adolescence: The role of self-regulation processes. *New Directions for Child and Adolescent Development, 133*, 61-76.

Goldin, P. R., & Gross, J. J. (2010). Effects of mindfulness-based stress reduction (MBSR) on emotion regulation in social anxiety disorder. *Emotion, 10*(1), 83.

Goldin, P. R., McRae, K., Ramel, W., & Gross, J. J. (2008). The neural bases of emotion regulation: Reappraisal and suppression of negative emotion society. *Biological Psychiatry, 63,* 3577-3586.

Goldin, P., Ramel, W., & Gross, J. (2009). Mindfulness meditation training and self-referential processing in social anxiety disorder: Behavioral and neural effects. *Journal of Cognitive Psychotherapy, 23*(3), 242-257. doi: 10.1891/0889-8391.23.3.242

Goldin, P., Ziv, M., Jazaieri, H., & Gross, J. J. (2012). Randomized controlled trial of mindfulness-based stress reduction versus aerobic exercise: Effects on the self-referential brain network in social anxiety disorder. *Frontiers in Human Neuroscience, 6*, 295. doi:10.3389/fnhum.2012.00295

Grolnick, W. S., Bridges, L. J., & Connell, J. P. (1996). Emotion regulation in two-year-olds: Strategies and emotional expression in four contexts. *Child Development, 67*(3), 928-941.

Gross, J. J. (2002). Emotion regulation: Affective, cognitive, and social consequences. *Psychophysiology, 39*, 281-291.

Gross, J. J., & Thompson, R. A. (2007). Emotion regulation: Conceptual foundations. In *Handbook of emotion regulation* (pp. 3-24). New York, NY: Guilford Press.

Habibi, A., & Damasio, A. (2014). Music, feelings, and the human brain. *Psychomusicology: Music, Mind and Brain, 24*(1), 92-102.

Hilmert, C., & Kvasnicka, L. (2010). Blood pressure and emotional responses to stress: Perspectives on cardiovascular reactivity. *Social Personal Psychological Compass, 4*, 470-483.

Hölzel, B. K., Carmody, J., Vangel, M., Congleton, C., Yerramsetti, S. M., Gard, T., & Lazar, S. W. (2011). Mindfulness practice leads to increases in regional brain gray matter density. *Psychiatry Research: Neuroimaging, 191*(1), 36-43.

Hutcherson, C. A., Goldin, P. R., Ramel, W., McRae, K., & Gross, J. J. (2008). Attention and emotion influence the relationship between extraversion and neural response. *Social Cognitive and Affective Neuroscience, 3*(1), 71-79.

Karp, M. J. M., & Bork, R. J. H. (2012). They never told me what to expect, so I didn’t know what to do: Defining and clarifying the role of a community college student. *Teacher College Record, 116*, 1-40.

Kirschbaum, C., Wolf, O. T., May, M., Wippich, W., & Hellhammer, D. H. (1996). Stress-and treatment-induced elevations of cortisol levels associated with impaired declarative memory in healthy adults. *Life Sciences, 58*(17), 1475-1483.

Kozasa, E. H., Sato, J. R., Lacerda, S. S., Barreiros, M. A., Radvany, J., & Russell, T. A. (2012). Meditation training increases brain efficiency in an attention task. *Neuroimage, 59*(1), 745-749.

Lang, P. J. (1995). The emotion probe: studies of motivation and attention. *American Psychologist, 50*(5), 372.

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., & Treadway, M. T. (2005). Meditation experience is associated with increased cortical thickness. *Neuro Report, 16*(17), 1893.

Lazarus, R. S., & Launier, R. (1978). Stress-related transactions between person and environment. In L. A. Pervin, and M. Lewis (Eds.), *Perspective in interactional psychology* (pp. 287-327). New York, NY: Plenum Press.

Lesch, K. P. (2007). Linking emotion to the social brain. *EMBO Reports, 8*(1S), S24-S29.

Loewenstein, G., & Lerner, J. S. (2003). The role of affect in decision making. *Handbook of Affective Science, 619*(642), 3.

Lotkowski, V. A., Robbins, S. B., & Noeth, R. J. (2004). The role of academic and non-academic factors in improving college retention. In *ACT Policy Report*. American College Testing ACT Inc.

Lucariello, J. & Naff, D. (2016). *How do my students think: Diagnosing student thinking—Understanding misperceptions is a key early step*. Retrieved August 2, 2016, from http://www.apa.org/education/k12/student-thinking.aspx

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences, 12*(4), 163-169.

Malinauskas, R. (2010). The associations among social support, stress, and life satisfaction as perceived by injured college athletes. *Social Behavior and Personality: An International Journal, 38*(6), 741-752.

Manuck, S. B., Olsson, G., Hjemdahl, P., & Rehnqvist, N. (1992). Does cardiovascular reactivity to mental stress have prognostic value in post infarction patients? A pilot study. *Psychosomatic Medicine, 54*, 102-108.

Martin, A. J., & Marsh, H. W. (2006). Academic resilience and its psychological and educational correlates: A construct validity approach. *Psychology in the Schools, 43*(3), 267-281.

Masten, A. S., & Obradović, J. (2006). Competence and resilience in development. *Annals of the New York Academy of Sciences, 1094*(1), 13-27.

Misra, R., & McKean, M. (2000). College students’ academic stress and its relation to their anxiety, time management, and leisure satisfaction. *American Journal of Health Studies, 16*(1), 41.

McClelland, M. M., Ponitz, C. C., Messersmith, E., & Tominey, S. (2010). Self-regulation: The integration of cognition and emotion. In R. Lerner and W. Overton (Eds.), *Handbook of life-span development: Cognition, biology and methods* (Vol. 1, pp. 509-553). Hoboken, NJ: Wiley & Sons.

National Academies of Science. (2000). *How people learn.* Washington, DC: National Academies of Sciences.

National Academies of Science. (2018). *How people learn II.* Washington, DC: National Academies of Sciences.

National Cancer Institute’s Team Science Toolkit. (2019). Retrieved from https://www.teamsciencetoolkit.cancer.gov/Public/Home.aspx

National Science Foundation (NSF). (2015, April). *Toolbox Project.* Retrieved from http://toolbox-project.org

Nolan-Arañez, S. I., & Bresciani-Ludvik, M. J. (2018). Positing a framework for cultivating spirituality through public university leadership development. *Journal of Research in Innovative Teaching and Learning, 11*(1), 94-109.

O’Donohue, W., & Lilienfield, S. O. (Eds.). (2013). *Case studies in clinical psychological science: Bridging the gap from science to practice*. New York, NY: Oxford University Press.

Olsen, R. V., Turmo, A., & Lie, S. (2001). Learning about students’ knowledge and thinking in science through large-scale quantitative studies. *European Journal of Psychology Education, 16*, 403.

Ong, A. D., Bergeman, C. S., Bisconti, T. L., & Wallace, K. A. (2006). Psychological resilience, positive emotions, and successful adaptation to stress later in life. *Journal of Personal Social Psychology, 91*(4), 730-749.

Oschner, K. N. (2004). For better or for worse: Neural systems supporting the cognitive down- and up-regulation of negative emotion. *Neuroimage, 23*, 484-499.

Oschner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Science, 9*(5), 242-249.

Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. *Journal of Personality and Social Psychology, 46*(4), 929.

Sarkar, M., & Fletcher, D. (2014). Psychological resilience in sport performers: A review of stressors and protective factors. *Journal of Sports Sciences, 32*(15), 1419-1434.

Seery, M. D. (2013). The biopsychosocial model of challenge and threat: Using the heart to measure the mind. *Social and Personality Psychology Compass, 7*(9), 637-653.

Schlossberg, N. (1989). Marginality and mattering: Key issues in building community. *New Directions for Student Services*, (48), 5-15.

Smith, B. W., Dalen, J., Wiggins, K., Tooley, E., Christopher, P., & Bernard, J. (2008). The brief resilience scale: Assessing the ability to bounce back. *International Journal of Behavioral Medicine, 15*(3), 194-200.

Stone, D., & Patton, B. (1999). *Difficult conversations: How to discuss what matters most.* London, UK: Penguin.

Van Eekeleni, I. M., Boshuizen, H. P. A., & Vermunt, J. D. (2005). Self-regulation in higher education teacher learning. *Higher Education, 50*, 447-471.

Tang, Y. Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., Yu, Q., Sui, D., Rothbart, M. K., Fan, M., & Posner, M. I. (2007). Short-term meditation training improves attention and self-regulation. *Proceedings of the National Academy of Sciences of the United States of America, 104*(43), 17152-17156. doi:10.1073/pnas.0707678104

Tinto, V. (1975). Dropout from higher education: A theoretical synthesis of recent research. *Review of Educational Research, 45*(1), 89-125.

Todd, R. M., Cunningham, W. A., Anderson, A. K., & Thompson, E. (2012). Affect-biased attention as emotion regulation. *Trends in Cognitive Sciences, 16*(7), 365-372.

Trammell, J. P., & Janet, J. P. (2013). Does stress enhance or impair memory consolidation? *Cognition and Emotion, 28*(2), 1-14.

Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology*, *86*(2), 320-333. http://doi.org/10.1037/0022-3514.86.2.320

Van Beek, M. (2016). *Personal communication on June 14th at the Mind and Life Summer Research Institute*. Garrison, NY.

Vohs, K. D., & Ciarocco, N. J. (2004). Interpersonal functioning requires self-regulation. In R. F., Baumeister and K. D. Vohs (Eds.), *Handbook of self-regulation: Research, theory, and applications* (pp. 392-410). New York, NY: Guilford Press.

Wright, R. A., & Kirby, L. D. (2001). Effort determination of cardiovascular response: An integrative analysis with applications in social psychology. *Advances in Experimental Social Psychology, 33*, 255-307.

Yeager, D., Henderson, M., Paunesku, D., Walton, G., & D’mello, S. (2014). Boring but important: A self-transcendent purpose for learning fosters academic self-regulation. *Journal of Personality and Social Psychology, 107*(4), 559-580.

Zohar, A., & Nemet, F. (2002). Fostering students’ knowledge and argumentation skills through dilemmas in human genetics. *Journal of Research and Science Teaching, 39*, 35-62.

Zolli, A., & Healy, A. M. (2012). *Resilience: Why things bounce back*. New York, NY: Simon & Schuster.

Zuberi, R., & Zuberi, R. (2012). Layers within layers—Self-regulation in a complex learning environment. *Medical Education, 46*(1), 7.

URLS Referenced

http://www.learningoutcomesassessment.org

https://tll.mit.edu/sites/default/files/guidelines/a-e-tools-methods-of-measuring-learning-outcomes-grid-2.pdf

https://facultyinnovate.utexas.edu/teaching/assess-learning/methods-overview

https://www.cte.cornell.edu/teaching-ideas/assessing-student-learning/measuring-student-learning.html

http://www.edutopia.org/comprehensive-assessment-introduction

http://www.assessmentcommons.org